The WAY AHEAD - Recent Developments in Road Safety Research

Prof. Erik Asmussen

The WAY AHEAD

A Liber Amicorum dedicated to Professor Erik Asmussen

including

Proceedings of the International Seminar

RECENT DEVELOPMENTS IN ROAD SAFETY RESEARCH

held at
Koninklijk Conservatorium, The Hague, 20 November 1986

Leidschendam, 1986

Institute for Road Safety Research SWOV, The Netherlands

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INTRODUCTION

This Liber Amicorum is intended as an homage to professor Erik Asmussen on his retirement from the directorship of SWOV. It contains papers by a number of authorities in the road safety research and policy field - long-standing colleagues of professor Asmussen - for the International Seminar on Recent Developments in Road Safety Research, which was organized, with the support of the Ministry of Transport in connection with the European Road Safety Year, by the Institute for Road Safety Research SWOV on 20 November 1986 at the Royal Conservatory, The Hague.
The book also includes contributions by some of the founder-members of the SWOV-team who are still active in road safety research and some of the first crop of students produced by professor Asmussen, who have been winning their spurs in departments responsible for road safety up en down the country for many years.
With this book we hope to pay a lasting tribute to the man who was not only "way ahead" in road safety thinking, but also showed us the way ahead.

ROAD SAFETY: KNOWLEDGE, RESEARCH AND POLICY

Matthijs J. Koornstra
Institute for Road Safety Research SWOV, The Netherlands

SWOV is one of the very few road-safety research institutes, that is dedicated solely to the safety aspect of road traffic. Although the lack of safety is only a negative output of the transport system, it is not the task of SWOV to investigate the optimization of the transport system in other aspects. In the nearly 25 years of its existence SWOV under the leadership of Erik Asmussen, however, has never neglected the need and value of transport. The rather unique position of SWOV, as it was already conceived in the early sixties has given it a particular flavour. Compared to other research institutes in the field, so it seems to me, SWOV has contributed relatively much to theoretical notions and methods of analysis. This may be due to its particular mission and independence as a research institute, it is nonetheless due to the long lasting efforts and inspiring conceptions of its director up to 1986.

With some proud, as the new director of the SWOV, I may bring back in your memory that already in the mid-sixties SWOV advocated that accidents are multi-causal chance phenomena. SWOV adjusted and applied as one of the first institutes multivariate-analysis techniques in the field of road safety. By doing so, SWOV abandoned the then popular paradigmas of mono-causal explanations and of the accident-prone driver. Historically this has been proven correct, since attempts to identify in advance these single causes and accident-prone drivers have failed.

In accordance of that line of thought SWOV contributed substantially to what we now call the "multi-causal dynamic system approach" in recent years. The dynamic system approach paired with the multi-causal chance conception, develops into a theory and methodology to search for critical variables and sequences through all the process phases of road safety. In this way of thinking it can be shown how measures to be taken optimize the system and how the diversity of measures should be integrated in the system in order to be effective.

In spite of painful budget reductions and by means of an internal reorganization SWOV will continue to be the institute with a front position in the field.

Apparently, society is learning to combine mobility and safety slowly, since in The Netherlands the death-rate (death per unit of transport) is halving each 10 years in the post war period. Similar results are obtained from other European countries. Depending on the growth of transportation and efforts we are able to direct to the unsafety of transport, the future may show less or more fatalities or severe accidents. With lower fuel costs and economic growth the rise of the transport-index may undo the effect of the lowering accident rates, resulting in an increase of casualties. Since letality is reduced far more than accidents itselves, emphasis must be placed on the prevention of the very accidents as well.

Despite of the growth of knowledge and fruitful usage in road safety measures, there still seems to be a lack of absorbing this knowledge or an absence of learning. This seems the case on different levels, as well as for individuals as for bodies on the local, regional or national levels. Examples may clarify this statement.

On the individual level no explanation is necessary if one realizes things like the shortage of seat-belt wearing, alcohol and driving and so on. On the local level I may mention the errors in evaluation of before-after studies in which the effects are mainly due to the before selection of statistical chance phenomena and not to the measures taken. Also on the national level sometimes it seems as if learning is absent. In a recent study of McKinsey for our Ministry of Transport it is concluded that it is fruitful to limit and differentiate protective measures. Since injuries occur more often in accidents with damage on the front and left-side, protective measures should be directed thereon. Such recommendations are not trivial, they are misleading, since in about 75% of car accidents the only person in the car is the driver seated in the left front while opposite traffic is passing on the left. I wonder if it would be recommended in Great-Britain too.

On the other hand sometimes researchers pay too little attention to the effects of longterm changes, because they focus on the here and now problems. If we, for example, look to the fact that in The Netherlands 40% of the mileage is performed on the motorways, where only 5% of the fatalities occur, it can be seen what a tremendous effect on safety and mobility the construction of motorways has brought in about 30 years.
In case we were able to move over 10% of the mileage from other roads to motorways, the reduction in injuries and fatalities would be somewhere between 10 to 15%. In a recent other study of McKinsey this fact is partly overlooked as an important cost-benefit factor. Moreover, only a minor part of the total motorway road networks should be reconstructed or enlarged to achieve such a moveover. The estimated reduction in unsafety costs however are over 100 million Dfl. each year.

This brings me to another aspect of the road safety problem. If one asks why motorways are so safe, no one will answer: "Because the driver is behaving safer there." On the contrary he is often speeding faster, if not too fast. No, we will say it is because the kind of road with nearly no conflict possibilities with opposite or crossing traffic and with excellent standards for curvature, skidding resistance and lane-width. The continuity in the construction enables the driver to predict these road characteristics ahead. This answer is given in spite of the fact that we also except that nearly all accidents are due to human failures. However, these two observations are not contradictory: it is the human driver who fails in situations he cannot manage. Apart from the training of the beginning driver we cannot restructure the abilities of the human being as a driver. The limitations of the human abilities must guide us in changing, constructing and optimizing the road, the regulations and the vehicle.

With respect to the road, it is our research-founded view that construction and the usage of roads should be strictly standardized without hardly any variation within a standard category. The reconstruction to a limited number of categories of roads is urgently needed. Two extremes of the road network in The Netherlands are standardized now: the motorway and the roads in the living area known as the "woonerf". A lot lies in between and asks for additonal work and research. SWOV is ready to work on it with the same effort as we did for the conception of the "woonerf". We are at least proud of the fact that this Dutch word, like the German word "Kindergarten", is becoming standard English.

With respect to the optimization of the car construction, it must be realized that accidents happen within a very short period of seconds. The preventive human action must take place before that period. It will be clear that the new technology of electronic devices and computers, which operate in fractions of seconds, can and will be of great help. This can be the case in three ways.
Firstly in sustaining the ongoing driving task in order to let the driver be the supervisor, who can pay attention to more crucial elements of his rather complex task.
Secondly in giving information to the driver about relevant cues that cannot or not early enough be experienced by the driver. The new and early information enables the driver to take action in time.
And thirdly in ultimate short periods of time in which the driver did not or could not take action while an accident becomes inavoidable, the task is taken over by the computerized car in order to avoid the accident or to restrict the severity of it. It is our opinion that application of these new technologies in the car, will be one of the major breakthroughs in safety in the future of transportation.

The design of road and car and computerized information handling on other road users and road aspects can overcome many inabilities of the driver. These inabilities are imposed on the driver by the traffic system of today in the relative rare circumstances that cause accidents.

Applied research is the main core of traffic research. It must be noted however that this more or less measure-orientated research and knowledge, has not very markedly contributed to an inductive process of theory formation and fundamental knowledge. As such this is not astonishing, since road-safety research as a professional discipline or rather interdisciplinair profession is only about 30 years old. But nevertheless nothing is so practical as a good theory. It seems to me that lack of theory even on very evident topics of fundamental nature hampers the progress in the application of research findings.

In order to let you have some insights in what I am aiming at, let me mention some of such topics.

- How, for example, are frequencies of fatalities, injuries, accidents with property damage, near-accidents or conflicts and exposition measures related? Can we predict and by what model one from the other, even in well-defined restricted conditions? It is one factor that underlies these outcomes and is the relation only disturbed by errors of statistical chance? Or do, in the ranked order of these outcomes, only nearby pairs have something in common that is not shared by other outcomes? With other words do injuries have something in common with fatalities that is not shared with mere accidents or represent they all identical, but more or less frequent and reliable measures of the unsafety of traffic conditions?

- What does exposure really mean? We generally use accident rates, where correction for exposure is done by dividing by units of distance travelled. But is mileage a good measure of exposure even in well-defined conditions? If we look at overtaking or crossing manoeuvres, length of the vehicles involved seems a very crucial element of exposure. Can we relate the same exposure measurements to car-car, bike-bike and car-bike accidents?

- Although it is accepted that accidents are multi-causal chance phenomena in a dynamic system, do we have methods of analysis for causal inferences? Are the relevant variables in the analysis time related in a causal-path-structure and if not, do we have methods for exploring such causal structures where relevant variables are of a different measurement level?

The answer there is negative or not yet known. It is at least the aim of SWOV to invest and to contribute in the future to these more fundamental topics.

There is another very serious problem that is inherent to road safety research: we do not have the relevant data. Due to the fact that accidents happen unpredicted, otherwise they should not happen, we have no reliable data describing the situation just before the accident. To compensate these actual shortcomings, we undertake studies of driver behaviour in direct observation in traffic or simulated environments. However, these detailed studies, how useful they are, cannot relate to real accidents because they do not happen then. It is as if we are working on the extremes of a scale: either we have very detaillistic data from which one hardly can generalize to road safety, or we have a large amount of data from which one hardly can learn the real causes of accidents. It is my opinion that research should be less driven by existing data and that effort must be put in research and active data-gathering on intermediate variables and on a level that is less broad and not too microscopic.
It is necessary to encourage and to finance such additional data-gathering which, with the help of modern technology, is now feasible.

So far a few words on the direction road safety research should take. I shall now conclude with some policy related topics on risk in traffic safety. I shall not elaborate here on the concept of risk, but concentrate on the commonly used (but actually incorrect named) risk-index as accident or death rate.
Per 100 million kilometres travelled the death rate in 1983 or 1984 in The Netherlands was about 1.7 in total. For passengercar occupants this rate is 1.2. For other modes of transport they are much higher: motorcyclists 21 times higher, moped-riders 10 times, cyclists 3 times and pedestrians 6 to 7 times higher. From such figures it is concluded that the risk of cyclists participating in traffic is 3 times higher than for car occupants while pedestrians run a risk twice that of cyclists.

However, if we do not express rates per distance travelled, but as a rate per time travelled, the risk comparisons are quite different. Pedestrians and cyclists are then of equal risk and have half the risk of car occupants.

The rate in distance travelled is used to correct for exposure and to express the freedom of mobility and choice of transport mode. This applies, however, equally for a rate based on time travelled. Apart from the somewhat demagogic remark that traffic safety is a matter of life and death and that we do not live distances but do live time, there is much in favour of discussions made on a rate based on time travelled from a policy point of view.

First of all unsafety in traffic can be compared with unsafety in other areas. Risk in activities are then expressed in rates based on engagement time. For example in The Netherlands accident death rates based on time spend in the activities in traffic are 3 to 4 times higher than for activities in house and about 10 times higher than for activities in work. Only the injury-rate for men in work is higher than the injury-rate in traffic. From these comparisons policy-makers could conclude that priority should be given to traffic safety. If we compare efforts and total safety costs I am not sure of the actual priority of traffic over work.

Secondly we can extend this line of thoughts to other interesting time-related safety aspects for policy-making. If we look at the distribution of age in traffic fatalities and in death caused by diseases such as cancer, it is interesting to note that, due to the high risk of youngsters, in traffic more than 36 years of an individual expected life time is lost in a fatal accident, for death due to cancer this is 15 years and for all other diseases it is less than 20 years.
Such comparisons are still more enlighting if we compare research costs per years lost by a certain cause. Research costs per year lost by cancer in The Netherlands are nearly twice as high as the research costs per year lost in traffic. Whether the pay-off in cancer research or in traffic is larger I will leave to you as an open question, but for sure, rates based on units of time have a lot to tell to policy-makers and researchers too. Let all our research efforts, cost-effective analysis and policy decisions be made for the benefit of the live of man.

CURRENT DEVELOPMENTS IN ROAD SAFETY RESEARCH

Dr. Jan C. Terlouw
Secretary-General of the ECMT

Road Safety is one of the major matters of concern to the European Conference of Ministers of Transport, as indeed it should be. The number of deaths each year on European roads is equivalent to the number killed in a major battle in the Second World War. No other cause of violent death in times of peace - earthquake, fire or flood - exacts anywhere near such a heavy toll as road traffic.

The ECMT does not itself carry out research in the field of road safety but, being basically a policy making organisation, tries to prepare policy decisions, largely on the basis of research done by others and by OECD in particular. The Conference gratefully acknowledges the importance of the work done by the SWOV and by Professor Erik Asmussen, its director for almost 25 years. He has given the SWOV a splendid name in the field of road safety research; his ideas and his drive have contributed so much to what has been achieved.

In the course of those 25 years, governments have come to recognise that road safety is a sphere in which they have to play an active role since it cannot be left solely to private organisations. The results have indeed been striking. For 15 consecutive years the numbers of dead and injured on European roads have fallen as a result of such measures as the compulsory use of safety belts, steps to prevent drunken driving, the improvement of infrastructures, and all the other decisions that are now so familiar. What is regrettable, however, is that it seems 1986 - declared road safety year by the European Communities - will see the number of road deaths go up again. Though certainly due to some extent to the very good results achieved in 1985, such an increase also makes it clear that we have to find new ways of attacking the problem. What has been called the honeymoon with the new measures is in fact over.

In ECMT, the following developments and lines of approach are seen as the most important for the near future, though the order in which they are listed is entirely arbitrary:

- An increasingly essential role for research

ECMT Member States' road safety research programmes have expanded enormously in the past 25 years: research on vehicles, infrastructures, the methods and effects of education, strategies and the effectiveness of information campaigns, regulations and their enforcement. Reports on such work have been given at the many congresses, symposia and seminars that have been held, especially during the present year. It is the task of researchers to advise the decision-makers just how effective potential measures may be. Insight into the complex problems has grown appreciably. Most of us are at one and the same time both a potential culprit and a potential victim in traffic. We are all the best driver in the world. Although we all know personally people who have been in serious accidents, we behave as if it could not happen to us. In this complicated sphere of psychology and technology, it is up to the researcher to measure, analyse, evaluate, compare and finally advise - a responsible task that is both difficult and indispensable.

- An increasingly multidisciplinary approach

Before the Second World War, governments played a very limited role in the improvement of road safety, a responsibility that was largely left to automobile clubs and private organisations. As car ownership increased - and with it the death toll - governments assumed their responsibilities, and the results have on the whole been good. It now seems that measures taken by the authorities alone cannot bring about much further improvement. There is increasing concern about the vital need for preventive measures which call for co-operation with the non-governmental sector. In order to attain road safety objectives, the full support of the public has to be enlisted, and the feeling is that this cannot be achieved without the help of the manufacturers, insurance companies, mass media, engineers, psychologists, the medical profession, to name but a few of the more important agencies. Some years ago, in the State of Victoria in Australia, members of the Parliament, the mass media and the medical profession worked together in an intensive campaign to make the public aware of what was going on on the roads. The results they achieved have been quite significant.

- New technologies: telecommunications, information, and computers

The impact of the new technologies is felt throughout the world and, of course, they have influenced and will continue to influence the transport sector.

Anyone who takes the TGV from Paris to Lyon can see that, in contrast with conventional railways, there are practically no signs and signals alongside the track. Everything is built inside the train. We can expect to see a similar pattern of development with respect to cars. Electronic systems, which give early warnings to drivers or even make the car respond automatically to dangerous situations, could improve road safety. Flexible systems of road signs are now being developed and will inform a driver of the actual situation he will find ahead. There is already quite a lot of evidence that drivers respond much better to such systems than they do, for instance, to a speed limit sign that applies over a particular stretch of road on which a reduction in speed is only necessary in some cases.

Furthermore, information about weather conditions, traffic jams, advice to the driver on rerouting, etc., is not only going to be useful for economic reasons, but can contribute to road safety. We must try to do everything we can to ensure that the systems being developed are interchangeable and can also be used in other countries after borders are crossed.

- Decentralisation

A high percentage of accidents occur in built-up areas. There are general reasons, such as reckless or drunken driving, but there are also specific ones which relate to the situation at the spot where the accident takes place. Since only the local council can know where such dangerous black spots are, there is a trend towards transferring part of the responsibility for road safety from the central government to local authorities. Initiatives like that of the PRI, which offers a prize for being "the safest city" in Europe, illustrate the efforts to decentralise road safety programmes.

- Great attention has to be paid to young people

Road accidents are now the main cause of deaths among young people in industrialised countries. It is becoming increasingly clear that, from a very young age, children have to be made aware that traffic is a part of daily life and is extremely dangerous. The primitive jungle of tigers and snakes has now been replaced by a jungle that can be even more hazardous. Education is a key word, and in this sense education means adaptation to the environment. Attitudes are changing. New approaches that give the young a better chance to get acquainted with traffic are being tried, as are new ways of teaching them how to drive. The problem is not how to hold a steering wheel or push down the accelerator, but rather how to adapt to the circumstances and show restraint.
There is much scope for improving the education of children where road safety is concerned, but the overall objective is, of course, to ensure that the training enables them to continue to behave safely in traffic on a permanent basis.

Human behaviour

The cause of up to 95 percent of road accidents is to be found in some form of human behaviour. It would seem that driving a car sometimes brings out agressiveness in people who are otherwise quite calm. The person who would never slam a door in someone's face, stamps on the accelerator when the light turns green, regardless of whether pedestrians are still on the crossing. A great deal of leniency is shown towards those who behave dangerously in traffic. We have sympathy for the victim but are almost as sorry for the driver, even when he has been reckless. Is this because we feel it could happen to us?

We certainly need deeper insight into the reasons for irresponsible behaviour in traffic. We need to have more precise knowledge of how general attitudes would be influenced if driving licences were more readily withdrawn in the event of serious violation of traffic laws. What should be the effect if careless drivers were found incompetent and sent back to school?

Today we certainly have one great advantage over the past in that the problem is fully recognised. Institutes like the SWOV have made a major contribution in this respect, and Erik Asmussen deserves our gratitude for what he has done.

RISKS OF YOUNG DRIVERS - CAN WE HELP THEM IN FUTURE?

Prof. Dr. K.H. Lenz
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The young driver: what distinguishes him, how is he recognized, what is typical for him? Well, he got his driving licence only recently, he wants to hold his own in the adult world of traffic, be one of them, in short: imitate them or, if possible, outdo them. He hasn't yet gained negative experience in road traffic, at least not as a rule, he regards mobility as a freedom plus, although the bounds of freedom were taught to him in driving school, but do they apply to him too? Couldn't one risk something sometimes, act on impulse, unrestrained, to show the buddy on the pillion seat what one is capable of?

No wonder that a lot goes wrong in such circumstances. Road accidents are nowadays the most frequent cause of death of young people. Their share in road accidents also is disproportionately high. Society spends considerable amounts of money annually - estimated at more than DM 8 billion - to alleviate the consequences of accidents, many of them severe, to help those who suffered permanent damage continue their lives in an acceptable manner. Although the risk of accidents of young drivers clearly increased in the past years, the fact of the matter is nothing new. What can accident research do to better the situation?

Today, I would like to take up only one aspect, that of driver education, because I believe that to be the best example to illustrate the work we are engaged in in our accident research in 1986.

As much as 12 years ago - in May, 1974 - a project team consisting of members of our staff and renowned experts from institutions active in this field, took up work on this problem at BASt. The project team's final report, published in 1977, highlighted the risks and incorrect patterns of behaviour of novice drivers and proposed special driver improvement programmes for young novices with previous motoring offences as a possiblity to improve the situation.

Those reading the proposals of the project team today are surprised about the foresight of the team at that time. This can be mainly explained by the fact that project teams - which are always tied to a time limit - consist of experts in various disciplines and institutions and are both independent and not subject to instructions. The instrument of project team activity is used today more than ever before when problems involving more than one discipline are concerned, but also in order to benefit in our work from the entire factual and expert knowledge of external specialists.

At that time, the project team stated in its reports among other things: "Experimental behaviour and a not yet mature anticipation of danger can certainly be regarded as characteristical features distinguishing all juveniles. But just these become then a serious problem when juveniles are confronted with road traffic. Countermeasures require explicit educational approaches concentrating on these very group-specific weak points, which are of focal importance in the process of safe education."

The above project team dealt expressly with the learning conditions of young novice drivers and established that these currently tend to reinforce the risks of young drivers rather reducing them. The project team suggested that young drivers with previous motoring offences participate in driver improvement programmes developed for specific target groups. To ensure the success of driver improvement training, to confirm, reinforce and strengthen it, all the measures applied towards this end have to tie in with each other, such as, e.g., the validity of driving licences for a limited time, the merit or demerit system in the case of successful probation or offence, betterment of safety education, strengthening of driver education in the fields expected to involve special accident risks later on, improving the awareness of the public.

When the group made its proposals, the times were not favourable for their application on a broad basis. In May 1976, the driver training and education legislation had taken effect and all hopes were placed on it as a means of attaining, among other things, the solution sought after: improvement of the safety of young drivers. However, none of the experts was able at that time to predict the exact gains in road safety which such courses or programmes could be expected to bring about. It was thus necessary and also right to evaluate the effectiveness and also the practicability of the team's proposals in a model test.

This brings us to another instrument used in modern accident research, i.e., the model test. Road safety is only one of the goals of our society, certainly a very important one, but one of which man's awareness is not yet highly developed. To have it is more accepted than to do something for it. Road safety is also in competition with other societal goals such as, e.g., speed, comfort, economical transportation, questions of energy and environmental protection.

For the attainment of better road safety in our society, it will be more important in future than it is today to predict as accurately as possible what a measure can do, where it might affect the interests of others, or what its negative results may be that have to be put up with.

Model tests take time, cost money and require scientific thoroughness, for they have to reflect on a small scale the results they are to achieve in reality. Small wonder that the final report on the model tests on programmes for drivers with previous motoring offences was published in 1982 only, as much as six years after the publication of the project team's proposals. The results were encouraging (Table 1): while, for example, about 12% of young novice drivers without driver improvement training got involved in an accident within the observation period of two years, this percentage could be reduced to 8% in the case of drivers with driver improvement training and no previous accident involvement. This means that every third accident of young novice drivers could be avoided by means of driver improvement training.

However, if there had been an accident involvement prior to the training programme, the percentage would only be 10%, i.e., the possible reduction is only half as high. But, here too, the general wisdom applies that bad habits should be counteracted as fast as possible to be overcome. A long wait generally only makes matters worse.

The difficulty raised by the selection of those in need of driver improvement training is not easy to cope with even on scientific grounds: how certain can one be of identifying a young novice driver in need of improvement training and how quickly can it be done, i.e., what and how much can he afford to do wrong on the road in order to be included in such programme? This is no doubt also a very interesting question, but was not the subject of research in this case. Based on their experience, traffic lawyers devised a pragmatic selection procedure.

The determination of effectiveness is however only the first step of evaluating the efficacy of a measure. The next question that ought to be asked is whether the costs are justifiable, i.e., will they be less than the benefits expected?
Let us return to our example: in the Federal Republic of Germany, about a million applicants for class 3 driving licences (private cars) paid a total of about DM 2.3 billion to learn to drive and obtain their licence in 1983 (Table 2). The introduction of the

Accident-involved drivers within the probationary period of two years in per cent

	without previous accident involvement	with previous accident experience
without driver improvement training	12%	12%
with driver improvement training	8%	10%

Table 1: Basic data on the effectiveness of driver improvement programmes

Present costs of training

driving school costs	DM 1.300
transportation costs	DM 90
time costs	DM 900
	DM 2.290

Based on 1 million learners per year a total of DM 2.3 billion p.a.

Table 2: Costs of obtaining a driving licence (1)

Additional costs due to the probationary driving licence legislation	
driver improvement programme (6 h theory, 6 h practical exercises)	DM 380
transportation costs	DM 20
time costs	DM 210
	DM 610
repetition of driving test	DM 1.000
Based on 200,000 driver improvement candidates per year and about 20,000 resittings of driving tests	
driver improvement programme	DM 122 million p.a.
repetition of driving test	DM 20 million p.a.
	DM 142 million p.a.
Additional costs of obtaining a driving licence due to the additional measures introduced: 6%	

Table 3: Costs of obtaining a driving licence (2)

Cost-benefit considerations	
overall accident costs in the Federal Republic of Germany	DM 36,0 billion p.a.
of which due to juvenile drivers aged 18-24 years (mainly responsible for the causation of the accident)	DM 8,3 billion p.a.
of which due to increased risk	DM 6,0 billion p.a.

Required effectiveness of planned measure based on balanced cost-benefit ratio:

$$\frac{142 \text{ million}}{6 \text{ billion}} \cong 2,5\%$$

Table 4: Costs of obtaining a driving licence (3)

probationary driving licence legislation will increase the costs of obtaining a driving licence by about DM 140 million p.a. or by 6% (Table 3), even though only the young novices committing a motoring offence within the probationary period of two years will have to submit to driver improvement training or, in particularly serious cases, resit the driving test. A measure involving additional costs of this nature has to produce benefits outweighing these costs.

In 1983, the overall accident costs in the Federal Republic of Germany were estimated at approx. DM 37 billion (Table 4). In all DM 8.3 billion of damage or 22 % of these costs fell to the share of young car drivers aged 18-24 years as those mainly responsible for accidents. If young novice drivers had the same accident risk as drivers above the age of 24 years, the damage would have been only DM 2.3 billion, which is to say that DM 6 billion p.a. of damage fall to the share of young novice drivers as a result of their high risks. Comparing the figure of DM 6 billion with the additional costs of driver improvement training of DM 142 million on account of the probationary driving licence legislation, the planned measure shows a balanced cost-benefit ratio and the required effectiveness. The planned probationary driving licence would have to reduce annual accident costs by at least 2.5% in order that the costs of the measure be less than the benefits due to the reduction in accidents.

Although the possible reduction in accidents by means of the envisaged measure cannot be estimated in exact figures for the time being, the effects of the measure - as confirmed by the model tests - are definitely estimated higher.

Two further important facts showed up in the model tests:

- the programmes are attractive, the majority of participants rate them as helpful in coping with their problems

- the chances of programme acceptance on a voluntary basis are very poor.

It is especially the last statement which leads to the assumption that the majority of juveniles are not aware of their deficits, regard aid as superfluous, in short, can only be moved to take part in some road safety education measure by a certain amount of coercion.

Whether decision makers have been convinced by these results or the increasing pressure of the very problem require them to act cannot be decided here. In any case, in its 1984 Road Safety Programme (para 26) the Federal Government announced its intention of introducing the probationary driving licence legislation in the Federal Republic of Germany. The new driving licence legislation provides for (Table 5):

- A probationary period lasts two years. In this period the young novice driver shall gain experience in road traffic, learn to be circumspect and demonstrate his ability in traffic.
- The probationary period is considered a failure if a novice, during this period, seriously offends against the rules. This is the case if traffic offences require entries in the Central Register of Traffic Offenders (VZR). However, not every one of such entries shall, on its own account, be followed by the verdict of having failed the period of probation. The weighting shall be based on the point system. A failed probationary period is assumed when a driver reaches or exceeds a certain number of demerit points considered as a point threshold.
- There are three point threshold levels. If a novice driver accumulates the number of points or more regarded as threshold level in each case, he shall submit to a special driver improvement programme (1st level), shall resit the driving test (2nd level) and, finally, shall submit to a medical and psychological examination to assess his driving ability (3rd level). In this point system, specifically set up for novice drivers, the three point threshold levels shall be definitely lower than the traditional ones in use.
- A driver improvement programme model consists of a theoretical part and practical driving exercises. The programme model was tested from 1977-80 within the framework of the driver improvement programmes for young novices with previous motoring offences. The experiences gathered in that test run make us believe in the success of such measures. The programme leaders shall be specially trained driving instructors.

The parliamentary and administrative procedures involved in the preparation and processing of these proposals have taken up more than two years. A particularly controversial issue has been the organization of the required driving licence file system to check offences. Problems such as, e.g., the requirements of data protection and road safety had to be properly balanced. In other words: it is permissible or even necessary to store personal data on novice drivers, that is to say file their offences in order that they and others may be ensured of better road safety? This conflict of aims, in this case, has been decided in the favour of road safety and the probationary driving licence legislation will come into effect in the Federal Republic of Germany as of 01 November 1986.

The next step was to convert the theoretical driver improvement concept into an instrumentation suitable for practical application. Specially qualified driving instructors were to be responsible for the training. On the initiative of the German Traffic Safety Council, a working team was established to prepare a programme leader handbook with the support of driving instructors, insurance companies, the Federal Ministry of Transport and BASt outlining how such a programme can be organized and held. The most important programme elements (Table 6) can be summarized as follows:

- Evolution of participants as a group
Participants introduce themselves to each other. The introduction is the first opportunity to practise speaking in a group and overcome one's inhibitions, if any. It is also part of the process of group development to talk about the traffic offences having been the reasons for submission to the programme.

- Identification of programme objectives and discussion
After participants have expressed what they personally expect of the programme, the main objectives and the substance of the improvement programme are explained and described by the programme leader. He makes clear that not only will the offences be discussed and analysed which had led to participating in the programme but also the problems and difficulties young novice drivers in general are known to have.

- Exchange of experience
At the end of the first session participants are asked to reflect on their previous experience in road traffic and to jot down for the next session the critical situations they been involved in, driving manoeuvres they find difficult and what they consider as their general shortcomings or failings. In the next session, these experiences and difficulties described by the participants are summarized on a blackboard or flip chart for all of them to see. They are then classified based on the deficits regarded by accident researchers as the ones typically characterizing beginners.

- Analysis of typical critical driving situations
This part of the improvement training, which is based on the case material collected thus far, is regarded as the focal point of the programme and is not the subject of only one session, although it is dealt with intensively in the second and third sessions. The material to proceed from are the critical driving experiences, difficulties and personal shortcomings participants had described. The programme leader asks for the details of some of these situations which are then analysed in the group to fully identify the causes and the development of each situation. The leader can also use this opportunity to discuss the shortcomings of participants relevant to the situations analysed and offer specific advice. The

According to the 1984 Road Safety Programme

- probationary period: 2 years
- failure of probation due to major offences (point demerit system)
- point thresholds and related consequences
  - participation in a driver improvement programme
  - repetition of driving test
  - medical-psychological examination of driving ability

Driver improvement programme including a theoretical part and driving exercises

Table 5: Probationary driving licence (1)

Important driver improvement programme elements

- group development
- identification of programme objectives and discussion
- exchange of experience
- analysis of typical critical driving situations
- driving exercise
- consequences of further offences
- behaviour alternatives
- critical review of training programme

Table 6: Probationary driving licence (2)

Objectives of evaluation research

- effects on accidents and offences
- acceptance of measures by novice drivers
- deficiencies of the programmes offered and how to eliminate them

Table 7: Probationary driving licence (3)

analysis concentrates especially on the conditions causing and leading up to such critical situations.

- Driving exercise

The practical driving exercises are not drills to improve one's skills and driving behaviour. Their purpose is to make participants realize their shortcomings in dealing with a car in order to be able to discuss them in detail. Being undertaken in subgroups of three participants among which the trips are subsequently analysed and discussed, the principles of group dynamics are also applied to the driving exercises.

- Consequences of further offences

The participants are asked to realize and discuss the consequences of further offences and the effects on their lives of a possible loss of driving licence. This provides once more an opportunity to demonstrate the possible practical effects of the disproportionately high accident risks of young novice drivers.

- Behaviour alternatives

At the end of the programme, behaviour alternatives and improvements to driving behaviour are worked out for each participant individually and discussed in the group. These should not be mere declarations of what one is planning to do but concrete and firm intentions directly based on the life style of each individual and his or her shortcomings as motorist.

- Closing session, critical review of training programme

At the end of the closing session participants are asked to describe their impressions of the programme.

The completion of the handbook for programme leaders within the short time available was possible only because of the twelve years of previous research efforts which had provided a wealth of knowledge and experience with improvement programmes for young novices with motoring offences to draw upon.

However, if one believes that the problem of young novice drivers is now solved to satisfaction and no longer an accident research topic in the Federal Republic of Germany, one is mistaken. When the legislation was initiated, the Federal Minister of Transport declared his intention to subject the countermeasures to evaluation research, which is to say to exactly identify, analyse and evaluate the effects on road safety of the measures. This leads us - after the analysis of the deficiencies and the formulation and testing of substantial proposals for the improvement of the situation - to the third instrument of modern accident research: evaluation research.

What are the objectives of such research (Table 7)?
At first the effects of the measures on accidents and traffic offences during the probationary period of two years and thereafter have to be determined. This also has to include the question of the acceptance of the new programme: conceivably young novice drivers could have their lawyers take legal steps against the administrative order and prolong court procedures till the intended measure becomes ineffective or programmes are not attended regularly or are not carried out as intended. Another objective of evaluation research is the detection of weak points in the system and proposals for their improvement.

As regards the methodology to be applied, several approaches should be used to be on the safe side. The driving licence file system to be established will have to be evaluated with great care, but it is also planned to question a representative selection of novice drivers, i.e., have interviews with 3000 drivers trained under the old and the same number trained under the new legislation and compare the answers.

In addition, it is also planned to evaluate the available general accident statistics with special regard to the problem under consideration and, finally, to talk with groups of novice drivers and instructors to obtain further information on this problem. We hope that the results of the different scientific approaches will eventually fit together to provide a realistic picture of the success or failure of the probationary driving licence legislation.

This again will tie up considerable research capacities and funds and take at least four years before a final report can be presented. But considering the annual costs of the measures mentioned at the beginning, the effort appears to be reasonable and justifiable.

I have chosen the example of the introduction of measures to improve the accident situation of novice drivers by means of educational programmes to demonstrate how accident research is undertaken in our country today, which elements are used and which time concepts are linked therewith. Not every project is as costly and extensive as the one described, but a tendency towards greater expenditures prevails and can be accounted for.

After completing 25 years of successful research in road safety, we are gathered here today to honour our colleague Asmussen by holding this seminar. Those accustomed to thinking in parliamentary time periods may find it difficult to comprehend how one can or must occupy oneself so long with road safety research. The example I described may be one of some assistance here. One has to work long and hard today to obtain results of practical value in road safety research. This is what we have admired in our colleague who is celebrating his jubilee today, and for which we thank him.

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ROAD SAFETY IN THE DEVELOPING ROAD TRANSPORT SYSTEM

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Introduction

Road safety* is concerned with avoiding traffic crashes within the road transport system. The system objective is to move people and freight from their current locations (or trip origins) to their desired destinations, as efficiently and effectively as possible, thus satisfying the needs of society. The occurrence of a crash is, of course, counter to the thrust of this objective. The objectives are not always clearly understood, despite the essential nature of this understanding. As Asmussen has noted (Asmussen, 1982), 'Systems involving human elements must, in the first place, be goals-oriented, which means that the goals to be achieved must be clearly understood and accepted by everybody'.

Nevertheless, it cannot be said that crashes are unexpected or unplanned parts of the road transport system. The economics of constructing the system are such that there are steadily diminishing returns from building additional safety into it. A stage is reached in the design process where further expenditure on safety is deemed to be unjustified. A simple example is the frequent decision to construct and operate two-way roads, despite the obvious safety benefits in using a divided road providing two one-way carriageways.

The decision to use the less safe two-way alternative has two links to the volume of traffic using the road. Firstly, as the volume drops, there will be fewer vehicles to benefit from the safety improvement. This argument assumes that there is a monotonic relationship between traffic volume and crashes and relates to the second link. This is that the number of two-way road accidents will drop as the traffic volume drops. Here we are dealing not solely with an exposure-type measure (the more vehicles travelling, the more crashes) but with a conflict or liability measure (the more vehicles, the more likelihood or overtaking manoeuveres).

* or 'unsafety', to use Asmussen's terminology.

The road system

To proceed further in this argument it is firstly necessary to recall that the road transport system comprises three interacting components viz:-

(1) the road infrastructure

(2) the vehicle

(3) the driver.

The example just given illustrates that neither of the two man-made systems (road and vehicle) will be perfectly safe. We are all aware from personal experience of the imperfections of the third components of the system.

In such an imperfect system, road crashes in aggregate will be inevitable but will be pseudo-random chance events on an individual level. Their causes can be categorised as follows:-

1. road infrastructure failures

2. vehicle failures

3. driver failures.

There are interactions between all of these, as illustrated in Figure 1.

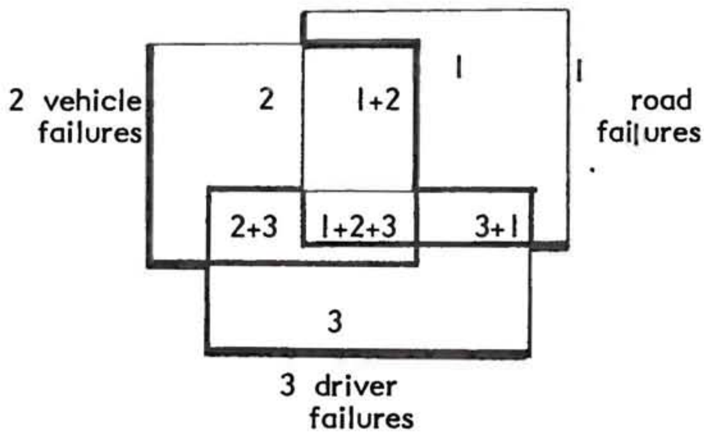

Figure 1: System failure combinations

These combinations, and some typical examples, are given in Table I.

Combination		Example
1	*	bridge failure
2	*	vehicle catches fire
3	*	driver has fit, falls from vehicle onto road
1+2	*	tyre blows out, vehicle hits roadside object
2+3	*	driver puts car into spin on curve, strikes head on side door pillar
3+1	*	driver misjudges curve, car leaves road and plunges into icy water
1+2+3	o	driver misjudges curve, hits roadside object, crushed by frontal intrusion of vehicle engine compartment

Note: * considered exceptional; o considered typical

Table I: Examples of accidents in each failure combination.

It is important to note that many of these combinations are illustrated by examples that are either very rare or almost artificial. Only 1+2+3 has a reasonably realistic example. The reason for this is that commonly occurring crashes do not represent a failure of one part of the system - rather they represent failure of the whole system to adequately control the effects of a subsystem failure. For example, if we examine each of the sub-element failures in turn we see that the consequences of each, other than in the exceptional cases in Table I, can be avoided by some combination of the measures in Table II. Note that category 'a' concerns avoiding the crash (Hadden's 'before crash' phrase) and category 'b' concerns softening the effect of the crash (Hadden's 'in crash' phrase). The Hadden 'after crash' phrase is outside the scope of this paper.

Category		Measure	Example
1 road	a.	a safer road	separation from oncoming traffic
	b.	a forgiving roadside	removal of roadside obstructions
2 vehicle	a.	a safer vehicle	provision of non-skid braking
	b.	a forgiving vehicle	removal or softening of interior protrusions
3 driver	a.	an adequately informed driver	adequate visibility of possible conflicts
	b.	an error-free driver	elimination of alcohol and fatigue

Table II: Ameliorative measures

If we examine each of these in turn as to their practicability and effectiveness we can conclude as in Table III.

1a	Safer road	(i)	For the physical components of the road, the safety technology is known. Given the funds and the space, complete physical road safety can be achieved. This can be seen in the superior safety record of free-flowing fog-free freeways. But it is unrealistic to expect every road trip to be able to be made under ideal freeway conditions.

(ii) For the road as an information source, the situation is not quite so clear cut. Some technology exists to give drivers an adequate preview of what they may encounter, but it is far from universal in either application or availability.

1b	Forgiving road	Measures to detect potential road and roadside hazards exist, as do techniques to shield vehicles from any irremovable ones. Once again, it is unrealistic to expect every road trip to be made on a road with a forgiving roadside.
2a	Safer vehicle	Techniques exist to produce a vehicle which provides significant tools for accident avoidance. For example: good visibility, good steering, good braking. Nevertheless, a great deal can still be done to provide the driver with more data on such items as the proximity of other traffic or the best route to take through a complex intersection or on the driver's ability to perform the required task.
2b	Forgiving vehicle	Measures to soften the interior of vehicles are well known, as are the related safety belt and airbag technologies. Many current vehicles do not fully utilise this knowledge and areas such as side intrusion require further development.
3a	An informed driver	Part of the information the driver needs can be supplied through the car (see 2a), part via the external traffic control system and part by prior education. Crash data generally indicates that crashes occur not so much through a lack of data but through misuse or deliberate overlooking of existing data. Nevertheless, more data can be supplied to drivers, e.g. on a forth-

coming traffic incident or fog patch. Provision of this data will often require a more elaborate system than is feasible on low volume roads.

3b An error-free driver — Many of the decision-making errors currently contributing to crashes are the result of conscious driver actions - alcohol, drugs, fatigue, aggression. These may be over-dramatic examples, for the speed and the route that every driver adopts in travelling down the road are the result of a self-paced decision that the driver alone has made, although admittedly subject to external pressures. There is clearly room for major improvements in this area, but little indication of feasible methods of achieving it.

Table III: Practicality and effectiveness of measures

The crash chain

It is useful to now consider the view that a road crash is actually a chain of events. This discussion can be particularised by using the Sabey's (1980) figures giving the prime causes of accidents as:-

Type	Combination	% of prime causes
driver alone	3	65
driver plus road	3+1	25
driver plus vehicle	2+3	5
other	(1,2,1+2,1+2+3)	5

So for most cases the chain of events is as illustrated in Figure 2. Asmussen (1982) has noted that many of the events in this chain are chance events, hence the actual crash requires a coincidence of these individually uncommon events. He has thus properly argued that the study of road safety must include not just actual crashes, but also the individual events with potential to contribute to a crash.

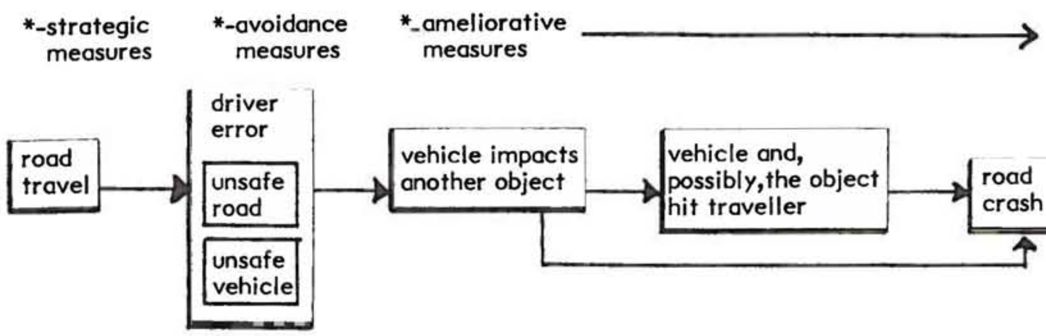

Figure 2: The accident chain

A key and previously well made point at this stage is that the crash can be avoided by breaking the chain at any point. Hence the emphasis in many previous efforts on softening or avoiding the impact by measures such as 1b and 2b in Table II. To a large extent, however, such measures are 'after the event' techniques, treating the symptom - e.g. out-of-control vehicle - rather than the disease - e.g. inappropriate speed selection. These specific treatments certainly have often been very successful, as evidenced by the effectiveness of seat belt wearing campaigns.

At the other end of the chain, it is possible to take strategic action to stop the chain starting by avoiding the need for the trip all together. This can be done by land use adjustments, public transport provisions or route closures. Such tactics are long term and quite broad in their effect.

Between the broad and the specific in Figure 2 lie the avoidance measures. Improving the safety of the road and the vehicle were both summarised in Table III (1a and 2a). The future prospects can be summarised as follows:-

1a.	Safer roads	(i) physical structure	The technology exists but inadequate funds are available to make all roads physically safe.
		(ii) information	Inadequate technology exists to structure and provide adequate preview and decision-making information. If the technology did exist, it would be probably not be affordable on many roads.

2a. Safer vehicles	(i)	physical structure	The technology exists to produce safe vehicles. However these are often priced out of the reach of many drivers.
	(ii)	information structure	Inadequate technology exists to provide adequate preview and decision-making information. If the technology did exist, it would probably be too expensive for many drivers.
3a. Informed driver		Little is known about ways of influencing a driver's perceptions and assessments of risk. Asmussen (1981) has noted 'Communication has to ensure that faults in the system are detected thereby permitting improvement, completion and correction of the process. Only under such circumstances can a stable system be realised'.	
3b. Error-free driver		Little success has been had in influencing drivers by education and only moderate success in discouraging them from activities likely to diminish their safety (e.g. drinking and driving).	

<u>Improving driver behaviour</u>

The above scenario has led a number of writers (e.g. Koshi, 1986) to argue that most of the 'easy' engineering-oriented safety measures have been implemented. They argue that safety gains in the future must, therefore, come from improvements in driver behaviour.

The author holds a much more sanguine view. There have been only minor demonstrated successes in modifying driver behaviour. Even in the wider modern society, one struggles to find examples of significant changes in behaviour, particularly changes in the direction of control and restraint.

The words control and constraint are deliberately chosen. If we merely consider the simple task of driving down a straight, smooth and empty road - all the critical decisions that the driver makes, vehicle speed, vehicle placement, driver attentiveness, driver risk-level - are decisions that he enters into a self-paced manner. This author sees nothing in current society to suggest that its mores will lead to citizens acting with more rather than less control and constraint. Most readers will be aware of the plausible arguments advanced by some concerning drivers seeking a constant risk level - make a safety improvement at a black spot and the driver will seek his risk-taking satisfaction elsewhere on the road system. The consensus emerging with respect to this risk homeostasis theory is that it at least has some part-validity.

In a sense I have argued that we are not by nature placid reactive controllers and that our societies are unlikely to apply the normal methods of ensuring placid obedience amongst its citizens. Hence, I see no large benefit from safety measures relying on improved driver behaviour. It seems to me that such measures reflect an excessively Calvinistic view of life - "if only drivers would behave better, our problems would go away".

But there is little prospect of driver behaviour improving. There is no evidence of any such past successful modifications. When behavioural differences have been observed, in space or in time, they have reflected larger-scale differences (i.e. differences between countries or between periods). Driving is too much part of our life for our driving behaviour to be capable of neat segregation and compartmentalisation.

The major driver behaviour modification which we do need to tackle is to create in the minds of all drivers a full awareness that some road space, e.g. residential streets, is a shared space. Even here, the successful attempts have been to modify the visual environment that the driver encounters rather than to modify his state of mind.

The technological approach

The view that I wish to put in the rest of this paper is that:

(a) there is far more opportunity for change in the vehicle-road part of the system.

(b) there is far more chance of successful change in the vehicle-road system.

In the rest of the paper I wish to explore changes in the vehicle-road system further. It is always risky to speak of the future too confidently, but in a paper to the IXth IRF World Conference in 1981 (Lay, 1981) I predicted, inter alia,

(a) vehicle control and routing via micro-electronics will be commonplace.

(b) electronic convoys (platoons) for movement and electronic fences for planning measures will be in use.
(c) peak operating speeds will drop but average urban speeds will rise.
(d) road accidents will have been reduced to minimal levels.

In reviewing developments in the last 5 years, it is pleasing to note that vehicle routing systems indicated in prediction (a) are now much more viable, with a number in field operation.

Prediction (b) is much closer, with the two major area traffic control (ATC) systems, SCOOT and SCAT, both putting much more emphasis on platoon control and with trials of advisory speed systems providing another method of platoon control. Planning objectives being built into ATC and individual signal sites are also seeing the creation of the first electronic fences.

Prediction (c) is beginning to occur, at least with off-peak ATC.

Prediction (d), however, has not been realised in any form. The reason for this can be seen in the following further quotation from my 1981 predictive paper.

I commented that "an extra-terrestrial visitor would be astonished as we attempted to explain to him our existing system of road operation - a system in which we permit almost unqualified and untutored drivers to make unassisted quick-fire and often emotional and drug-affected judgements on the gamut of their operations, with neither external communication, monitoring, controls nor other than the most primitive feedback. Even headways and clearances must be guessed without aids or learning patterns. It is a primitive unsophisticated system whose most noticeable feature is that it still works astonishingly well".

More recently I have commented (Lay, 1986) that: "Open loop systems are ... like fired bullets ... The car behaves like an open loop system in between the driver's intermittent sampling of the external environment. The feedback in the servo loops is negative in that the information it provides about errors must be taken into account during the control process. (The System) is burdened with the following problems:

i) there may be inadequate input available (e.g. night time driving, avoiding hazards on the road, negotiating complex intersections).
ii) the system has no way of routinely handling out-of-range inputs or uncommon events (e.g. a blown tyre).
iii) the driver may sometimes sample the external environment inappropriately...

iv) overload is dealt with by simply shedding part of the demand...
v) the error comparison is affected by stress, arousal, conditioning, motivation and type of input.
vi) the driver may make serious errors".

I think we often lose sight of just how primitive a control system our road transport system is.

It is remarkable that humans can operate it so well, but my basic thrust of course is that our efforts should be to improve the technology and not place further demands on the operator.

Before discussing some positive aspects, one major negative comment must be made. I feel that my extra-terrestrial visitor would doubt that we were serious about our road safety concerns and regulations when we permitted vehicles to use our road system which can easily out-perform its regulations: there is a basic incongruity in permitting vehicles capable of operating at 150 km/hr or more on roads with legal speeds of 100 km/hr. The mechanical engineering argument that it is really acceleration performance that is being provided could surely have been resolved by now by providing high acceleration without high speed. And if this is incongruous, how does one describe the permitted operation of these same vehicles on urban streets with speed limits of 40 km/hr? 'Design-for-safety-purpose' is certainly a phrase that doesn't enter the mind.

Technological alternatives

Within the vehicle the driver requires far more information on the conditions that he is likely to encounter, and in sufficient time to undertake corrective or evasive action. Subtle techniques for doing this are now being provided on Dutch freeways and should be feasible within urban ATC systems. However, such advice is probably needed most where the appropriate technology is least likely to be found, i.e. on low volume rural roads.

One of the calculations that we all like to ignore (Lay, 1986) is that in night time driving on unlit roads, no headlight system can provide a driver with adequate sight distance to stop before some just-seen obstruction. For reasons such as this and to cover for a driver's many and inevitable lapses in attention and good judgement, it seems paramount that vehicles develop systems of presence detectors able to at least warn drivers of imminent conflict. The basic technology for doing this has been around for almost 50 years. Once the systems are proven in the car, they will need to be able to take over some of the required evasive tasks from the driver.

A variety of other such measures spring readily to mind, and it is not appropriate to pursue each here in detail. It is important to mention however, that one of the great advantages of such non-human sensing is that the signals will be able to be fed directly into system management devices. With microprocessors, real-time processing and intelligent (knowledge-based) systems, sensible advice or direction will be able to be supplied to the vehicle. The vehicle will thus be no longer an isolated passively reacting unit, rather it will become an active participant in the whole network. This may not necessarily be to road safety's advantage. Often road safety gains a priority that it would not receive in any purely national decision making (e.g. with respect to the speed limits). In the light of media publicity, we sometimes forget the relative rareness of serious road crashes.

On the major road system I have been arguing, in effect, that the infrastructure developments will further both the application of existing technology, as it can be afforded on lower volume routes, and also the much more extensive use of control and information technology, acting between the parts of the system.

On the minor road and the street system I believe the changes needed will be in both categories. We are just now beginning to understand the external factors which influence driver behaviour and some of these lessons will become more widely applied. A particular example is the realisation that vehicle speed can be reduced by reducing the available sight distance. The task here will be to use such physical tricks and constricting slow points in a way which maintains community acceptance, both as traffic devices and as improvements to visual amenity.

Conclusion

As the paper has been a list of reviews and comments, I don't wish to conclude by summarising them. Rather I would like to pursue a new theme that I believe arises from the foregoing arguments. This theme is that if we are to make further advances in road safety, we will need to resolve a particularly serious gap in our knowledge before we can advance much further.

In much of our past road safety work we have concentrated on the extremes in the system... The out-of-range events that have led to accidents, events such as high speeds, high alcohol levels, severely reduced visibility, the risk-taking of young males, etc.

In doing this we have failed to adequately understand the behaviour of the normal driver. We have measured the out-liers without measuring the mean.

We have monitored individual drivers, particularly those having trouble with the system. But we know far too little about the behaviour of normal seemingly-safe traffic streams. In between the 'perfectly' safe uneventful trip at one extreme and the crash trip at the other, there are all those other trips with their minor incidents and potential conflicts - trips largely unexplored, despite Asmussen's advocacy. This problem also shows up in our concentration on fatal crash statistics, with a much lesser interest in casualty and property-damage-only statistics.

But further technological and sociological advances will need hard data on such simple factors for ordinary drivers as:-

1 what headways and clearances do drivers routinely adopt?
2 how and why do they brake and accelerate?
3 how do they plan their steering strategy
  - within a straight line?
  - on curves?
4 what determines the speed drivers adopt?
5 what motivates their short term route choice?
6 what messages do drivers accept from the visual environment?
7 what degree of control will they accept, given that they have other options to utilise?
8 how do drivers perceive and then assess risk and what risk levels do they adopt. What trade-offs are made in the course of a safe trip?
9 what is a driver's dominant motivation (time minimisation?) and how is it assessed?

Factors 7, 8 and 9 at the end of the list are perhaps the key to what I have been arguing. Driving is a self-paced task, but do we know what that task really is? and how it is paced? What are the real risks and trade-offs that drivers make on every 'safe' trip that they undertake.

It is particularly pleasing to note here that some of the best information in this area has come from Asmussen and his group at SWOV.

It is difficult to see how further advances can be made without answers to these questions. Even if we proceed along the technological improvement route that I have been advocating, the basic system will still be operator-determined for at least the next 10 years. Hence any technological improvements will need to be compatible with those operators. Work such as that undertaken by

Asmussen and his colleagues is clearly leading us in the right direction.

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ROAD SAFETY RESEARCH - INTERNATIONAL CO-OPERATION AND DEVELOPMENT

Burkhard Horn
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It is my great honour and privilege to speak to you today. May I take this opportunity to convey, on behalf of the Road Transport Research Programme of the Organisation for Economic Co-operation and Development, our most profound gratitude and sincere appreciation to you, Professor Asmussen, and SWOV for the longstanding co-operation and international involvement in road safety research and development and the impetus you have given to this sector which has been of traditional concern to the Dutch government.

I am pleased to have this opportunity to review where we stand on some of the important road safety issues that are before us. This is a good time to take stock of the progress we have made. We can be proud of past positive long term trends, but must recognise the worrying backfall in 1986 as well as the enormous tasks that still loom ahead.

Today's meeting should provide a good occasion to set the record straight on some fundamentals so we can direct orientations to the real issues at hand. It is noteworthy that the focus of this seminar is on meeting actual developments. Far too often discussions of road safety issues get lost in too optimistic interpretations of accident trends or, on the other hand, too dark assessments of the risks ahead.

As guardians of the public interest, we - representing road safety research, knowledge and independent judgement - are called upon to propose cost effective accident countermeasures the financing of which may be in competition with other sectors possibly providing even greater economic benefits. It is up to us - in co-operation with the industry - to prove that "traffic safety" can very well be married with "mobility". This is a matter of public representation, information and standing.

Traffic safety is one of the road transport sectors where the link between research and decision-making is, or should be, especially close(*). Mechanisms need to be reinforced that ensure the uninterrupted dialogue between, on the one hand, researchers and

(*) OECD Road Safety Research: A Synthesis. OECD, Paris, 1986.

scientists and, on the other hand, policy makers and road safety administrators.

After significant improvements in the last year it is likely that European road accident statistics in 1986 - the "International Road Safety Year" - will demonstrate a substantial fall in our road safety record. The euphoria some people had in 1983-85 is bound to die away.

We now have to look at comprehensive research-based assessments for the future.

Given the enormity of the road safety task, we need reform, not rhetoric:
- reform in policy;
- reform in approaching the road safety problem;
- reform in practice, i.e. application and implementation;
- reform in research; and
- reform in teaching and education, i.e. in "producing" a new breed of road safety professionals.

Above all we should call for a broad public debate on directions for the future. I believe it is important that we begin to discuss the actual situation in all available media and to discuss policies with all those responsible that will lead us into the next century.

It is essential to set safety goals. These are critical ingredients of clearly focused road safety policies and programme management. In 1983/84 there were about 120 000 traffic fatalities in OECD countries. The goal for the year 2000 could be to half this number of fatalities and bring it down to 60 000 which would still represent an enormous number. We should support this by governmental policy and legislation, enforcement, where appropriate, infrastructure investments, targeted education programmes and regular public statements and announcements given by the representatives of the highest echelons in the countries.

Measured steps must be taken to affect the risk levels associated with different road user groups and/or vehicles and those associated with different types of infrastructure and environment. Instead of setting quantitative safety goals in terms of reduction of accidents, fatalities or injuries, would it not be more expedient to devise a system that is aimed at equalising (and lessening) risks or risk levels of the various road user groups or other components of the traffic and/or safety complex? In order to provide a framework for focused action programmes, it would help to set desirable safety standards in terms of "acceptable" risk levels that should be adhered to.

For instance, we know that highway work zones have an unsafety record that may be 10-30 times higher than that of normal unobstructed road sections. We also know that secondary roads and even more so tertiary (low volume) roads are far more "dangerous" than high level facilities. We know the lower safety records of the young, the elderly, the pedestrian, the two-wheeler, the truck, when comparing them with that of a 35-45 year old, married family head driving a Mercedes at normal speed. Setting safety standards to be attained and laying emphasis on reducing the range between risk levels of various road user groups and vehicles, road facilities or traffic conditions might be an approach worth considering. It might guide us in establishing and implementing effective countermeasure programmes by basing them on quantitative risk standards to be aimed at.

In bringing about change and in ascertaining that changes will be effective, and of course positive, the total traffic and "unsafety" system has to be considered. Due respect must be given to the multiplicity of potential actors (and victims) as well as individual and collective decision-makers.

The OECD report on integrated road safety programmes(*) prepared by a Group under the Chairmanship of Erik Asmussen puts this message forth. A dynamic systems approach is proposed to provide a conceptual framework for safety policy and research and integrating individual safety measures in coherent "packages" to reinforce and extend overall impacts. This helps in problem identification and analysis, development of responsive research programmes as well as adequate research methods and techniques, integration of accident countermeasures, resource allocations, cost/effectiveness analysis, and evaluation of integrated packages of countermeasures.

While being a management tool, the dynamic systems approach as the centre-piece of an integrated safety programme needs further development and real life testing. Since the urban accident situation is especially complex (and appears to worsen in many countries), integrated urban road safety and traffic programmes need to be developed urgently. Indeed it is at the local (urban) scene where there is ample room for co-ordinating and integrating the actions of the various population and professional groups concerned, where a great deal of good will and personal commitment exist and can contribute to developing comprehensive local traffic safety initiatives, and where central (national) incentives can be effectively followed up as well as rewards and funds most purpose-

(*) OECD, Paris, 1984

ly utilised. Research is therefore called upon to support and structure integrated local safety policy by the help of dynamic systems concepts and controls.

No new large scale safety measure confined to a single action and likely to have a major impact - such as alcohol legislation, seat belts, speed limits, crash helmets - is in sight. As in other sectors of public concern this has led to emphasis on management research having recourse to social-sciences. Its aim is to eliminate institutional constraints and barriers so as to help to liaise between, and hopefully integrate, administrative and professional decision making structures and processes and individual safety measures. It is a new sector of road safety research and has traditionally been neglected, but such assessments are of crucial importance. This is not to say that technical and behavioural road safety research activities be given up. They remain important and essential as the whole traffic and safety context and system is subject to evolution and change.

Obviously, management research studies are particularly difficult to carry out, because they have to be undertaken within the core sphere of institutional decision-making and may, because of their necessarily critical approach, create unease on the part of policy-makers. However, it should be recognised that they are indispensable, because the concept of an integrated road safety programme is basically geared to modify social and group behaviour and attitudes that shape and ultimately determine the road safety score.

In such research consideration must be given to the whole complex of enforcement and control - the willingness of politicians and control organs to exercise their funtions and working tasks in a democratic environment and within the general context of social security and welfare goals. Closely linked to it, the role of automobile insurances needs scrutiny: reviewing their experience, the premium structures in regard to road safety impacts, access to their data files for research purposes, and the like. Also independent studies are needed to describe and set performance standards and safety goals for the attention of the automobile and the trucking industry in regard to road safety; questions - such as: has the experimental safety vehicle (ESV) R & D programme in the 1970s been a successful, useful, cost/effective undertaking? - need to be answered. In essence, international joint research is needed to provide an objective and independent assessment of the various legislative, regulatory, governmental, professional, industrial and private institutions and links and to try to pinpoint present pitfalls.

In this broad context, a special point in case - especially within the EC and its Member States - is the complex of "liberalisation" (and/or deregulation) versus harmonization (and/or standardization) in the transport sector. Assessments are needed to clarify possible effects on liberalising or deregulatory measures on traffic safety. This concerns chiefly the truck and road freight transportation.

Sound and effective road safety policies, plans, programmes and research must be based on a comprehensive, reliable and up-to-date data base. Having conducted at least on specific accident enquiry for each of the over 40 OECD road safety projects within the last 15 years or so, I can confirm the persisting limits and gaps of national accident data bases - not to speak about international comparability, although tools exist to bridge some of the national differences. For sake of completeness, let us once more stress the need for adequate road user and vehicle exposure data.

Physical research on infrastructure and vehicle related safety features must continue. Above all, investments must be provided to implement acquired research knowledge to improve low standard roads and rehabilitate deteriorating road structures.

It is also time now to strengthen our research focus on safety related components of road user information and communication, technology and systemise R & D on the vehicle and its equipment, the driver, the road and its environment. Technology (and industry) will not wait. Regulators and public research agencies must be prepared - even better to take the leadership - to guide the introduction of such technologies in the overall transport and traffic safety system.

It has been estimated that about 50 per cent of the United States Gross National Product is tied up in telecommunications, information and electronics. In order to ensure that the (driving) public we serve are full beneficiaries of these powerful technologies in the future, co-operative international research must set the scene: the goal is to establish functional standards that future driver aid and guidance systems must adhere to. In order to fully exploit these technologies for road safety and traffic purposes, the behavioural and ergonomic component is critical. Research in this area needs to be reinforced and the results should be formulated in such a way that they are transferable into precise recommendations.

In this vein, it is the duty of the medical profession and research to provide more support to road accident prevention. Physicists are invaluable partners in developing new solutions to some of the existing (and forthcoming) traffic safety challenges; they should be encouraged to fertilise, and integrate into, established research teams. National public health agencies - and, internationally, WHO - might be stimulated to reinforce their actions in this direction.

After this brief description of some of the major issues in our present situation - with its challenges, truisms for some observers, and possible new directions - let me stress the need for continuous international research co-operation and information exchange between our countries facing similar problems.

More severe road safety problems exist in the third world. International solidarity, help, advice and information are even more pressing. Vigorous aid programmes on this issue - possibly combined with road maintenance schemes and general education programmes - are required.

Finally, let me make clear that some of the actions I am advocating cannot be implemented without public commitment, advanced research, sufficient investments and dedicated, well trained manpower. There are too few university chairs for transport safety. We need more Professor Asmussens. We require trained traffic safety professionals at all the various public and private institutional levels. Only by stimulating the development of focused curricula in our educational establishments, can we hope to create a breed of road safety researchers, managers and practitioners that wil achieve substantial improvements and attain the goal to half the current road accident toll at the end of this century.

RESEARCH AND POLITICAL DECISION MAKING

Michel Frybourg
Ingénieur Général des Ponts et Chaussées
Professeur associé au CNAM, France

A multiplicity of agents

Road safety measures are managed by a multiplicity of agents: various ministries or departments, national agencies, professional disciplines (engineers, police, magistrates..) whose interest in road safety may only be marginal. It is absolutely essential in this sector, more than in others, to assess the "institutional effect" which must be considered as a fact and be taken into account in the management of a policy applied to a dynamic system. What is at stake is that many future measures taken may be either short of breadth or are subject to transient effectiveness.

An integrated safety programme is a set of co-ordinated activities to be carried out by a variety of agents of different nature (governmental or private organisations and acting at different levels) with the aim of solving a number of well-defined safety problems. In such a programme the various measures are adjusted to each other so that the total effect of the package of measures is larger than the aggregated effects of separate measures.

Speed limits

It is important to consider the non-safety impacts of a potential programme and, conversely, the effects that public or private initiatives, in general, may have on road safety. In some countries, speed limits on motorways have long been used to enhance safety, yet, if complied with, can yield fuel savings and possibly reduce vehicle maintenance and repair costs. For truckers, on the other hand, additional time must be spent on the road leading to increased operating (wage) costs.

For some car manufacturers, speed and the automobile are one. Speed creates the prestige of a constructor and established its image. It exacts optimum performances from brakes, steering and suspension... and necessarily the most advanced technology available, the kind which paves the way for the future. Speed motivates engineers, children and potential buyers alike. It is the extra 'something' that goes with a car. So what is good for safety looks not good for market but, in Europe, can we have a commun market for the car production and not a commun market for the utilisation? Speed on motorways is related with the level of pollution and the same country can it be ahead in environment protection and behind in speed regulation?

Drinking-and-driving

The importance of driving after drinking as a factor in the occurrence and seriousness of road accidents has given rise to several nation-wide statistical research studies during the last fifteen years. These studies are partly devoted to an examination of changes in behaviour so far as drinking-and-driving is concerned following the passing of laws on legal limit and preventive checks. An evaluation of the repercussions of these legislative measures upon accidents as a whole takes up a major part of the research.

These various questions raise a fundamental issue which is that of the acceptance by road users of a new 'norm', based upon a new law, which may conflict with certain often traditional habits having to do with alcohol consumption. An effect of the wider use of vehicles has been to make into a criminal offence what had hitherto been a socially accepted - and even within certain traditional limits an encouraged kind of behaviour. Before the passing of laws regulating road user behaviour there were indeed none tending to reduce the 'social' consumption of alcohol.

Decision-making process

The decision-making involved in a comprehensive road programme contains elements both of a political and of a technical or scientific nature. It is therefore not a strictly rational process in the sense that benefits and costs are related to specific objectives in an optimal way. Senior managers in charge of setting up road safety programmes require the support and involvement of many disciplines and managers in both the transportation and non-transportation sectors to make decisions on the components of road safety programmes and their effective co-ordination.

High priority countermeasures to be included in national programmes have to be identified through a process which includes bringing together researchers, programme managers and senior decision-makers for face-to-face interaction. Researchers are required to provide a forecast of the effectiveness of as yet untried programmes based on this knowledge. Programme managers bring to the group an understanding of the practical problems of programme development and delivery which affect the timing, cost and acceptability of programmes. The senior managers make critical contributions regarding the availability of resources and social acceptability of alternative strategies and programmes.

Traffic safety measures addressing a single aspect of road safety, such as drunk driving or speed limits have reaching the point of diminishing return. The promising safety measures for the future seem to be those derived from comprehensive problem analyses that transcend organizations and disciplines and that are drawn from the broadest and most creative range of solutions. We cannot avoid to take car design and car utilisation as a whole; the same for the social consumption of alcohol, with or without driving. An integrated programme should be structured in such a way that it enhances the value of the safety measure. So speed limits have to be accompanied by an adaptation of the other components of the system (e.g. road and vehicle design, traffic management, driver communication) so as to avoid counterproductive or opposite effects.

Manage the conflicts

One of the most important issues is that of ensuring a consensus between the various individual or collective 'actors'. From the outset, when designing an integrated programme, the existence of potential conflicts must be recognized. This may bring into play cultural, technical, economic, and psychological dimensions. There is no benefit in evading this question. It is better to clarify and 'manage' these conflicts; if this is not done, illusion may lead to the failure of the programme. In spite of the complexity of the analysis of the road safety problem, it is possible to suggest that those responsible have been under the influence of a certain degree of "technocratic naivety", the effect of which has been a restriction of the social mechanisms and cultural determinants leading to inertia, resistance and conflicts.

It does not suffice to build an integrated road safety programme: there is a need for following up its functioning, how it measures up to reality, and how it affects current conditions, how it actually varies from predictions and to what extent individual and social behaviour adapts to or diverts from the situation aimed at. For example, ten years after the generalised speed limit was introduced, we may see in Europe that the top speeds of newly-produced vehicles and motorcycles are clearly above those we had before the introduction of the generalised speed limit. We have to clarify i) which measures can reinforce each other; ii) which measures work against each other; iii) which measures are lacking, e.g. to support intended measures or to reach certain objectives.

Conclusion

Social sciences include political science but for researchers be involved in managing conflicting interests is an uncomfortable activity. The safety research ghetto has to be broken down and even if inconvenients appear, if research results go against commercial lobbies or cultural traditions, there is no benefit in evading this kind of question. It is better to clarify and 'manage' these conflicts. Those who order research have to take account that political science is science and not politics. Researchers have to be protected of conflicting interests as far as they do their work: research and not policy.

The organisation of road safety measures or programmes is too often based on a logic of juxtaposition rather than interaction or co-ordination. In fact, the aim of accident prevention is to improve the knowledge about the function of the human operator as well as the interfaces between the operator and the system. We must focus our attention on the human being, what he really is, and adapt traffic tasks in accordance with his capabilities rather than accusing him for his errors every time he shows his inability to cope with an emergency situation. For this reason, a responsible attitude at all levels of safety work requires clarity, transparency, debate and critical assessment.

An integrated programme implies efforts of many institutions which usually are not supposed to directly respond to the requirements of focused co-operation. Incoherence related to the diversity of interests between economic agents and public authorities must not lead to fruitless antagonisms but they have to be dealt with in order to attain acceptable trade-offs. For this reason researchers must participate in political debates of arbitration and decision-making - trying to attain the same profound effects as for instance those due to "catastrophic" incidents - so as to contribute to the modification of thresholds which, at a given time, separate what is considered reasonable from what is not. In this way researchers can contribute to focused actions thus avoiding an approach based on unexpected and a posteriori public opinion changes.

PROGRAMS FOR THE IMPROVEMENT OF ROAD SAFETY

Voyce J. Mack
Department of Transportation, U.S.A.

As most of you know, the U.S. Department of Transportation is organized along modal lines with the responsibility for road safety research assigned to two agencies: the Federal Highway Administration (FHWA), is responsible for the safety aspects of highway design and operation, and the National Highway Traffic Safety Administration (NHTSA), is responsible for the regulation of the vehicle and qualifications and licensing of drivers. This division of responsibility provides coverage of the three elements deemed critical in the safety equation: road, vehicle and driver.

Despite our efforts to assign specific responsibilities, some overlapping exists in areas such as: impact of human factors (e.g., driver capability and response) on highway design and operation); and heavy truck safety where both agencies cooperate in the regulatory process.

The FHWA program is divided into 3 major areas: large truck safety, roadside safety hardware and traffic control devices. With respect to large truck safety, this has been a major safety issue since 1982 when the Congress created the National Truck Network and allowed wider and larger trucks to use the highways. Truck accidents increased 16 percent between 1984 and 1985 and as a result there is a national concern spurred on by the media and the American Automobile Association over the impact on safety from large truck use of urban freeways. Modifications are needed in our highway design standards to safely accommodate the larger trucks authorized by the Surface Transportation Assistance Act (STAA), and we have to analyze truck accidents on urban freeways and identify actions we can take to alleviate the safety problems resulting from their use of those freeways.

The second area of concern involves roadside safety hardware. Although we have made great strides in improving the safety of our roadsides, fixed objects account for more fatalities than any other single category (28.2 percent). About half of these fatalities occur when an errant vehicle hits man-made highway hardware such as poles or guardrails (3,300 fatalities a year). We are proposing a series of projects to address the highway hardware safety problem. These include: (1) the development of more forgiving traffic hardware for use on curves and downslopes where present hardware does not perform well, and (2) providing the states with guidance on bridge rail, terminal and transition designs which have been tested by FHWA and others and found to perform satisfactorily. In addition, we are looking into the feasibility of developing a new generation of traffic hardware to meet the multiple needs of a wide range of vehicles for different functional classes of high.

The third area, Traffic Control Devices, involves major issues of concern to a number of FHWA offices. FHWA's ten years' experience in evaluating the highway safety improvement program has consistently shown that well maintained traffic control devices are our most cost effective highway accident countermeasure. Signs and markings are the most effective of these devices, particularly at night when other visual cues cannot be seen. Unfortunately, signs and markings lose their nighttime reflective quality faster than their daytime visibility and there are no standards for reflectivity like there are for daytime visibility. Accordingly, many devices are left in place long after they are no longer effective at night. In 1987, we plan to continue research to determine minimum nighttime visibility requirements of these devices and develop simple, practical means of measuring their reflectivity. Another major safety issue is work site safety. In 1984, there were over 700 fatalities in work zones; that is a 40 plus percent increase over the 1982 toll. With states doing more and more work under traffic conditions, we need to give renewed emphasis to traffic control in work zones. In FY 87, we propose to provide this emphasis by developing work zone management guidelines which will pull together the current technology in work zone management in one document for use by operating agencies. In addition, we will conduct research to improve traffic delineation and guidance in work zones.

There are two other projects proposed for FY 87 to meet special FHWA needs that do not fit neatly in the last 3 categories. One will evaluate a National Cooperation Highway Research Program recommendation to change national policy on safe stopping sight distance. The other is to transfer technology on new statistical techniques which should simplify and improve state efforts to analyze accidents and evaluate the effectiveness of improvements.

With respect to the National Highway Traffic Safety Administration activities, emphasis will continue to be on seat belt usage, drug and alcohol countermeasures, and driver licensing.

1. Seat Belt Usage

The growing support we are seeing today for safety belts is one of the most remarkable movements in the history of highway safety.

From the grassroots on up and from the President on down, Americans have joined together to end the senseless carnage that we once simply accepted as part of the price to be paid for motor vehicle travel.

The laws are working as intended. In the 8 states which have had mandatory use laws in effect long enough to make comparisons between 1985 and the previous year, nearly 300 lives have been saved.

The first state to pass a mandatory safety belt law was New York. In 1985, fatalities and serious injuries dropped to the lowest level since 1949, i.e., the lowest in 36 years.

In the first six months the Illinois law was in effect, incapacitating injuries by motor vehicle accidents were reduced by 25 percent.

In Texas, the State Board of Insurance lowered by 5 percent the statewide average on all private passenger auto insurance, an estimated $138 reduction in premium costs to policy holders, in anticipation of reduced injuries and fatalities due to the Texas safety belt law. Texas reported belt use quadrupling in six major cities and tripling in three smaller cities.

Safety attitudes of the American people are changing for the better. Recent polls find more than 70 percent favor belt use and in all states with laws, an even higher percentage want those laws enforced.

Unfortunately, strong support for safety belt laws does not always translate into actual use of safety belts. In many states, use is running around 40 to 50 percent, rather than the 70 to 90 percent that DOT would like to see all over America. Passing the law is only the beginning; enforcement and public education are the keys to making these laws work.

More than 30 countries mandate safety belt use, some with laws on the books ten years or more. What these countries have found is that meaningful sanctions play a major part in safety belt use. Belt use decline if the legislative sanctions for nonuse are not enforced.

Although the United States cannot claim leadership in mandating safety belt use, we are proud that laws requiring child passenger protection (i.e., child safety seats) are in effect nationwide. DOT recently released a report on the benefits of the child safety seat and the results should come as no surprise. We found that

child safety seats are one of the most efficient and beneficial auto safety devices available, if used properly. We found that overall use and correct use increased dramatically between 1979 and 1984. This is because of state laws, more convenient design, and educational programs.
The payoff for parents who carefully follow the manufacturer's directions is that the risk of death is substantially reduced, by more than 70 percent. The risk of serious injury drops almost as much (67%). One note of caution: safety seat use drops off sharply as children get older, 68 percent of infants under age one were in safety seats during 1984 but only 17 percent of four year olds were. One likely factor is that every state requires infants to be in safety seats but only eight states and the District of Columbia require them for those four years old or older.

2. Drunk Driving

Paralleling our steady progress in belt use, we are witnessing a dramatic shift in this country in how we deal with the drunk driving problem.

Just a decade ago, we regarded the drunk driver as a nuisance. Today, that driver is viewed in the proper perspective...as a potential killer. Citizens all over America are accepting, even demanding, not only stiffer enforcement of the law but changes in life style that cause drunk driving. Thanks to voices from the grassroots, we are seeing measurable, dramatic changes. For example, the number of fatally injured drunk drivers declined by 26 percent between 1980 and 1985. That is an incredible accomplishment.

For young people 16 to 24, drunk driving represents the leading cause of death. Although accounting for only 20 percent of licensed drivers in this country and driving less than 20 percent of the miles traveled, these 16 to 24 year olds are involved in 42 percent of all fatal alcohol-related crashes.

In 1984, the President signed into law a bill encouraging states to set 21 as the legal minimum drinking age. Although we normally defer to the states on traffic law issues, in this case, the President feels that a uniform drinking age will eliminate "blood borders", where teenagers have a positive incentive to drink and drive, crossing state lines to take advantage of lower drinking age laws, then returning home under the influence. States that do not enact legislation to raise the drinking age forfeit a portion of their entitlement to Federal highway funds.

Today, 43 states have this important, life-saving measure on the books. I am confident that the remaining states will follow and we will soon have our uniform drinking age.

3. Driver Licensing

We have a serious problem to address in the commercial vehicle area. First, tractor-trailers. In 20 states, any person who is licensed to drive an automobile can legally drive a tractor-trailer without meeting any special training, testing or licensing requirements. Currently 31 states have some form of classified licensing system. That number will reach 32 when Oregon's new classified licensing law takes effect. We urge the other 18 states to join their ranks at the earliest opportunity, so that we can be assured that every state sets reasonable standards for drivers of larger vehicles.

Another practice that must be eliminated concerns commercial drivers who hide traffic convictions in one state by simply obtaining a new license in another state. We must make certain that operators carry only one license so there is a single, complete record of each driver's history.

Florida is one of the 30 states and the District of Columbia that have joined the Driver License Compact. We hope the other states will soon adopt the "one-license/one-record" concept and support it by forwarding conviction data to a driver's state of record.

There is growing recognition of the problems faced in licensing elderly drivers. Older people are the fastest growing part of the U.S. population. Census bureau figures show that between 1960 and 1980 the number of people over 65 years of age grew 54 percent. Those over 75 are the nation's fastest growing age group with their numbers expected to double by the end of this century.

DOT, the Veterans' Administration, National Academy of Sciences, and the private sector are funding a major two-year study on improving safety and mobility of elderly persons. Among the issues to be considered are night vision, auto design, and the design of highway signs. Ten states and the District of Columbia now impose more stringent licensing standards for elderly drivers. Other states are now beginning to consider this problem.

4. Drug Countermeasures

President Reagan has called on all Americans to join in a national crusade to help eliminate the drug problem that plagues our society. The President has announced a campaign that will focus on drug testing and prevention in the market-place and in schools.

NHTSA already has programs in place that will be a part of this national effort. One example, the Los Angeles Police Department (L.A.P.D.) has developed procedures for detecting drivers who are under the influence of drugs. We are now working with the L.A.P.D. to develop a drug recognition training program and an implementation guide for other law enforcement agencies.

During National Drunk and Drugged Driving Awareness Week, to be held in December, we expect more attention to be focused on the drugged driving problem and hope for innovative countermeasures to be considered.

The WAY AHEAD

Th.J. Westerhout
Chairman of the Board of the Institute for Road Safety Research SWOV, The Netherlands

The Dutch pioneer in the field of road safety Asmussen has handed over his life's work, SWOV, to a younger man. This work, the SWOV organization, offers prospects for our future. The way ahead of us has been cleared partly by his pioneering work. This contribution to the Liber Amicorum is based on his approach: he only ever looked back in order to see ahead.

Introduction

To look back from the point of view of the SWOV Board on the ideas and achievements of Professor Erik Asmussen after almost 25 years of SWOV and road safety research in general is no easy task. His importance to SWOV and to the research has been enormous. As the pioneer he had to cut his own way through the forest of contradictions. He blazed a trail for road safety research nationally and internationally; he ran ahead, clearing new paths of knowledge for the improvement of road safety.

The Board is proud to have had such a pioneering spirit as Director of SWOV. The Board and staff of the organization owe thanks to Professor Asmussen for his unceasing efforts to build SWOV and road safety research "from scratch" and for the constantly repeated stimulus of his innovatory ideas.

Even though he is retiring from the directorship of SWOV he will not be lost to road safety research. He will continue his work towards the integrated control of road safety in his teaching of young people, and guidance of their research, at Delft University of Technology. Happily, we at SWOV will still be able to take advantage of his great expertise and inventiveness: as scientific advisor and chairman of the Scientific Advisory Council of SWOV he and his knowledge and new ideas will remain available to us.

A look back for the future

The choice of staff has played a major role in the development of SWOV and of road safety research. In the Board's opinion Professor Asmussen succeeded again and again in recruiting and keeping creative, expert people around him. The loss of one of his fellowpioneers, Dick Griep, had far-reaching effects; a gap like this can never be filled completely.

Several times during SWOV's relatively short history we have found that our staff possess a high degree of resilience, enabling them not only to make up for a loss of this kind but also resist the "storms" that have battered the organization. The last few years have afforded the best proof of this. The struggle for SWOV's existence has been fought shoulder-to-shoulder by the Board, the Director, the Works Council and the staff. The reorganization towards the new-style SWOV has begun with enthusiasm, with the old Director giving a good deal of encouragement from the sidelines. Now it is up to the new Director, Mr. Koornstra, to take the helm and provide scope for the expertise and creativity, the resilience and enthusiasm to develop. Professor Asmussen always provided his staff to a greater or lesser extent with such scope for development, as is indeed necessary in a research organization, albeit this is not always understood in the "outside world" - the very "world" that reaps the benefits of SWOV working at full efficiency.

The Board also wishes to mention some high points of SWOV's day-to-day work. Professor Asmussen has experienced many that are worthy of mention: the first SWOV report to appear ("The moped rider in traffic"); the first research project to bear fruit, to which Asmussen contributed a great deal ("Roadside safety structures"); the first white paper on Road Safety, for which SWOV first made public its views and knowledge of improving road safety in the "Contributions to the Road Safety Memorandum", which disposed of the traditional approach to road accidents in terms of liability and the model of the accident-prone driver.

Many major and minor high points followed: it would take too long to list them all here. There are two that must be mentioned, however. It was under Asmussen's chairmanship that an OECD Road Transport Research scientific expert group internationally accepted and adopted his view of the integrated control of road safety, owing mainly to the contribution made by SWOV. This resulted in the OECD report "Integrated road safety programmes". Last but not least, the report proposing a new-style SWOV served as a basis for the ministerial decision on the continuation of SWOV in 1985 and on SWOV's position and functioning in the future.

Lastly, a few other high points in SWOV's existence. For many years SWOV organized an international Day of Study, followed by the Intertraffic conferences, also international. Then, in 1976, came the Future in Safety conference. To date five National Road Safety Conferences have taken place, organized by SWOV and ANWB.

The Days of Study and conferences each presented a piece of the progress that had been made in theoretical and practical approaches to road safety.
Following ten years of a Crown lectureship at Delft University of Technology, in 1982 Asmussen was appointed Extraordinary Professor of Road Safety there, a post he still occupies.

Not all the high points have been of a scientific nature, however. In 1979 the SWOV organization had 90 staff and was internationally one of the leading research institutes. After many moves and temporary offices, suitable accommodation was found in 1981 in Leidschendam, where 70 staff now work - the government cutbacks have not left SWOV untouched. They work in a new building, with new conditions of employment, in a new-style SWOV.

It is only right and proper that we should call this Professor Erik Asmussen's life work. He ran ahead and cleared the way before us; he was and showed "the WAY AHEAD"!

TOWARDS A DYNAMIC SYSTEM APPROACH TO ROAD SAFETY

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This paper was written as a tribute to Professor Erik Asmussen, to mark his stimulating and innovatory role in the development of road safety research. For many years he made me a party to his search for new ways of achieving effective and integrated control of road safety, and this paper is a reflection of this.

Introduction

Road accidents are a diffuse phenomenon, difficult to get a grip on. They are like an epidemic caused by a virus which appears in many different forms and can hit any road user at any time, anywhere, in any situation. Not only do road users have virtually unlimited freedom of decision and action; planners, designers, constructors, engineers, legislators, managers and supervisors have almost as much. The massive scale of road traffic and the unlimited freedom create a complexity scarcely to be found in any other area. It is a miracle, really, that the traffic system functions as well as it does, albeit not at the optimum. But nor is it any wonder that all sorts of things "go wrong", at the expense of human lives.

The freedom of decision and action at the various decision-making levels resulted in a fragmented approach to road safety: a kind of "Brownist movement" of efforts at the various levels, isolated from one another. The whole question of road safety was split up not only into components (human, vehicle and road) but within each of these into modes of transport and administrative bodies. The goals were separate and constantly changing, and sometimes conflicting. Sometimes solutions were put forward to problems that had not been analysed. Signs and examples of this approach are still to be found. There are those who would like to improve people. Road safety education without a clear knowledge of what road users need to "be capable of, know and/or want" often results in a fragmented, unsystematic approach; it even results in the "conditioning" of children on the roads, giving still more precedence to the freedom of other traffic, especially cars. Others work on improving vehicles: cars, motorcycles, mopeds, cycles (especially racing and semi-racing bikes) go faster with greater and greater comfort, cars crash better and better - at least as far as the occupants are concerned. Yet others work on improving the roads. The result is that more time and money has to be set aside for the first one thing and then another. The complex of relationships between people, vehicles, roads and environments, between the various modes of transport, and between the decision-making levels is largely ignored.

It was thought, and is sometimes still thought, that the drawbacks of the attention shifting from one individual element of road safety to another could be overcome by the comprehensive approach, where a list is made of every possible measure directed at people, vehicles and roads. A list of this kind, however, includes redundancies and overlaps: the saving in lives would exceed the actual number of deaths and injuries many times over! However complete the comprehensive approach may be, there remains the problem of what system and priorities to adopt on the basis of the problem analyses, since there is usually more than one way of improving a particular problem situation: comparisons and choices constantly have to be made.

The historical development of approaches and philosophies

The philosophy of road accidents, and consequently the approach, was for a long time monocausal, and there is still a tendency to think about road safety in this way: if we find the cause of an accident and remove it, one like that will not take place again. The first "road safety philosophy" regarded every accident as one too many, but also as unique. The whole problem became lost in casuistry. Each accident is an independent problem, the solution to which is to remove the cause. The fact that the solution may introduce fresh problems is not considered, any more than is the fact that another solution might deal with more than one problem. It goes without saying that this philosophy is inadequate to deal with one million road accidents, 50,000 accidents involving injury or even 1,500 fatal accidents.
The every-accident-is-unique-and-one-too-many philosophy results in perfectionism regarding details of the individual elements, ignoring the interactions between the elements. Thus the intended effect is not achieved, and in some cases unexpected and unwanted effects occur. For example, installing traffic lights at a quiet intersection in the countryside because one serious accident has taken place between a cyclist and a car crossing each other's path would seem to be a way of preventing accidents of this kind in the future. But ... what about the effect, after a while, of having to wait at red for nothing...? Even worse crashes, with people driving through red lights; a new kind of crash, with the driver ahead deciding at the last minute to stop for the red light! Only an example, and a fictitious one, as it happens, but these things happen! It is a question of keeping road users "quiet", or do those responsible really not know any better?

Besides the monocausal casuistic approach, there was the "accident-prone driver" philosophy of road safety. This recognizes that chance plays a part in involvement in accidents, but the road user's behaviour is regarded almost exclusively as the cause. The question of liability is central: "inappropriate behaviour" is a term often heard. The argument is taken even further, however. Being involved in an accident once could be bad luck, even if the person is to blame: "causing" several accidents cannot be mere chance. Such "accident-prone drivers" have to be removed from the roads or forced, by punishment or reeducation, to make themselves into "gentlemen of the road". This approach assumes that chance acts "fairly", ignoring the fact that one driver spends twice as much time on the roads as another, at different times etc. Every attempt to identify the "accident-prone drivers" has failed, in fact. This approach is still common. The road accident records are not the only example: here human error is still noted as the most important cause of accidents, more important than shortcomings or defects in vehicles, roads and traffic situations. The "accident-prone driver" philosophy results in a selective, human-oriented approach to road accidents, more or less ignoring the other elements. Its failure is caused partly by an unintended effect on road users. Those who have never been involved in an accident see this as confirmation that they may consider themselves to be far above average as road users. As a result they not only overestimate themselves - the pride that leads to a fall, when they find that they cannot "cope" with a critical situation after all - they also become less alert to critical situations.

These approaches and the increase at the time in the numbers of road accidents may have been behind the next philosophy of road accidents: that they are a chance phenomenon about which nothing can be done. All that can be done is to try to prevent damage and injury. This approach acknowledges that the numbers of accidents fluctuate, but expects them to stabilize eventually around a certain "mean". It is impossible to reduce the "mean", since chance phenomena cannot be changed - they are fated, as it were. This approach completely ignores the meaning of the term "chance phenomenon", partly because of the ineffectiveness of the monocausal approach (which was still upheld); the measures rarely if ever had the desired effect. The accidents-are-chance-phenomena-and-so-not-much-can-be-done-about-them philosophy resulted in almost complete concentration on dealing with the consequences of accidents, preventing damage and injury. Cars which are crashproof - at least as far as the occupants are concerned; lighting columns that break or collapse on impact; crash helmets for motorcyclists and moped riders and car seat belts exemplify this approach. Its effects should certainly not be underestimated, but they remain limited.

The limitations of the monocausal approach were increasingly recognized. The multicausal approach to road safety made its entrance some fifteen years ago. This saw accidents as multicausal chance phenomena. Everyone who participates in traffic runs the risk of being involved in an accident. Various interrelated factors play a part - albeit the interactions are merely considered in a static "black-box" model. These interactions between the human, vehicle, road and environmental factors are partly deterministic and capable of being influenced. A good deal of them, however, must be regarded as stochastic at present. Diligent efforts were and still are being made in research and practice to find these factors. Advanced statistical techniques are being developed and applied to organize them. Finding the coherence between the various factors remains a problem, however, as does classifying and setting priorities for the measures. A choice has to be made between various factors that contribute to the occurrence and course of accidents.

First it was decided to try to improve the human factors in particular, since it was assumed that these would be the easiest to change. This idea was found to be far too optimistic. Effects were absent or at least imperceptible. Consequently a strong emphasis on effectiveness and "environmental" factors (the road, the vehicle, the traffic environment) came about: adapting the "environment" to road users, to their capabilities and limitations was the aim.

The result of this static-multicausal-black-box-approach, in which it is difficult or impossible to indicate the interrelations between the factors, is that in practice measures are often found to be less effective than expected. Because of the absence of any coherence between the factors, it "turns out" that the measures have been taken in the "wrong" place, and in the worst cases that they are the "wrong" measures: for example, felling trees to avoid vehicles running into them can result in head-on collisions between vehicles if gaps are created through which the wind can blow. Measures on the preceding section of road (e.g. speed-reducing measures) combined with other measures on the spot (e.g. to allow for emergency manoeuvres) would probably be more effective.

There is increasing awareness of the absence of any coherence between the various factors that contribute to the occurrence and course of accidents, and consequently an approach is being sought which enables the interrelated factors to be regarded as a whole and which regards the relationships between them (the human, vehicle, road and environmental factors) as primary. The system approach, derived from organizational theory, turns out to be a usable theoretical and practical approach. At the moment static black-box models are being used; the main difference from the multicausal approach, however, is that a problem-oriented strategy is used to select the system boundaries. Problem situations (including the "area of influence") are studied and analysed, rather than sets of factors. The static system approach still does not provide a satisfactory explanation of phenomena and effects of road safety measures.

The drawback of the static multicausal and static system approaches is that they ignore the dynamic character of traffic and accidents. This is why we need a dynamic system approach. The accident black box also has to be opened. Every state that is observed in a "snapshot" with a history and a follow-up; states are changing constantly. What is important in road accidents is the process of change in the course of the accident and everything that precedes and succeeds it: the "accident process". Within the accident process - or rather the traffic process - discontinuities can be found in the changes of state: these reflect the phases of the accident process. The critical states in each phase are partly the result of prior actions, events and circumstances. Each critical state has a memory, as it were. A succession of critical states (each reinforcing the next) produces a critical chain of circumstances - or combinations of circumstances - that determine the nature of the crash, the consequences and recuperation.

The dynamic system approach has developed into a method for examining dynamic and complex phenomena in reality and controlling them. The use of this approach (not to be confused with "system dynamics") in research and to control accidents is still in its infancy. It offers good prospects, however, not only for the effective control of accidents but also for the optimalization of the way traffic systems work and the integration of all efforts (direct and indirect) to control safety.

The dynamic system approach to road safety

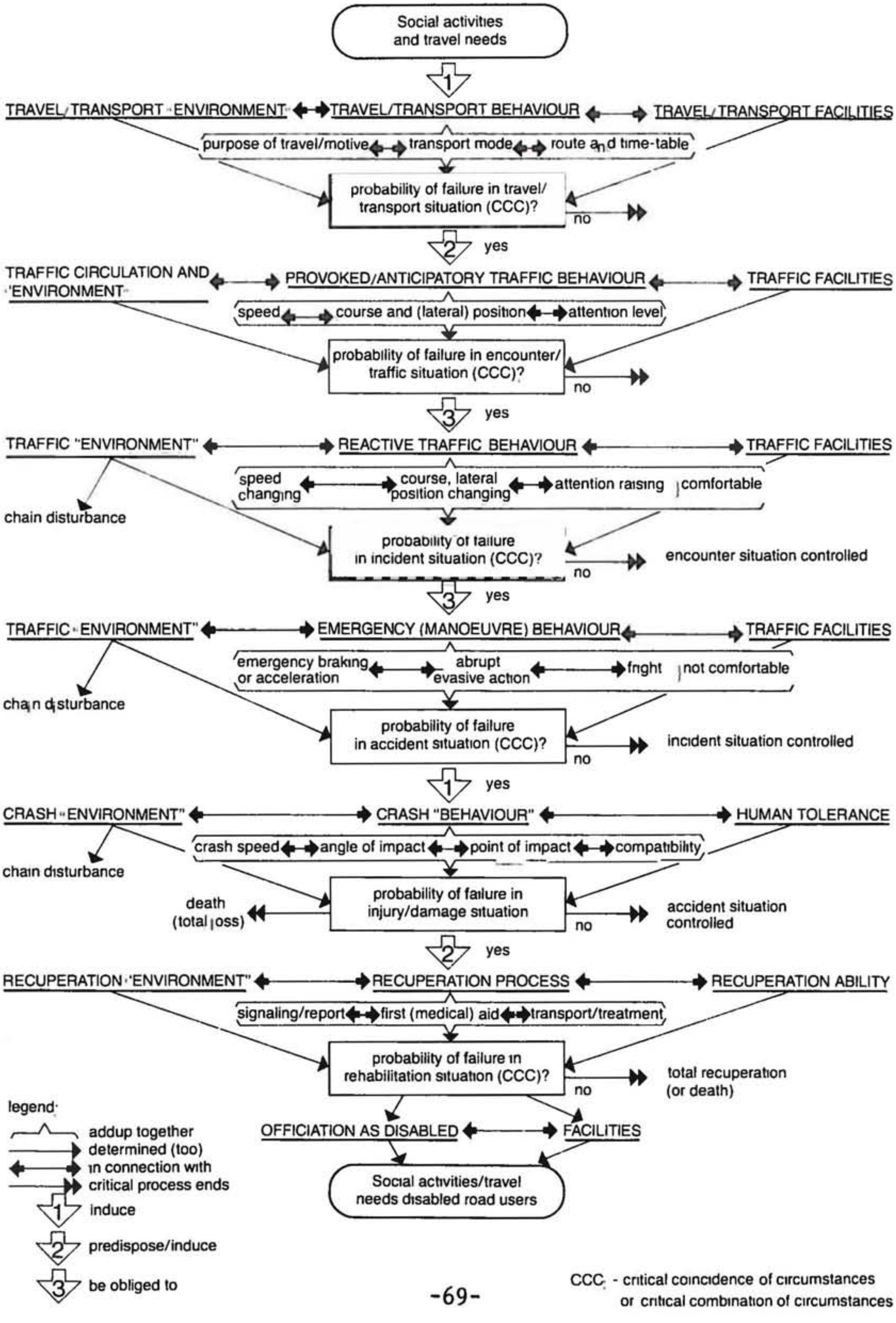
In a nutshell, the dynamic system approach to road safety works as follows. Both the transport and traffic process, which can result in accidents, and the crash process are regarded as a chronological - the dynamic aspect - complex of successive, increasingly critical combinations of circumstances and events. These eventually result in injury and damage and in the "recuperation process", in which critical combinations of circumstances can again occur. In theory a halt can be called to the process in any phase. Because it is a dynamic process, it is necessary in many cases to intervene in the circumstances prior to the accident (the crash). There is rarely a single cause or circumstance, but usually a critical combination of circumstances. Only coherent packages of measures related to vehicle, road and environment combined with publicity and education can make the transport and traffic process safer, and it is extremely important to coordinate behaviour and environment to each other and to reinforce the existing internal control mechanisms in the transport and traffic system.

Individual interests, motives and preferences in travel situations, individual traffic behaviour of road users in traffic situations and individual traffic risks are the basis on which road safety should be considered. The individual road user in or on his vehicle (including "Shanks' pony") on the roads in the midst of other traffic is the elementary level, the elementary system for the study and control of road safety. The "sum-total behaviour" of individuals can only play a part in the considerations if it is ordered into homogeneous processes and/or groups. This is necessary if any kind of structure is to be introduced. Not all behaviour by individuals is unique; the best strategy for acquiring knowledge is to look for the common features, similarities, invariables. What we are concerned with is the functional homogeneity in the phenomenon of road accidents. It is possible to isolate the common features, the homogeneity, in the whole traffic process from the point of view of safety? This is not so easy, certainly not if the distinction is to be significant. For example, not all elderly road users have the same type or scale of problems in traffic; elderly cyclists, on the other hand, have considerable problems with emergency manoeuvres in encounters with motorized traffic. In the first case we have a large group (all elderly road users) with few defining features and thus little homogeneity (different problems on the roads); the second group is much smaller and much more clearly defined as regards homogeneity (common feature: difficulty of emergency manoeuvres in encounters with motorized traffic).

What we have been looking for is a method of ordering or structuring the traffic process from the safety point of view so that homogeneous processes can be identified. The result is a conceptual model referred to as the phase model of the transport and traffic unsafety process at the elementary level (see Figure). The phase model is based on the following principles.

1. The transport and traffic unsafety process is a dynamic process, i.e. it is a chronological complex of successive critical circumstances and events. Each state observed is a "snapshot" and has a history, a "memory" and a follow-up. The follow-up is determined by the memory, the road user's goal and his behaviour alternatives.

Figure 1. Phase-model of the Transport and Traffic Unsafety Process



2. It is a model of a process that becomes increasingly critical once a phase is reached where critical states cannot be overcome. In each phase of the process a critical situation can arise which unleashes a chain of critical states which are increasingly difficult to control: the time and room for observing, deciding and acting become less and less.
3. Each phase involves different critical combinations of circumstances, different relationships between behaviour and environment. The transition from one phase to the next is a greater or lesser discontinuity, i.e. in a particular phase the road user has behaviour alternatives which differ from those in the previous phase.

This conceptual model is in turn based on other theoretical models, some of which are as yet incomplete. These include:
* models concerned with individual risk control, which improve our understanding of how road users observe, decide and act in risky situations and how these situations arise;
* models of communication and learning processes in traffic, which improve our understanding of the internal control mechanisms in the traffic system and how to reinforce them;
* models of the crash phase, including the primary collision, the secondary collision and the way forces act upon humans, which improve our understanding of crash processes and help us to develop ways of preventing injury and damage.

The conceptual model provides opportunities for the development of coherent theories and the improvement of our knowledge, and it shows the points to work on to achieve the integrated control of road safety, in other words the optimalization of the transport and traffic system.

The phase model of the transport and traffic unsafety process

The phase model of the transport and traffic unsafety process in effect describes the nature of the traffic process insofar as there are critical changes in state with increasing losses in relation to the goal. In it the individual road user is central as the elementary system. Internal control mechanisms in the traffic system are brought about by the relationships within collections of individual road users, vehicles and traffic environments. Other road users are regarded as part of the individual road user's traffic environment. External control mechanisms, operated by the "collective decision-makers", are designed to influence the internal control mechanism of the elementary system. The points at which this takes place are the critical combinations of circumstances in the various phases which entail a risk of failure for individual road users.

At the elementary level we are concerned with a road user travelling and participating in traffic. Figure 1 shows the phases of the transport and traffic unsafety process split up according to discontinuities in critical states and thus by the nature of the behaviour alternatives a road user has to bring an "accident process" once started, or critical state, under control.

A decision to engage in an activity at another location, e.g. to visit relatives, makes it necessary to travel. The nature of the travel goal, the motive for travelling, the mode of transport chosen, the route and the timetable together determine the travel behaviour. The circumstances in which a road user travels can in themselves entail a risk of failure or a potential loss. Two examples: a timetable that is too tight, a hurried journey to an important meeting - result: fast driving and attention already on the meeting; unclear route indications at a diversion - result: searching, sudden manoeuvres; risks of failure in abundance. These risks in or as a result of travel behaviour are only manifested in traffic behaviour, manoeuvring. The journey or travelling circumstances preordain, as it were, the start of a chain of fresh risks of failure for the road user.

Critical states in travel behaviour influence not only speed, direction and lateral position on the road and the alertness of the road user, they can also make all the subsequent phases more critical. A road user in a hurry has less peripheral perception and may overlook traffic crossing his path. In the event of an encounter he is more likely to accelerate in an attempt to pass in front than to brake, and similarly in the incident situation.

The traffic behaviour of a road user, provoked by travel and traffic circumstances (in particular vehicle, traffic and road characteristics), and anticipating possible discontinuities in the path of the road and encounters, takes the form of speed, direction and lateral position on the road and in the traffic flow, and alertness. The provoked and anticipatory traffic behaviour can be regarded as a continuous change of state: following the road, following a stable flow of traffic.

Every change in state can result in a change in the risk of failure: encounters with other road users, instability of a traffic flow, discontinuities in the path of the road, etc. A lot of these risks can be overcome by timely and adequate reaction: braking or accelerating, deviating to the left or right, increasing one's alertness are the opportunities available to the road user for reactive traffic behaviour.

Failure to react in time and/or adequately, owing to misjudgement of the situation or lack of information or experience, results in an increase in the risk of failure. The time for acting becomes even shorter, the opportunities fewer in many cases: we can speak of an incident. Often, however, fresh risks of failure occur during, or as a result of, the reactive traffic behaviour, when another road user has an unexpected reaction. The only way of preventing an accident then is for the road user to carry out an emergency manoeuvre: swerving, an emergency stop and a call on "survival" reflexes are the types of emergency manoeuvre behaviour available. If the emergency manoeuvre is successful, so that the vehicle remains on the carriageway without hitting anything, we call this a "conflict" - a near miss.

A chain reaction can affect other road users if, during an emergency manoeuvre, a vehicle crosses to the other side of the road (obstructing oncoming traffic) or comes to a halt on its own side (obstructing following traffic). This effectively starts a new "accident process" for the other road users.

Every year in the Netherlands at least one million emergency manoeuvres are unsuccessful (if they take place at all): result - one million accidents. High speed at the start of the manoeuvre, inadequate time, not enough distance (including the danger of skidding) produce risks of failure which, if they materialize, inevitably result in a crash (accident). The extent of braking or swerving determine the collision speed, the angle of impact and the point of impact. Together these make up the crash behaviour of the vehicle (and to some extent of the occupants or riders) and the object collided with. Slight damage to bodywork is not recorded. A chain reaction can also take place here. The risk of damage and injury, the damage and injury pattern, does not depend solely on the crash behaviour of the vehicle and object. Crash circumstances, such as characteristics of vehicle exterior and interior and the resilience of occupants and riders have a considerable influence, as does the wearing of seat belts, crash helmets etc.

After the crash phase comes the recuperation process. This begins with discovery and reporting of the accident, followed by first aid (including emergency medical aid), removal of the injured to hospital and finally treatment. We need not concern ourselves here with the recovery and repair of damaged vehicles. During the entire recuperation process fresh risks of failure occur which affect the damage and injury pattern. These generally occur in the timespan between the crash phase and treatment. In some cases the outcome is serious (permanent) damage. The absence of actions needed to save life or incorrect first aid; stagnation in the removal of victims - owing to inaccessibility of the scene of the accident or traffic congestion; and incorrect or inadequate treatment - e.g. incorrect diagnosis - can entail risks of failure or critical combinations of circumstances which determine the ultimate effects.

Many victims recover, but every year fresh invalids are added to the list from previous years. We shall not consider rehabilitation, the social care and training of those handicapped in road accidents, in detail here. They do, however, have to be able to make use of travel facilities so that they can carry out their activities as they did before becoming handicapped.

The above description of the phase model of the "accident process" makes implicit use of theories, in particular in the examples. A more detailed description would require more theories demonstrated by examples. It will be found in the identification and analysis of the nature of problem situations that theoretical knowledge of traffic and accident processes is indispensable to any application of the phase model.

For the sake of brevity we shall merely list the applications of the model.

1. It provides information on how to collect data systematically for the identification and analysis of problems.
2. It provides a system of problem analysis for research and policy purposes.
3. It provides ways of placing theories and knowledge in context.
4. It provides a system for analysing effects of measures, both to predict the effects of proposed measures and to analyse measures once taken.
5. Last but not least, it provides ways of showing how measures affect the transport and traffic unsafety process, so that measures can be coordinated and integrated, and also so that alternatives can be compared more effectively.

Qualitative observation and monitoring methods

Once we have analysed the nature of problem situations, and formulated hypotheses, we have to examine how far these correspond to reality. For this purpose a number of observation and monitoring methods are currently either available or at such an advanced stage of development that they will become available soon.

1. Travel behaviour: the Central Bureau of Statistics study of travel behaviour, and all the smaller variants, provides information on motives for travel, choice of mode of transport and distances (in some cases also choice of route).

2. Observations of traffic behaviour: speeds and intensities have been monitored for a long time; changes in speed, alertness and position on the road can be observed in specific situations with video equipment (and vehicles fitted with instrumentation); development work is still needed on the analysis of these observations.
3. Conflict observations: various recent publications describe the state of affairs and developments (which are rapid); a Dutch conflict observation technique has now been developed and described in a manual (the DOCTOR method).
4. Crash simulations: full-scale tests and mathematical models of the crash phase have produced injury-predicting (and damage-predicting) models which are beginning to bear fruit.

Summary - Conclusion

Ideas about improving road safety, and efforts to do this, are still based on different conceptual frameworks and different methods, which are not always effective. These conceptual frameworks and methods have now been placed in historical perspective, leading to the dynamic system approach to improving road safety, which could become a common conceptual framework for the integrated control of road safety.

The phase model of the transport and traffic unsafety process is central to this approach; it is no more than a means of structuring the phenomenon of road accidents, however. Without theories on transport and traffic unsafety processes, e.g. theories on decision-making, communication, learning, traffic flows, behaviour and crashes, the phase model merely gives a description of the common features of virtually every accident process. The applications of the model in the context of the dynamic system approach - provided theories are also applied - could eventually result in an integrated approach to road safety; the necessary development work still remains to be done, however.

THE DEVELOPMENT OF THE POSTCRASH DOMAIN IN ROAD-SAFETY RESEARCH AND POLICY

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Introduction

The road-safety domain of policy and related research can be devided in a number of subdomains in various ways, depending on the point of view that appears relevant. The most common subdivisions, both in research and policy making are according to:

a. policy instruments, i.e. education, enforcement and engineering;
b. components of the traffic system, i.e. man, vehicle, road;
c. chronological fases related to the accident, i.e. precrash, crash and postcrash.

There is always a certain amount of arbitrariness in the subdivision of the field of governmental responsibilities in policy sectors. Whether road-safety policy is a part of traffic policy or of health-care policy is mainly a matter of choice. Equally, if the area of road-safety policy is subdivided, for each subdomain the question may rise, whether it would not be preferable to relate it to some other policy domain. In particular this has been the case with the postcrash domain, which is the subject of this paper.

The determination of priorities and planning of research in some field of social relevance is generally based on both political and scientific considerations.
Current policy responsibilities raise questions that could be answered as a result of research undertaken to that purpose or on the basis of knowledge obtained in earlier research. Policy makers can be expected to give a relatively high priority to research projects of this kind. It should be acknowledged that often the determination of priorities by policy makers is not of a purely rational character. Political/ideological starting points as well as ethical and emotional considerations may play an important role. In a number of cases there seems to have been a strong relationship between the efforts of policy-making authorities spend in the field of road safety and their personal involvement in road accidents and their consequences.
Attitudes of scientists are more likely to aim at research, shifting the frontiers of knowledge forward. Research of this kind may be expected to provide answers to questions not yet but shortly relevant for policy makers. Though science aims at

providing objective knowledge it should be admitted that scientists too are not free from subjective preferences. As far as research planning in the road-safety domain is concerned, the questions rising from current policy-making problems are mainly generated by representatives of departments involved: the Ministry of Transport and the Road Safety Directorate (DVV).
The scientific contribution to research planning in the road-safety domain is to a high degree provided by the Institute for Road Safety Research SWOV. The director of such an institute plays of course a central role in the development of a scientific vision.

It seems natural not to restrict a paper of the present kind to a state of the art in postcrash, but also to give a brief sketch of the development of scientific vision in this subdomain of traffic-safety research. For this task no one seems better equipped than Asmussen. The reader will have to content himself with a rough summary of the facts as observed by the author during little less than a quarter century.

A retrospective view

The development of a SWOV-vision with respect to a subdomain of its research responsibilities like postcrash can be traced along relevant statements, publications and management acts.
In the first period of its existence, during which the SWOV increased from a one man business to an institute with a variety of research specialists, the organization was based on the component tripartition: man, vehicle, road.
This structure is reflected in the 1965 SWOV-Contributions to the Minister of Transport's "Road Safety Memorandum". Nothing can be found in that document on postcrash research as a subdomain of road-safety research, nor on emergency aid as a subdomain of road-safety policy.
During the years following it appears that in a vast majority of problem areas at least two and fairly often all three components are relevant. Apparently road safety research is not to well served by this tripartition.
Around 1970 the vision has developed that:
a. a subdivision of the road-safety research domain according to chronological fases in relation to the accident is most appropriate;
b. the postcrash domain is a part of the road-safety domain;
c. the postcrash domain is equivalent with medical aid, which is controlled effectively by the Public Health Department.

These views are expressed in the structure of the institutes organization emerging from a reorganization about that time, resulting in two divisions for research in the precrash domain,

one for fundamental and one for applied research, and a third division for both crash and postcrash research.
Postcrash research is part of the duties, however with a low priority, as is evident from the annual research programmes of these years.
Meanwhile in the field of documentation a start is made to provide a sound basis for future research. The same course is promoted in international contacts (IRRD in particular), however, at that time with little effect. The predominant opinion then was, that postcrash is health care, which is essentially no road-safety subdomain.

In 1975 SWOV produced a document: "Basic materials for a Road Safety Policy Plan". A separate volume is devoted to postcrash research and measures. With respect to research the conclusions are categorical, with respect to measures still rather reserved.
The tide has turned, however, resulting in the vision that:

a. postcrash is a domain much wider than medical aid;
b. specialized approach of isolated subsections of the postcrash domain will not result in an optimal postcrash policy.

Due to increasing financial restrictions since that time and to existing obligations in other areas of road-safety research it is hardly possible to find room for activities in the postcrash domain.
Around 1980 one scientist is made free parttime for a rough survey of the postcrash domain and its problems. About that time the Road Safety Council advised the Minister of Transport concerning postcrash problems. This was followed by a decision to announce a research programme. By the end of 1982 a research task was given to SWOV, with the result that a year later a report: "Inventory of the postcrash policy domain" was delivered.
In the present National Plan for Road Safety measures are included to improve emergency aid. The SWOV tries now to increase research efforts in postcrash in its subsequent annual programmes.

State of the art

The postcrash domain is considered to include all activities developed in order to smooth out the adverse effects of road accidents as far as possible. In the case of reversible injuries this may be achieved by medical care, while in case of irreversible injuries compensation can at least partly be given. Material damage can generally be smoothed out by repair or replacement, while the consequences of traffic obstructions can be reduced by regulation systems or radio information. It is evident that many of these activities require professional skill while it is equally evident that in the early postcrash fases emergency aid will mainly depend on road users without any training.

The SWOV-"Inventory of the postcrash policy domain" was based on the observation that road accidents may generate a diversity of adverse effects: injury, damage and related problems. A variety of activities, both of layman and professionals is required, in order to remedy these adverse effects, to support victims and other road users involved in accidents. The diversity of these activities is mainly characterized by two aspects:

a. the typological aspect of the activity, i.e. the damage or problem category which it aims to smooth out;
b. the chronological aspect of the activity, i.e. the particular fase after the accident during which the activity is effective.

A matrix structure of the postcrash domain (Figure 1) can be created based on these two aspects. It illustrates in about one page the complexity and the extension of the postcrash domain, the principle zones of mutually interfering activities and forms a useful basis for further research activities, in particular an inventory of current activities and measures.

The following longitudinal zones, related with typological aspects can be distinguished:

1. Medical care, in order to cure injuries.
2. Psychotherapy for victims of road accident induced psycho-trauma.
3. Technical support to cope with vehicle damage.
4. Technical support to cope with damage to infrastructure and road furniture.
5. Special traffic control measures to reduce accident induced traffic obstructions.
6. Juridical support to determine matters of liability.

The following lateral zones, related with chronological subfases of the postcrash domain can be distinguished:

1. Detection of the need for emergency assistance.
2. Alarming of a central agency to call for professional assistance.
3. Ambulant aid can be partly given at the accident spot, partly even by layman.
4. Transport of victims and damaged material may be needed when local assistance is insufficient.
5. Intramural support is given in hospitals, rehabilitation centres and nursing homes, as well as in workshops, offices and court rooms.

It is obvious that in most accidents only a fraction of the post-crash support activities is wanted.

Injuries occur in less than 20% of the accidents.

Estimates on traffic accident induced psychotrauma are of the same order, however, related so far only to injury accidents.

Vehicle damage is the most common adverse effect of road accidents.

Obstacle accidents are only a minor fraction.

chronological subfases / damage category	assistance at the accident spot				trans-port	indoor support	
	detec-tion	alarm-ing	ambulant aid			hospi-tal & work-shop	reha-bili-tation
			layman	profs			
injury							
psychotrauma							
vehicle damage							
damage to road furniture							
traffic obstruction							
liability							

Figure 1. Main structure of the postcrash domain.

Traffic obstruction and liability problems also occur only in a fraction of the cases.

As far as chronological subfases are concerned, only about one in four or five accidents is reported to the police. The majority of road users involved in accidents tries successfully to escape detection. Of course a much higher fraction is reported to the insurance companies. Today claims are estimated to cover about 60% of all accidents.
Since there is no central agency for emergency alarm in the Netherlands there is no accurate information available about the number of cases in which professional aid is called to the accident spot with the exception of ambulance vehicles. Intramural support is fairly well registered in the medical profession. Of the other categories no central registration is available.

For an efficient postcrash policy it is necessary to have the disposal of quantitative information about the required and available emergency aid and related facilities. Discrepancies between needs and means, in total numbers as well as in distributions over the time and space, indicate where policy efforts are likely to give the best results. From the brief summary given above, however, it is obvious that quantitative data are scarce. Therefore an "inventory of current activities and measures" is started to provide information on the availability of emergency forces. Data on means and needs are necessary but not sufficient for the evaluation of measures. The determination of priorities needs data on costs and effects of partly or fully answering requests for professional support.

One of the main arguments in favour of an integral study of the postcrash domain was the hypothesis that there was a lack of co-ordination between emergency aid forces with the risk of a far from optimal use of existing facilities, funds and time budgets. Verification of this hypothesis would require considerable efforts. It finds some support in a few examples of what could be referred to as "black incidents in emergency aid".

E1. A moped rider runs at high speed with his head into the rear end of a lorry. A witness hurries to the nearby police station in order to call for medical care. Three quarters of an hour later a police car arrives. The need for medical care is affirmed and an ambulance is called. It is not certain that the victim would have survived, if immediate care was given.

E2. In most hospitals traumatology is done parttime by a general surgeon. Only 8% of the hospitals can afford a fully equipped traumateam today. The ambulance service in a minor municipal hospital is not allowed to bring heavily wounded multitrauma victims directly to a nearby traumacentre. During observation and second transport much valuable time can be lost. The present collection of "black incidents" does not exceed 20 cases, spread over the entire postcrash domain. A national enquiry during one year might result in a complete blackbook.

It is obvious that guidelines are partly based on arguments other then the interest of the client calling for help. Avoidance of false alarm is one of them. The financial interest of the own organization appears to be an other one. Co-ordination, both between parallel/competing organizations and between organizations operating in line, seems a promising approach.

It was not the intention to give in this paragraph state of the art information on isolated areas of the postcrash domain. Only a rough sketch is offered on the state of integrated research in the domain, and of co-ordination between emergency aid forces.

Prospects

It seems appropriate to look forward and to consider prospects for future progress in this subdomain of his previous responsibilities, that can be offered to Asmussen at the occasion of his farewell from SWOV.

Prospects for future developments in postcrash (as in any domain) depend not only on the range of the existing possibilities but also on the effectiveness of exploitation, which in turn will largely depend on the attitudes of those responsible for postcrash research and policy making. In research the dominating opinion at present is that integral research programmes, both in the entire postcrash domain and in its major subdomains, should have priority number one.
In policy making the necessity of co-ordination between emergency aid forces is given high priority.

An integral survey of the postcrash domain is meanwhile in progress, aiming at an "inventory of current activities and measures". Several studies, integral over major typological and chronological subdomains, are started:

1. The development of the physical condition of road accident victims during the postcrash fase as a function of injury patterns and the quality of medical treatment.
2. The frequency and severity of traffic accident induced psychotrauma and the effectiveness of various therapies.
3. A study on alarm systems for emergency aid forces.

Other studies in this category are being prepared presently.

In the past prospects for international co-operation in postcrash research have always been rather poor. OECD Road Transport Research Programme concentrated on transport, construction and safety, not including postcrash. In over hundred-thousand IRRD-documents specific postcrash literature is scarce. It seems, however, that recently the tide has turned.
OECD Steering Committee members have asked IRRD to consider the possibility of including postcrash research in their documentation activities.
During the ATEC '86-congress representatives of several countries made statements in favour of an integral approach in postcrash research.

The potential output of postcrash measures can only roughly be estimated. In the Netherlands annually about 1500 fatalities occur. Half of these are instantly killed, the other half dying within 30 days following. This latter group is the potential

profit group for postcrash efforts. Conservative estimates are, that a 10% reduction in fatalities is a realistic expectation.
The number of injury accidents registered annually in the Netherlands is about 50,000. The real number is estimated 3 to 4 times higher. In principle this entire group should be considered as a potential profit group for postcrash measures, the profit consisting of a reduction in temporary or permanent disability.
Other profits to be expected of postcrash policy efforts are in the area of social and material damage suffered by people involved in road accidents, whether or not beyond their own responsibility.

ERIK ASMUSSEN, THE GENERALIST

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I met Erik Asmussen the very first day, I began my work at the Philips Lighting Laboratory in Eindhoven, straight out of college. It was early August, 1958. At that time, Asmussen was pursuing one of the lines he always considered as most important in linking research to application: joining the different aspects that actually belong together in one organic structure; the idea of integration that came to fruition in his work on road safety research. The problem at hand was what we termed at that time the luminance technique, the idea being that the luminance (the brightness) of a road pavement is more relevant as the criterion of quality for a street lighting installation than the illuminance, that is the amount of light falling on the road surface. Now, the illuminance (or the illumination as it was called in the past) is a fairly straight-forward affair. It can be calculated and measured fairly easily, and more important, it can be defined and described quite accurately. The luminance at the other hand is more complicated and more elusive, as it involves the road surface as a light reflector and the visual system as a receptor. It deals with the brightness with which the road surface is perceived by an observer under specific conditions at a specific location while lit by the road lighting installation. The luminance has, however, to do directly with what the observer (the traffic participant), perceives in traffic, whereas the illumination is not. One can "see" the luminance, and not the illumination.
The idea was an old one; it was revived and promoted by our boss, the chief at that time of the laboratory, mr. (later Professor) Nito de Boer. De Boer concentrated on the visibility aspect on the concept, but it was Asmussen who first realized that one must be able to predetermine the luminance in the design stage and to measure it after completion of the lighting installation if the idea should be marketed with any degree of success. For this, Asmussen introduced the electronics in the photometry, on the road, a revolution while all photometry was still made visually - a cumbersome, inaccurate and rather subjective affair. This was no small feat at the time that transistors were still in their infancy. Actually, Asmussen applied the then rather new photomultiplier tubes. It took some time before the idea was accepted by the photometrists. The hardware was simplified by the introduction of photodiodes and photoresistors, and of integrated circuits, but the break-through was realized by Asmussen, who introduced ideas and technologies from quite different fields. Another part of the

luminance technique was the road surface as a light reflector. Asmussen introduced the measuring methods that are still used everywhere, and that are the basis of the subsequent calculating and classification systems. Finally, the predetermination of the luminance in the design stage was considered, but at that time Asmussen followed his career elsewhere. Incidentally, this problem was solved only recently when fast, cheap computers came available.

This episode is exemplary for the way Asmussen worked: surveying the problem area in general, looking for answers to the general problem, setting up requirements for the solution of details, and taking care that the detail problems are actually solved - in fact, an approach more of the research manager than of the experimentator, although he could cope with experimental aspects as well.

In the long run, the luminance technique was a big success, both technically and commercially. It stayed the backbone of design methods and practices for lighting installations and for lighting equipment for several decades, actually until it dawned generally that one crucial step was omitted right in the beginning: no one ever had asked himself the question as what is the actual function of road lighting. Which brings us to the next episode.

When SWOV was founded in 1962, Asmussen left Philips to became its first director. His interest in road lighting remained, but his activities were elsewhere. His contribution was another important new one: considering the actual function of all sorts of devices and measures. This was worked out and put into effect in the design of the guardrails: in stead of a crude "crash barrier", Asmussen perfected the concept of the "guide construction" by realizing what is the actual function of it: not primarily to catch cars that stray into the median but to guide them in such a way that damage and injuries are kept to the minimum. This lead to the system that was a standard in the Netherlands for many years, and that performed quite well until trucks became too fast and too heavy to contain them.

In early 1968 I joined the staff of SWOV. In my new job I had many different subjects to consider, but road lighting still was (and still is) an important area of interest. In actual practice, most questions regarding lighting and visibility ended on my desk.

About the first thing Asmussen asked me was whether I had ever considered the actual function of road lighting; whether I even had thought about why people fussed about it and spent a lot of money on it. In fact, the thought had never occurred to me. I felt rather embarrassed, as, just the moment the question was put to me, it seemed the most natural thing to do: to consider why you do what you are doing. The embarrassment decreased only slightly when I discovered from a subsequent study of the available literature

and a (carefully put) survey under my lighting colleagues that no one ever had put himself that question. The farest one got was the realisation that at night one cannot see a thing because the daylight is lacking and that one consequently could expect that everything should be all right when one put up lamps that more or less could simulate daylight. If not in light levels, then at least in light distribution.
The actual function of road lighting, however, is quite different. It is to allow the traffic participant (and not only just the car drivers) to acquire the visual information - both as regard its quality and quantity - that is needed to perform his traffic task. This implies that the daylight situation is not automatically the best situation; in fact, in many respects it is not. This is illustrated by the fact that the visual surround on a rural motorway at night when lengthwise mounted (so-called catenary) lighting is applied, often is better than at day. Another implication is that the means to realize an optimum information acquisition include many other systems as well, and not only just the road lighting: marking and signalling of vehicles and obstacles etc. In fact, in many respects such "alternatives" may contribute more than the (overhead) road lighting.
These considerations, and in fact the question put to me by Asmussen, triggered a completely new approach in road lighting, in the fields of theory and research as well as in practical applications. The basis was the "analysis of the driving task" that was being developed at that time by Dick Griep, who died in a motor accident shortly afterwards. Apart from a great friend and a dear colleague, SWOV lost a brilliant researcher; the investigations in this area in fact never recovered fully from the loss. The theory and the research was, however, advanced enough to include many ideas in the "functional approach" for lighting applications. Again it took quite some time before these concepts were accepted but more recently the idea of considering the function of a device before you set up its specifications, caught on. The international lighting organisation (Commission Internationale de l'Eclairage CIE) established in 1983 a Technical Committee that is currently engaged in pursuing these considerations. SWOV plays an important role in this Technical Committee. Integration and functional analysis are two key concepts in the contribution Asmussen made to road safety research. Joining the parts that belong together, even if traditionally they are studied in isolation; and considering carefully what exactly is the function of the devices (and the measures more in general) that might be applied. From these elements gradually the systems approach was developed, where the transportation system is studied as one organic unity, one general system with many closely intertwined aspects of which road accidents are only one; a system that in its turn is a part of a larger socio-economic system. Studying these systems requires

courage and phantasy, and it must be done by generalists, not by specialists.
The area of study is far too large for one single person to cope with. It will take many researchers to complete the structure of the transportation system, particularly when one takes into account that the purpose of it is reducing the toll in human suffering resulting from road accidents. Erik Asmussen, the generalist, contributed very significantly to the foundations of that structure.

ROAD SAFETY RESEARCH AT MUNICIPAL LEVEL

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Concern for road safety

Concern for road safety is reflected in the policy programmes of most municipal authorities in one way or another, but it is often confined to a general objective such as "improving road safety for the weaker road users". Specific plans of activities to deal with road safety problems systematically are all too few and far between, unfortunately, in the municipalities.

We are faced with the unsatisfactory state of affairs that, despite the fact that everyone agrees that road safety should be improved, not enough is being done in practice.

Uncertainty

One of the major difficulties municipal authorities face in trying to conduct an effective road safety policy lies in the nature of road safety measures, the effect of which is uncertain in many cases. An example of an area where there is much less uncertainty will make this clear: if a screen is installed alongside a road to reduce traffic noise, the drop in noise level can be calculated precisely in decibels.

It is often difficult to establish a causal connection between a road safety measure and the effects: how, for instance, are we to ascertain the returns from an investment in road safety education? This uncertainty is one of the reasons for the lack of willingness to put money into road safety measures.

Acquisition and application of knowledge

How can we reduce the uncertainty as to the effect of measures? The key words are acquisition and application of knowledge. In many cases research is needed into these matters. Municipal authorities, however, are not keen on research; they tend to think in terms of measures. The best-known example is the frequent use of the "universal panacea" of installing traffic lights when a location is regarded as, or proved to be, unsafe.

It would be wishful thinking to expect municipalities to organize road safety research on their own initiative. Ways should there-

fore be found of encouraging them to do so; in some cases central government grants might be appropriate.
The second important point is the dissemination of information. Lastly, the emphasis placed on road safety in the training of traffic engineers should be increased.

Grants

Only one type of road safety research is commonly carried out by municipal authorities in the Netherlands: analysis of accident black spots. The popularity this type of research now enjoys is due not least to the incentive provided by central government. The Minister of Transport and Public Works submitted the guide on "Tackling Accident Black Spots" to the municipal executives on 16 May 1980. Just under a year later (on 11 March 1981) the same Minister introduced the Accident Black Spots Grants Scheme, under which municipal authorities can claim reimbursement of 80% of the cost of employing independent advisory bodies to carry out such analyses. Of the 749 municipalities, 109 (15%) took advantage of the scheme. The percentage of municipalities with polulations of over 50,000 was 62 (31 of the 50); this is because the vast majority of black spots are in the large municipalities. There are 6,439 locations in the Netherlands where 12 or more road accidents were recorded during the 1980-82 period, 4,397 of which (68%) are in municipalities with over 50,000 inhabitants.

Tackling accident black spots could make a major contribution to removing unsafe situations. There are some drawbacks to this approach, however.
- Even if all accidents could be prevented at black spots (which is impossible), this would only be a small percentage of the total number of accidents: only 25,161 (15%) of the 136,513 accidents involving injury recorded throughout the Netherlands during the 1980-82 period took place at the 6,439 black spots.
- Tackling locations with the largest actual numbers of accidents is not necessarily the most effective way of improving road safety. These are generally busy and complex locations where it is not usually easy to improve the situation.
- If a black spot is seen merely as an isolated point, detached from its function in the traffic system as a whole, there is a danger that attempts to improve the situation there will merely shift the problems to the surrounding area.
It is certainly not enough, then, just to deal with black spots.

Dissemination of information

There is more information available on improving road safety than is actually used. The following example may illustrate this. The number of "injury accidents" between motorized traffic turning right and slow traffic going straight ahead is particularly high. Unfortunately there are no national figures. In The Hague as many as 10% of accident victims among moped-riders are involved in conflicts of this particular type. We know that they often take place on free-standing cycle tracks. A good deal of information on ways of reducing the seriousness of such conflicts was produced by a survey of the effects of the cycle routes in The Hague and Tilburg, and other surveys indicate how a reduction in accidents involving injury can be achieved by modifying the design of highway facilities. Yet the information available is not always used.

Luckily a good deal has been done in recent years to make the information obtained available to municipal authorities: for example, the handbook of "Recommendations of Urban Traffic Facilities", the "30-kmph Handbook" and the manual on "Traffic Facilities for the Handicapped". More can and must be done with the existing knowledge, however. An information centre which could answer municipalities' questions would certainly serve a need. There are currently many bodies which a municipal official can approach, but it is not always clear which type of information each has.

Proposals for road safety measures must be properly backed up. Not only does this help to convince the municipal executive that the particular measure is necessary, it is also more likely to be the most effective one.

Training

It is very important to pass on the information obtained to traffic engineers. A superb example of research serving municipal policy is the popularity of conflict observation. Nowadays, if a hazardous traffic situation is reported to a municipal authority it is common for someone to go and have a look at the site. Everyone has heard of "technical weather" - but the quality of the observations is often no better than that of the Dutch weather! Each situation is assessed on the spot; the way in which this is done depends on the person who has taken on the job, consequently the assessment of the problems is highly subjective.

Over the past few years techniques for observing and analysing traffic conflicts systematically have been developed in various countries. Considerable differences in local conditions have given rise to a wide variety of observation techniques. A number of conflict observation techniques have been tried in many parts of the Netherlands, but there was a need for one that was universally applicable, methodologically sound and controlled in use. SWOV and IZF/TNO have developed a technique specially for the Dutch situation, and this has recently been put into operation. The first training course for observers was held in April 1986. Municipal traffic engineers will also be able to take the course. The advantage of the new method is not only that traffic behaviour can be analysed systematically; its uniform application will also enable the information obtained to be communicated and exchanged more effectively.

It is essential that more consideration be given to road safety in the training of traffic engineers. In his addres to the fifth National Road Safety Conference on 24 and 25 April, Erik Asmussen made the following remarks:
"There is a great need for road safety professionals who can be employed in both central, provincial and municipal government. There is a great need for road safety professionals who all speak the same language, think and work in the same conceptual framework. Further education for professionals of this kind at both university and higher vocational level would seem to me to be the best in-depth investment that could be made at this moment."
Knowledge of the identification and analysis of problems, the phase model of the traffic - and accident - process and a mastery of road safety problems as a whole are something every traffic engineer should carry in his or her baggage. It is still not too late to attend Erik Asmussen's lectures!

THE USE OF ROAD SAFETY KNOWLEDGE IN PROVINCIAL GOVERNMENT

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Introduction

The importance of research into road safety is generally realized. In the Netherlands SWOV has played a leading part in this for two decades, not only in the field of practical and basic research but also to improve the terminology and bring about a structured way of thinking about the accident process. The credit for this new way of thinking is largely Erik Asmussen's.

There is no point, however, in doing research and creating new models unless the results reach those who can actually influence road safety: car manufacturers, highways authorities, educational and monitoring bodies, and not least ordinary men and women who use the roads. Communicating knowledge, especially on a subject as complicated as road safety, is no simple matter. There are many ways: seminars and conferences, publications, publicity campaigns etc. These all share the common feature that are concerned with a single aspect of the complex of factors that make up road safety: seat-belt wearing, drinking and driving or the design of cycle tracks, for instance.

Erik Asmussen soon realized that to put across a way of thinking and encourage a broad view among people concerned with road safety, another form of communication is needed, and he worked with this aim in mind, first setting up a postgraduate course in road safety for those who deal with it in their work and later teaching civil engineering students at Delft University of Technology.

It is the effects of this latter activity of Erik Asmussen's that we should like to go into here. We both took courses, with an interval of a few years between us, in road safety research under Erik Asmussen and for five years we have been employed by the Public Works Department at the Province of North Brabant, where one of the things we deal with is road safety. In the course of this paper we shall look first at the kind of knowledge a person acquires by taking a course in road safety - in other words the mental baggage a person entering the field in this way carries around with him. We shall then consider the specific road safety activities the Province of North Brabant has undertaken, especially research, and the effects of our "baggage" on the work of the Province.

The knowledge acquired during the road safety course

As taught by Erik Asmussen at Delft University of Technology, the subject of road safety comprises four parts:

1. current knowledge in the field;
2. current research;
3. general principles and methods of research;
4. problem analysis and analysis of complex processes: the phase model of the accident process, where background influences are also considered, plays an important part here.

We found this approach very welcome, especially since - at least when we were students - not much attention was given to the last two topics in civil engineering studies. We were among the first students not only to take the subject of road safety but also to take our final qualifications in road safety research. Erik Asmussen gave us an opportunity to take part in research then taking place at SWOV: thus we were able to apply the problem-analysis approach in practice and help in the development of the phase model.

The core of problem analysis is that each problem is unravelled into logical steps, each time posing such questions as: What is the size of the problem? To whom is it a problem? Are there solutions available? etc. A systematic analysis of this kind obviously makes sense, but in practice we find that many are not able to approach a problem in this way, tending rather to apply a solution without asking whether it fits the problem. The ability to think in this systematic way is therefore a great benefit, especially since it is applicable not only to road safety problems but also to all sorts of policy and research problems and management duties. To give just one example: the SDM method which is often recommended as an approach to questions of computerization is based on the same principles as the type of problem analysis Erik Asmussen teaches his students.

By helping with research being carried out by SWOV in the final part of the course students gain experience of working in a multidisciplinary organization, and they have an opportunity - without having to make any special efforts - to find out about the entire range of road safety knowledge available worldwide. This is all the more the case in that Erik Asmussen gives his students the opportunity to examine a broader field than just the one in which they are carrying out their own research. Nor should we omit to mention that all the staff of SWOV contribute by their generosity in providing information.

We believe, as implied above, that the training road safety experts receive, both theoretically at Delft University of Technology and in the practical work of research at an institution such as SWOV, is highly worthwhile. The enigineers concerned thus not only become road safety experts, they are also capable of thinking systematically, they have learnt how to work in a team and they have a knowledge of research methods which can be used in other fields as well.

Armed with this knowledge we both started work at the Province of North Brabant in 1981, one immediately after completing the course, the other after working at SWOV for a few years.

How the knowledge is used in provincial government

North Brabant has been devoting a good deal of attention to the problems of road safety since the mid-seventies. One of the reasons the Province recruited us was to have the requisite knowledge to set up a road safety department to guide its policy.

North Brabant had already started carrying out road safety research and introducing measures, and it was one of the first provinces to make concrete efforts to meet the sharp change in public opinion in the seventies on the effects of traffic on people's well-being. A descriptive study was carried out in 1975, in collaboration with SWOV, to obtain a clear picture of the nature and extent of the problems. This led in 1977 to a follow-up study of a number of specific points and a study of certain relationships. We shall consider the latter study in some detail, since in its final form it was particularly influenced by the ideas on how to tackle road safety problems in which Erik Asmussen played such a formative role.

The design decided upon in 1977 for the "Relationships" study was based on the idea that there are unambiguous, generalizable relationships between various road, traffic and accident factors. It would therefore be possible to take the statistical relationships discovered between these factors as a basis for a strategy for modifying the road factors so as to produce a drastic reduction in the number of accidents. To carry out the study a method had to be devised, again in collaboration with SWOV, for collecting and classifying the road, traffic and accident factors to be included in the study: the method devised was the "sectional method". Then complicated statistical methods and techniques had to be developed to prepare the data assembled using the sectional method for analysis. The "log-linear" models were taken as a basis from which to develop the HOMALS, CANALS and PRINCALS techniques of analysis.

It was decided to carry out the analyses at several levels, corresponding to the relationships between road, traffic and accident factors on:

(a) sections (200 m-sections of road with the associated location factors);
(b) intersections;
(c) "strands" (road links consisting of consecutive sections and intersections with continuity factors derived from the basic data).

When we took up our appointments at the Province in 1981 the study had reached the stage where the first general results of the analyses were becoming available and an initial attempt had to be made to translate them into practical policy terms. It was immediately obvious that there were going to be problems. The results of the various analyses showed that there were hardly ever simple, generalizable relationships between road, traffic and accident factors, and that these factors alone were not enough as a basis for policy. On the contrary, in most cases the relationships are more complex, with situation-linked interactions between road users playing a part. Consequently, from 1981, partly because of our past relationship with SWOV, even closer collaboration took place with SWOV in an attempt to find out how to make the results of the study usable for policy purposes. Closer examination showed that they could be used if they were placed in a broader context.

A suitable context was found in the form of the phase model of the accident process which SWOV was hard at work developing at the time. This formed a basis for bridging theory (the results of the study) and practice (policy formulation). It turned out, moreover, that the results of the study not only supported the theoretical work on road safety problems but also, in many cases, provided fresh stimuli.

In this respect the results of the "Relationships" study have been translated into policy terms and, in combination with the phase model, have given rise to major recommendations on the design and implementation of present and future research and policy on road safety.

We realized that the whole process that took place in the Brabant study would not have produced a satisfactory result had not the policy making officials of the Province been able to speak the same "language" as the SWOV research workers. This is further proof of the value of Erik Asmussen's teaching at Delft University of Technology.

Nor has policy work in North Brabant been confined to applying the results of the "Relationships" study; the attempt to tackle accident black spots, the inclusion of road safety measures in projects based on completely different considerations and the establishment of priorities in the highways sector generally are based on the importance the Province attaches to road safety.

The latest offshoot has been the Regional Road Safety Policy trial carried out in North Brabant during the past two years, based entirely on the "problem-oriented" approach to road safety problems. This has made use of the phase model at both administrative, organizational and analytical level. Here again it is not difficult to guess how much credit is due to Erik Asmussen in the field of road safety in general and the development of the phase model in particular.

Conclusion

At the start of this paper we argued that the theoretical and practical training of road safety experts is an important addition to the other ways of communicating knowledge. Our experience has shown that by using this expertise a government body (provincial in this case) can have a more structured road safety policy which covers a wider area than just the management of its highways; in the long run this can be expected to have a favourable effect on road safety. If road safety experts are to function in this way, however, they must have a broad-based training, they must be able to communicate their experience effectively and, above all, they must have a way of thinking that enables them to be deployed more widely than just in the field of road safety. It is due to Erik Asmussen that road safety experts of this kind are being trained in the Netherlands.

ERIK THE FOREMAN

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Introduction

This is a (too) short retrospect on 23 years of co-operation; this is a narrative which sketches a picture of the growth and development of a research institute; it is the story of a pioneer; this is not a scientific treatise; this has been meant as an homage to our (former) director.
In brief, this tale - it has no more pretention - is a typical contribution to a "Liber amicorum".
And because of the special nature of this epistle, it has not been written in English - as the other contributions are - but in Erik Asmussen's own language. I offer my apologies to the English readers, but it has to be as it is.

1962 t/m 1967: De opbouw

Op 12 juli 1962 werd de SWOV formeel opgericht.
De buitenwereld zat er beslist niet op te wachten. Verkeersonveiligheid was immers een kwestie van mentaliteit. Als iedereen zich maar als "een heer in het verkeer" wilde gedragen, dan zou er helemaal geen probleem zijn. De oorzaak was dus bekend. Onderzoek was eigenlijk niet nodig. Bovendien was echt onderzoek het terrein van universiteiten en hogescholen en vooral van TNO als het om toegepast onderzoek ging. Kennis was dus, voor zover nog nodig, elders voorhanden.
Het bureau van de nieuwe SWOV zou dan ook klein kunnen blijven. Niet veel meer dan een soort onderzoekimpressariaat.

In dat klimaat werd op 1 januari 1963 ir. E. Asmussen de eerste directeur van de SWOV.
Na een oriëntatie in binnen- en buitenland neemt Asmussen de handschoen op en bereidt toch een eerste eigen SWOV-onderzoek voor.
De achtergrond is duidelijk. Zonder eigen onderzoek geen kennis, zonder eigen kennis geen inzicht ... en inzicht, een eigen visie is een vereiste om als gesprekspartner te worden erkend, zowel door de beleidsmakers als door de wetenschappelijke wereld.

Begin 1964 verschijnt het eerste rapport: "De bromfietser in het verkeer" en wordt in Utrecht een internationale studiedag georganiseerd. De basis voor een nieuwe visie op de verkeersveiligheidsproblematiek wordt gelegd. Krantekoppen reageren al meteen met:

"Heilige huisjes sneuvelen op studiedag", daarmee doelend op de volgende uitspraken:

- Blijvende brokkenmakers bestaan niet; het betrokken raken bij ongevallen is veeleer van tijdelijke aard bijvoorbeeld door gebrek aan ervaring;
- Enkelvoudige ongevalsoorzaken komen hoogst zelden voor; verkeersongevallen ontstaan meestal door een samenloop van omstandigheden waarvan menselijk falen slechts één en lang niet altijd een noodzakelijke voorwaarde is.

De steen is in de vijver geworpen en de golven verspreiden zich. De nieuwe visie botst op bestaande ideeën en instituties, maar Asmussen heeft het gelijk van nieuwe wetenschappelijke kennis aan zijn kant. De gedragswetenschappen dragen die aan. Een ingenieur die kennis uit de experimentele psychologie in zijn eigen denken integreert is een nieuw fenomeen. Het wordt ook niet direct begrepen. Sommige critici van de SWOV snappen niet dat een ingenieur tot directeur is benoemd; dat had een pedagoog of zoiets moeten zijn. Opvoeden en straffen dat is immers de beste remedie.
Het SWOV-bestuur heeft (gelukkig) meer vertrouwen in de nieuwe benadering en geeft Asmussen de ruimte om zijn ideeën uit te werken en vorm te geven. Schrijver dezes heeft aan de totstandkoming daarvan vanaf 1 augustus 1963 mogen meewerken.
Het is daarna snel gegaan.
In 5 jaar tijd groeide de jonge SWOV uit tot een instituut met 30 medewerkers. Het onderzoekprogramma breidde zich gestadig uit. Middenbermbeveiliging, slipongevallen, stads- en dimlichten, veiligheidskleding en voorrangsregels zijn een paar onderwerpen uit de begintijd, die de bekendheid en autoriteit van de SWOV tot stand hielpen brengen. Het sterke punt was daarin steeds de doordachte opzet en de methodische aanpak van ieder onderzoek. Het devies van Asmussen was niet nieuw, vadertje Cats zei al: "denckt aleer ghij doende zijt en doende denckt dan noch", maar de vasthoudendheid waarmee hij dat toepaste, bracht velen tot wanhoop. Vooral degenen die dachten dat er voor hun problemen pasklare antwoorden bestonden. Die moesten steeds vaker ervaren dat het denkwerk van Asmussen en allengs ook dat van zijn medewerkers, hen ook dwong tot beter nadenken over de eigen problemen. Onderzoek bleek wel noodzakelijk, maar niet het recept voor alle kwalen.
Eén medewerker van het eerste uur moet hier wel genoemd worden, wijlen Dick Griep († 1976). Als jong onderzoeker, zo uit de (Amsterdamse) school van Prof. A.D. de Groot heeft híj vooral voor een wetenschappelijk verantwoorde onderbouwing gezorgd van de door Asmussen uitgedragen ideeën. Welke ideeën, visie, tenslotte culmineerden in de "Bijdragen voor de Nota Verkeersveiligheid" (1967).
Het verkeersveiligheidsbeleid van de Minister van Verkeer en Waterstaat was voor de eerste keer onderbouwd door uit wetenschappelijk onderzoek verkregen kennis en inzichten. Het fundament voor

vele jaren was gelegd. De SWOV (= Asmussen) was in de verkeersveiligheidswereld niet meer weg te denken.

1967 t/m 1976: De uitbouw

De volgende stap in de ontwikkeling van de SWOV is, zowel inhoudelijk als organisatorisch, te karakteriseren als de uitbouwfase.
Inhoudelijk begonnen Asmussen en zijn SWOV, nationaal en internationaal de vleugels steeds verder uit te slaan.
Het initiatief tot oprichting van de Stuurgroep Menselijke Factoren in de Preventie van Verkeersongevallen had verstrekkende gevolgen.
Niet in het minst omdat het Asmussen lukte dat, de onlangs overleden eminentie van de Nederlandse Volksgezondheid, Prof. Dr. Piet Muntendam, zich als voorzitter van deze Stuurgroep beschikbaar stelde. Met Dick Griep als één van de secretarissen van de stuurgroep toetste Asmussen hierin zijn ideeën aan een gemêleerd gezelschap van wijze en erkende specialisten in hun vakgebied. Eén keer in de 3-4 maanden kwamen ze bijeen, waaronder:

. Mr. G.E. Langemeijer, één van de grootste kenners, zo niet de grootste, van het strafrecht en de toepassing ervan.
. Prof. Dr. J.P. van de Geer, hoogleraar in de experimentele psychologie en als methodoloog dé man van de psychologische statistiek.
. Prof. Dr. J.W. Tesch, toentertijd voorzitter van de Gezondheidsorganisatie TNO en buitengewoon hoogleraar in de algemene en sociale gezondheidsleer.

Asmussen had ze bij elkaar gekregen en wist ze 8 jaar bij elkaar te houden. Toen had de Stuurgroep zijn functie vervuld. De grondgedachten waren houdbaar gebleken, de lijnen voor de toekomst waren uitgezet. De vruchten van dit werk waren van velerlei soort.

Door het werk in de Stuurgroep kreeg de door Asmussen voorgestane multidisciplinaire benadering van het verkeersveiligheidsonderzoek extra inhoud en gestalte. Ook werd hierin de aanzet gegeven tot de introductie en toepassing van moderne statistische methoden en technieken bij het analyseren van verkeersongevallen en andere grote databestanden.
Dit was vooral van belang omdat de SWOV inmiddels een zodanige eigen know-how had opgebouwd dat zij de discussie met andere meer gespecialiseerde onderzoekinstituten aankon en ook opzocht.

Steeds meer onderzoekwerk werd uitbesteed. Daarmee werd toen al de basis gelegd voor de rol van de SWOV die Asmussen steeds voor ogen moet hebben gehad en die pas sinds kort formeel is erkend, namelijk, die van "architect van onderzoek". De combinatie van creativiteit en vakmanschap.

Maar Asmussen stond er op dat de SWOV ook zelf onderzoek bleef doen. Als leerschool en proeftuin, maar vooral als er sprake was van politiek gevoelige beleidsproblemen. In die gevallen voerde de SWOV het gehele onderzoekhandwerk liefst in eigen beheer uit. Daarin immers kon zij ook haar maatschappelijke functie tot uitdrukking brengen.
Uit die tijd dateert dan ook de kennisopbouw in probleemgebieden als "alcohol" en "snelheidslimieten". Kennisopbouw die er voor heeft gezorgd dat de SWOV op deze gebieden ook internationaal veel wetenschappelijk gezag kreeg.
De internationale uitbouw kwam in die jaren vooral op gang via de OECD-Steering Committee on Road Research, waarin Asmussen voor Nederland zitting had als deskundige. In de werkgroepen deden veel SWOV-medewerkers hun eerste buitenlandse ervaring op. De ervaring in kennisopbouw en -uitwisseling die in deze werkgroepen werd verkregen, was geleidelijk aan voor de SWOV van levensbelang geworden.
Immers, de kwaliteit van het wetenschappelijk gehalte van de SWOV kon op den duur alleen in het contact met de internationale wetenschappelijke wereld worden getoetst en op peil gehouden.

Terug naar de vruchten van de Stuurgroep Menselijke Factoren. Behalve dat het rijke inhoudelijke vruchten heeft afgeworpen, heeft het werk in de Stuurgroep indirect ook belangrijke organisatorische gevolgen voor de SWOV gehad.
Door Muntendam, die op persoonlijke titel ook lid van het SWOV-bestuur was, werden contacten met het toenmalige departement van Sociale Zaken en Volksgezondheid gelegd. De door Asmussen bepleite epidemiologische benadering van het fenomeen verkeersonveiligheid sloot aan bij de invalshoek die het Ministerie voor het volksgezondheidsbeleid aan het ontwikkelen was. Men begon het SWOV-onderzoek mede te subsidiëren, welke subsidie uitgroeide tot een substantieel deel van de totale SWOV-financiering. Mede hierdoor kon de SWOV-organisatie zich in deze periode uitbreiden tot een instituut met bijna 80 medewerkers/sters, met een onderzoekstaf van circa 35 academici of gelijkgestelden uit 8 verschillende disciplines.
De steen die in 1963 door Asmussen in de rustige vijver van het denken over en omgaan met verkeersveiligheidsproblemen was gegooid, was een reusachtige kei, een rots gebleken te zijn. In 1976 zijn de grootste golven inmiddels uitgewoed. Het (water-)peil in de vijver is echter belangrijk gestegen. En de SWOV - het kind van de pionier Asmussen - is inmiddels een flinke volwassen vis geworden die in de vijver rondzwemt en nu en dan weer eens voor wat beroering zorgt.

In de "Bouwstenen voor het (nieuwe ministeriële) Beleidsplan Verkeersveiligheid" dat in 1975 verschijnt zijn de gevolgen van Asmussen's rusteloze denkenergie al weer merkbaar. Door de introductie van het "fasemodel" wordt het systeemdenken, de systeemtheorie in het verkeersveiligheidsonderzoek geïntegreerd.

1976 t/m 1984: De afbouw

De uitbouw liep in organisatorische zin op zijn eind. Met ruim 80 medewerkers was de SWOV tot internationaal één van de grootste onderzoekinstituten op het gebied van de verkeersonveiligheid uitgegroeid. Maar ook nationaal was het hoogste punt bereikt. Bij het 15-jarig bestaan vloeide het pannebier. De afbouwfase kon beginnen.
Bij het Ministerie van Verkeer & Waterstaat krijgt de SWOV een nieuwe behoeder in het Bestuur en een tegenspeler bij het werk. De politiek (geïmponeerd door de output van de SWOV?) kent aan de bestrijding van de verkeersveiligheid een hoge prioriteit toe en de coördinatie van dit beleid wordt toevertrouwd aan de nieuwe Directie Verkeersveiligheid. De vader (Asmussen) en de moeder (de Rijkswaterstaat) van de SWOV gaan evenwel niet uit elkaar. Op bestuurlijk niveau blijft de Rijkswaterstaat haar moederlijke zorg over de volwassen SWOV uitstrekken.

Inhoudelijk is het moeilijker om van een afbouwfase te spreken. Wetenschap bedrijven zonder vernieuwing is de dood in de pot. De kwantitatieve randvoorwaarden kwamen evenwel in zicht. De ontwikkeling in kwalitatieve zin ging evenwel, zeker waar het Asmussen betrof, gewoon door.
Hoe groot het wetenschappelijk gezag van de SWOV (lees: Asmussen) inmiddels was geworden mag blijken uit het feit dat één van de standaard SWOV-rapporten "Gedragsbeïnvloeding van verkeersdeelnemers" door de Japanners (gedeeltelijk) in hun eigen taal werd vertaald.
In Nederland krijgt dit wetenschappelijk gezag zijn erkenning door de benoeming van Asmussen als buitengewoon hoogleraar Verkeersveiligheid van de TH-Delft. De studenten kennen Asmussen dan al een paar jaar door de leeropdracht die hij sinds 1972 vervult. En de afgestudeerden komen door het volgen van postakademiale cursussen Verkeersveiligheid ook al ruimschoots aan hun trekken.
Het lijkt er op alsof Asmussen in de afbouwfase van de SWOV, zijn eigen aandacht vooral richt op de toekomst van het wetenschappelijk denken bij de aanpak van de verkeersveiligheidproblematiek.
De afbouw van het SWOV-interieur moet hij (bewust?) meer aan anderen overlaten. Zijn inhoudelijke sturing blijft echter overal voelbaar. Enkele feiten uit deze jaren zijn:

- Het Nationaal Verkeersveiligheidscongres (NVVC) wordt in samenwerking met de ANWB voor de eerste keer in 1978 georganiseerd. In de organisatiecommissie is Asmussen de trendsetter.

- In 1979 verschijnt het nulnummer van SWOV-schrift. De vorm en presentatie worden door anderen bepaald. De inhoud blijft een aangelegenheid van "EA".
- Het OESO-beleid inzake de coördinatie van internationaal verkeersveiligheidsonderzoek moet in 1981 op de helling. Asmussen wordt verzocht zitting te nemen in de werkgroep die een nieuwe visie moet voorbereiden. Hij neemt gelijk het voortouw want ook voor Nederland denkt hij al enige tijd aan wat hij een "Oriënteringsnota" noemt. Creativiteit gekoppeld aan efficiency; twee vliegen in een klap.

Geleidelijk aan wordt echter het gevolg manifest van Asmussen's niet aflatende ijver om steeds maar weer naar hogere abstracties, nieuwe en betere generalisaties te streven. Voor een aantal medewerkers blijkt de organisatorische afstand, de hiërarchie, een handicap te vormen; voor anderen gaat het te snel. Nog voordat bepaalde ideeën waren doorgedrongen in de toepassing van het onderzoek stonden er vaak al weer andere klaar, een nieuwe invalshoek of een voor het eerst geëxpliciteerde theorie. De organisatie zoals die in de zeventiger en begin tachtiger jaren is uitgebouwd en afgebouwd blijkt niet meer aan de door de overheid gewenste aan onderzoekinstituten te stellen eisen te voldoen.
In 1984 ziet Asmussen dat ook in en kondigt intern zijn vertrek als directeur van de SWOV aan. Begin 1986 wil hij met VUT en de verbouw van zijn SWOV laat hij graag aan anderen over. Wel legt hij nog gauw even het fundament voor die verbouwing. De Nota SWOV-Nieuwe Stijl die in 1984 door het Bestuur en de Staatssecretaris van V & W wordt vastgesteld, grijpt in velerlei opzichten terug op zijn ideeën over het marktgericht functioneren van een modern onderzoekinstituut.
Daarmee levert Asmussen onbewust het bewijs dat de stelling die de econoom Keynes ooit heeft geponeerd "vroeger of later zijn het ideeën, en niet gevestigde belangen, die een bedreiging vormen voor het goede of het kwade" veel waarheid bevat.
Wat de eerste directeur van de SWOV betreft is daarmee het aandeel, heel duidelijk dat van een pionier, een voorman in de opbouw, uitbouw en afbouw van de SWOV afgesloten.

1984 - heden... en daarna: De vérbouw

Hierover is nog niet veel te zeggen. Het is in het verband van dit liber amicorum ook niet relevant. Het proces is in volle gang en de verbouw van de SWOV moet in 1989 voltooid zijn onder leiding van zijn nieuwe directeur drs. M. (Matthijs) J. Koornstra. Ook hierin is echter de hand van Asmussen te bespeuren want op aanbeveling van professor De Geer (uit de Stuurgroep Menselijke Factoren) was Koornstra de eerste externe adviseur die Asmussen in zijn SWOV heeft binnengehaald. Asmussen was en is nog steeds de A en de Ω van de SWOV.

Naschrift

De Duitse schrijver Heinrich Böll zegt in één van zijn verhalen (zie: "Brief aan mijn zonen"):

"Vertellen is een gevaarlijke bezigheid. In de verteller schuilt altijd de opschepper, de snoever, die op de keper beschouwd immers altijd een held of op z'n minst een lijdzaam persoon is."

Zelfs Homerus schijnt zich in zijn Odyssee daaraan bezondigd te hebben.
Als er lezers zijn die zo'n gevoel krijgen en zich afvragen wat de schrijver van dit verhaal heeft bezield en/of bedoeld, dan weten ze het nu!
Ik voel mij dan gelukkig wel in goed gezelschap.

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