SWOV in 1979

A review of research results published in this year

INSTITUTE FOR ROAD SAFETY RESEARCH SWOV
P.O.BOX 71 2270 AB VOORBURG THE NETHERLANDS

Contents

The Institute

The Institute for Road Safety Research SWOV was founded in 1962. Its object is, on the basis of scientific research, to supply the authorities with data for measures aiming at promoting road safety. The information obtained from this scientific research is disseminated by SWOV, either as individual publications, or as articles in periodicals or via other communication media.
SWOV's Board of Governors consists of representatives of various Ministries, of industry and of leading social institutions. The Bureau is managed by E.Asmussen, Director.
Its departments include a.o.: Research co-ordination, Research services, Pre-crash research, Crash and Post-crash research, Methods and techniques and Information.

Introduction

E Asmussen
Director Institute for Road Safety Research SWOV

'SWOV in 1979' is the third of a series in which the Institute for Road Safety Research SWOV briefly reviews its research results published in a given year. Those who have read the previous booklets will recall that 'SWOV in ....' is not an annual report in the true sense of the term. This publication relates only to the substance of scientific work, which can thus be dealt with in greater detail. Nevertheless, these booklets give only a brief review of the latest publications. The object is to give those interested quick information on the knowledge SWOV has collected, which may form the beginning of further communication. With the same objects but a different approach, an information bulletin, 'SWOV-schrift', was published for the first time in September 1979. This is a quarterly, and is sent free to about 5,000 individuals and organisations working in the wide field of road safety in The Netherlands. SWOV-schrift contains brief items on reports and other publications, it gives information on current or forthcoming research, and also responds to topical questions, raised for instance by politicians or the mass media. 'SWOV-schrift' is (for the time being) only available in Dutch. If you are interested in receiving this information bulletin please let us know.

SWOV's social responsibility in view of the subjects it researches and the grants it receives require it to devote great care to the dissemination of knowledge. From its very beginnings, SWOV has been active in publishing its research reports. An increasing number of readily accessible publications are also being made on a single research project if this is likely to be in the interests of a large group of organisations or individuals. In 1979 this was the case, for instance, with the subject 'Wet-weather accidents; what can road authorities do about them?', which is gone into further in 'SWOV in 1979'. The point of departure in all these information activities is that SWOV's research in assisting policy-making must be of the maximum effectiveness. We also hope there will be an exchange of knowledge and viewpoints, so that SWOV can evaluate and improve its work. Knowledge is hardly a marketable product. Its dissemination is a social need; it must promote communication between research workers and society. This communication is a two-way process: research must be the foundations on which policy is based, while the community put forward ideas for fresh research. Sometimes new methods will have to be thought out and existing ones adapted in order to meet specific research requirements. This 'development of the instruments' – examples of which are given in this

Trends in road safety

booklet – may also influence the approach to problems in other research projects. And so research retains its momentum.

If you wish for more information about SWOV, or would like a complete copy of a research report please apply to SWOV's Information Department.

E.Asmussen
Director Institute for Road Safety Research SWOV.

In 1979 there were fewer deaths on the roads. According to the 1979 provisional figure, about 2,000 people died following a traffic accident, compared with 2,294 in 1978.
This decrease occurred mainly in the first quarter, when there were 40% fewer deaths than in the first quarter of 1978. This was largely due to the wintery weather, though it cannot be said exactly to what extent. In the second half of 1978, there were already slightly fewer deaths than in the year before, and the same applied to the second, third and fourth quarters of 1979.

With the collaboration of the Central Bureau of Statistics (CBS) and the Road Accident Recording Department (VOR) of the Ministry of Transport, SWOV now has detailed, estimated accident statistics within four months after the month of the accidents.
These are provisional figures that must be used with the necessary care.
The road accident data are subdivided into accidents resulting in injury and/or death, by mode of transport, by age groups, by accident location: inside or outside built up areas, and by time: day or night. Information is also given on mileage covered and weather conditions.
Every quarter, a specification is drawn up concentrating on the number of fatalities, i.a. for the Road Safety Directorate (DVV) of the Ministry of Transport and Waterways. These specifications are solely to denote the trends. They allow hypotheses to be formulated at an early stage which can be tested in the annual analysis. The material is as yet too limited to clarify the trends. Many of the changes noted in the quarterly specifications may be coincidental.

Advisory report

In May 1979, SWOV gave a number of statistics on road safety problems that are attracting interest, in an advisory report to the Road Safety Directorate for the meeting of Ministers of Departments concerned with road safety.

Between 1950 and 1970 there was a four fold increase in the number of road deaths in this country, viz. from 822 to about 3,200 a year. In 1971 and 1972 there was hardly any increase, but in 1973 a big decrease started owing, among other things, to the effects of the energy crisis and the results of countermeasures as a new legislation on drinking and driving (Nov. 1974), compulsory use of helmets by moped-riders (Febr. 1975) and of seat belts by front seat occupants of cars (July 1975). In 1976 and 1977 there was an increase. In 1978 and 1979, however, the number decreased again.

Road deaths per 100,000 inhabitants in most countries show the same pattern: an increase up to 1973, followed by a striking decrease. After 1974 or 1975 deaths increased again.
The Netherlands, with about 18 deaths per 100,000 inhabitants, does not compare particularly badly with neighbouring countries.

The number of Dutch traffic fatalities per 100,000 inhabitants by age is highest for 75 years and older, averaging 42 per annum. In the 15 to 24 group it averages 30 per annum, in the 25 to 54 group 13 per annum and in the 0 to 14 group it is 8 per annum. After 1950 traffic fatalities increased much more among the 15's to 24's than in other groups.
In this age group traffic injuries are by far the biggest cause of death.
In the 0 to 4 group most of those killed in 1976/1977 were pedestrians, in the 5 to 9 group pedestrians and cyclists deaths were equal, in the 10 to 14 group most were cyclists, in the 15 to 19 group moped riders accounted for the biggest proportion; of deaths in the 20 to 65 groups most were motorists, among the over 65's pedestrians and cyclists predominate again.
Over a third of all deaths relate to 'slow' traffic (mopeds, cyclists and pedestrians). Two-thirds of them are killed after a collision with a car, one third after a collision with a motor lorry or delivery van. All lorries together, however, cover only one tenth of the mileage of all private cars.
Taking the country as a whole, the ratio in numbers of road deaths as between inside and outside built up areas averages 40-60%.
In connection with the 'Year of the Child', additional statistics for children were analysed and compared. In recent years, 300 children aged up to 14 have been killed every year in traffic. About 80 per cent of them were road users themselves. In the age group 0 to 6, 1972 figures show that 75 per cent of pedestrian fatalities occurred in the victims' own home streets, and in the 7 to 14 year age group 35 per cent.
The introduction of seat belts was also discussed in the report. From 1975 to 1977 they are estimated to have saved between 1200 and 1500 lives. If **all** car occupants including rear-seat passengers had **always** worn belts in 1977, there would probably have been another 400 to 500 fewer road deaths.

Traffic safety in The Netherlands.
R-79-19. (Only in Dutch.)

Overall analysis of traffic accident estimates for the first quarter 1979.
R-79-26. (Only in Dutch.)

Slow traffic

A symposium was held in Paris from 14 to 16 May 1979 on traffic safety of pedestrians and cyclists.
It was organised by the OECD, the Organisation for Economic Co-operation and Development. SWOV-researchers presented reports on 'Urban planning, traffic planning and traffic safety of pedestrians and cyclists' and 'Data requirements for traffic safety research and policy'.

Traffic safety in city centres and residential areas

The first report deals, inter alia, with the influence of urban planning and traffic planning on road safety in city centres and residential areas.
In very many cities throughout the world – from Uppsala in Sweden to Nagoya in Japan – traffic plans have been implemented in recent years with a view to improving the quality of life and accessibility of city centres. Drastic plans were needed especially for older city centres because they had not been designed to cope with the growing demand for space for moving and parked cars. The city centres threatened to suffocate slowly but surely. To satisfy the demand for space for motor traffic would have meant striking at the very hearts of the cities. Other solutions were therefore sought which would improve the quality of life without imperilling accessibility.
In most cases the solutions amount to excluding or limiting private motor traffic and giving preference to pedestrians, cyclists and public transport.
Studies have meanwhile been made in a number of cities to see what effect these measures (one-way circuits, pedestrian areas and so on) have had on traffic safety. In practically all of them a considerable reduction was noted in the number of accidents. Some researchers do, however, warn against taking measures relating to only a small part of the city centre, because there is a big danger of the problems simply being shifted to the surrounding area.
As regards residential areas, accident research indicates that they are safest of all if through traffic is routed round the outside of the area and if local access roads are kept outside the residential area proper.
It is already fairly customary to design a hierarchical system of roads for new residential areas.
Main routes that are not built up must be provided for through traffic. Building along the access roads for district traffic must be kept to a minimum. Moreover, traffic engineering measures on the local access roads will have to create surroundings emphasising care for the most vulnerable road users such as pedestrians and cyclists. In these surroundings, motor traffic must not predominate. The residential streets where the sojourning function is of primary importance, must be made unattractive to traffic without a destination in these streets. Investigations in twenty British cities show that a simple cul-de-sac structure for residential streets provides the greatest road safety. In such a structure all residential streets come to a dead end with a turning space at the end.

Safety of pedestrians, moped riders and cyclists

The report 'Data requirements for traffic safety research and policy' is a critical appraisal of the data needed for measuring and elucidating traffic hazards of pedestrians, cyclists and moped riders.
For road safety policy it is important to know where the greatest traffic hazards are and for whom. Data of hazards alone – for instance the number of accidents and their outcome – give too little information for this. In order to compare traffic hazards for pedestrians and motorists one will have to know, for instance, how much time both categories spend in the traffic or what distances they travel. If different geographical areas are to be compared then the number of inhabitants, for

In city centres there is an increasing need to weigh the respective interests of fast traffic, slow traffic and public transport

instance, or the number of social activities can be included in the comparison. Details of time, distance, number of inhabitants and so on are known as exposure data. The choice of the exposure data largely determines the results of the comparison and hence the administrative priorities of counter-measures. An example will make this clear. The pedestrian's traffic hazards as compared with the motorist's will be much greater if the mileage travelled is the measure of exposure than if the time spent in traffic is taken, since a motorist covers a much greater distance than a pedestrian in the same length of time. The choice of exposure measure is therefore a matter of policy.
In practice, however, there is little choice at present because hardly any data are available about exposure.
Apart from the policy-makers, safety and exposure data are also of importance to individual road users. On the basis of these they can assess the risks attaching to the various kinds of road usage. They can make use of this knowledge, inter alia, in deciding whether or not to make a journey, in choosing the mode of transport (as far as they in fact have any real choice) and in their traffic behaviour.

Research into the causes of accidents and evaluation of countermeasures also makes use of safety and exposure data.

But in this case exposure is defined as the frequency with which traffic situations occur in which there is a risk of accidents. The more such situations occur, the greater the expected number of accidents. Consequently, a proportion of the accidents can be clarified from the number of potentially dangerous situations.
How many there are can hardly ever be determined directly. Hence another measure must be found to ascertain what proportion of accidents can be clarified by exposure. A suitable measure might be, for instance, the mileage. The ratio between mileage and number of accidents, however, will not be the same in all circumstances and ought therefore to be determined from case to case. But even if this is not done, the mileage can still be used as a measure of exposure. The greater the mileage, the greater the number of potentially dangerous situations – and hence the number of accidents – will be.
In this event, mileage is merely a general exposure measure. Other general measures for clarifying some of the accidents by exposure are, for instance: number of vehicles, road length or population. A further explanation can be sought for the accidents remaining after adjustment for exposure.

In recent years, research into traffic safety of pedestrians, moped riders and cyclists has employed many different exposure measures. Which ones were used depended on the objective and the availability of data.
For data of safety for pedestrians, moped riders and cyclists, it is mostly preferable to use accident statistics. But the recording of accident statistics still calls for considerable improvement. In some cases, they cannot be used for various reasons. There has thus been a constant effort to find alternative data, for instance on conflicts, feelings of unsafety and traffic behaviour.
The possibility of using conflicts instead of accidents is gone into in detail in the next section. Possibilities of using feelings of unsafety or traffic behaviour as measures for traffic safety of pedestrians, moped riders and cyclists are at present still very limited.

The traffic conflicts method

In some cases, accident statistics cannot be used for road safety research, it was stated in the previous section. This applies particularly to a residential area so small that there are not enough accident statistics for accident research within a reasonably short period or for reliable conclusions regarding the causes of local traffic hazards. For obtaining supplementary or alternative data, most experience has been gained with the observation and analysis of conflicting traffic behaviour between road users.

Traffic conflicts can be broadly defined as events in which a road user suddenly reacts to the proximity of another road user or a fixed object. It involves an abrupt manoeuvre in conditions of increased risk of a collision, that is to say a near-miss (or better: a near hit).
Such conflicts are more numerous than (recorded) accidents, and therefore research workers can make more of these measurements and start analysing them earlier than by taking accidents alone.
The drawback of conflicts, however, is that assessment of the events allow more scope for different interpretations; in other words, these data may be less reliable than accident statistics.
There must be agreement on events regarded as conflicts and those as normal traffic behaviour.
Some of the criteria for defining an event as a conflict are:
– a slight distance between two road users, or a road user and a fixed object;
– the time gap with which two road users overtake or intersect;
– the impulsiveness of a reaction, such as evasive manoeuvres;
– changes in speed and course.
In order to measure these data and to lessen or eliminate the risk of a false

estimate, use can be made of video equipment and electronic data processing.
There are also problems as regards the validity of the method: to what extent can conflicts predict the risk of accidents in reality? If there is a fixed relationship between number of conflicts and number of accidents, if it can be said for example that in given traffic situations conflicts 'pass off harmlessly in nine cases out of ten on average but lead to a collision the tenth time', only then can conflicts replace accidents as a criterion of danger. But the conflicts method has not yet been developed so far.

In 1979, with a view to improving this research method, an international comparative experiment was made at two intersections in Rouen, France. Differences in assessment of a conflict by teams of observers from various countries continued to exist, but there was greater understanding of one anothers techniques. Soon after, a seminar was held in Paris (the sequel to a seminar in 1977), at which it was decided to continue the experiment on a sounder basis.
In The Netherlands, SWOV is co-ordinating the development of this method in co-operation with various research institutes.
The Netherlands Institute of Preventive

Slow and fast traffic segregated in time across the intersection

Medicine TNO, Leiden, is carrying out a study in order to develop a method specially focused on the behaviour of child pedestrians. The children are followed for thirty minutes and all their encounters are recorded. Observations are also made at special locations, such as school exits, and entrances and exists of residential areas. The Institute has already made two studies regarding reliable observation of (conflicting) encounters between children and other traffic in residential environments.
It is at present studying the relationship between conflicts and accidents, and the validity of the method.
As part of the Demonstration Project on Experimental Cycle Routes in The Hague and Tilburg, the Institute of Perception TNO, Soesterberg, is making video recordings of the behaviour of cyclists and motorists which are partly analysed automatically. The aim is to define behaviour in quantitative terms. Stationary video pictures are selected and successive positions of vehicles translated into positions in the plane of the street so that changes in course, in speeds, distances and time as between road users can be determined. The data are on punched tapes, and further processing is computerised. SWOV is taking part in further development of this method.

Urban planning, traffic planning and traffic safety of pedestrians and cyclists. Report presented to the 1979 Road Research Symposium on Safety of Pedestrians and Cyclists, OECD Headquarters, Paris, 14-16 May 1979. F C M. Wegman. R-79-7.

Data requirements for traffic safety research and policy. Report presented to the 1979 Road Research Symposium on Safety of Pedestrians and Cyclists, OECD Headquarters, Paris, 14-16 May 1979. P C Noordzij. R-79-8.

Review of traffic conflicts technique studies. M van den Hondel & J H Kraay. R-79-9.

Traffic conflicts as a basis for a road safety research method: A review of the possibilities and limitations of the conflicts method. J H. Kraay & S. Oppe. R-79-12. (Only in Dutch)

Development and application of the conflicts method, and international co-operation and road safety research. J H Kraay. R-79-21. (Only in Dutch)

Current research projects on traffic conflict stechnique studies. M van den Hondel & J H Kraay. R-79-31.

Drinking and driving

At the end of 1974 the law relating to drinking and driving was drastically changed, with the initial consequence that drunken driving greatly decreased. Slowly but surely, however, the effect of the '1st November Act' has waned and will probably have vanished altogether before long.

Consideration of new countermeasures is thus very necessary. In order to assist the authorities with this, SWOV has made an inventory of the advantages and disadvantages of a large number of potential countermeasures. The report has been presented to the Road Safety Directorate (DVV) of the Ministry of Transport and Waterways in March 1979. It is being used in the inter-departmental consultations on future policy.

One of the possibilities of lessening the danger of drinking and driving mentioned in the SWOV report is research into 'sobering remedies'. G van den Brink and J J de Gier (Utrecht State University, Sub-faculty of Pharmacy), were commissioned by SWOV to make a literature study to ascertain whether there was any purpose in promoting further research into sobering remedies.

Coffee may intensify the adverse effects of alcohol on driving

There are no sobering remedies

The conclusion from the literature study was that at present there is no usable agent that terminates or radically reduces the adverse effects of alcohol on traffic behaviour. Nor is such an agent likely to be developed in the near future. There is thus little point in promoting research.

Besides covering commercial preparations sold as 'sobering remedies', the study extended to medicaments and other substances that are supposed to have sobering side-effects. The substances discussed in the literature study can be divided roughly into three categories:

- those slowing down the emptying of the stomach so that the alcohol is assimilated by the blood more slowly and reaches the brain in somewhat lower concentrations;
- substances having a direct effect on the brain;
- substances promoting the breakdown of alcohol.

Substances of the first kind do have some effect; they are foods of all kinds, especially carbohydrates, fats and proteins.

The other two kinds were found either not to work or to be unusable in practice (for instance because they have to be injected straight into the brain).

Don't drink on an empty stomach and don't take coffee to sober up

Anyone who is going to drive is wiser not to drink any alcohol beforehand. If it is very difficult to avoid drinking an odd glass, the effect of alcohol can be slightly lessened by first having a good meal and by eating cocktail or other snacks with the drink. But no miracles should be expected from eating to lessen the influence of alcohol.
Many hosts and hostesses offer their guests a cup of coffee of a glass of a cola drink before they leave because they believe these have a sobering effect. This is not true; caffeine-containing beverages intensify rather than lessen the adverse effects of alcohol.

Sobering remedies; A literature study regarding the activity and applicability of various substances as a means of counteracting the effects of alcohol. G.van den Brink & J.J.de Gier, (Utrecht State University). SWOV publication 1979-3N. (In Dutch; a translation in English is in preparation.)

Safe driving on wet roads

On wet roads car occupants run two to three times the risk of being killed in an accident as on dry roads. The extra hazards on wet roads are due among other things to skidding. In recent years SWOV has carried out much research into the possibilities of limiting skidding. Attention was devoted mainly to improvement of vehicles on road surfaces. If we could take measures to reduce hazards on wet roads to the same level as on dry roads, in The Netherlands the lives of some 200 motorists a year could be saved.
When there is water on the road, contact between tyre and surface deteriorates. A motorist then finds it more difficult to keep his car under control by braking and steering, and the risk of an accident increases.
Contact between tyre and surface will be poorer the thicker the surface-water film becomes.

Preventing puddles forming on the road

The best way of preventing skidding accidents is to make sure no water remains on the road. But this is never completely possible in practice and the objective should be to keep the film of water as thin as possible. In the first instance, this is a task for the road authorities.

In road design, the authorities must provide for the proper combination of transverse and longitudinal gradients to prevent rain water accumulating. When a road is built its pavement can be constructed so that water is collected right away by the top layer and removed to the verge. This requires a top layer with very many interconnected cavities. There is a bituminous paving material meeting these requirements, mostly known as porous asphaltic concrete.
It has the additional advantages that it greatly reduces the inconvenience caused by splash and spray and has good reflecting properties in rainy weather. A drawback is that the cavities may gradually fill up with dust, sand and oil residues and that extra care is needed in winter against slippery surfaces.
Nevertheless, porous asphaltic concrete should be considered in many cases in order to limit inconvenience caused by surface water. Under the top layer, the most stable mixture possible of asphaltic concrete or even cement concrete should be applied, which will greatly reduce the rate and extent of rutting. This is important because deep layers of water form especially in ruts. Road authorities can also do a lot to eliminate water problems on existing roads. Ruts can be eliminated by filling them in, by planing the pavement surface, or by applying a fresh top layer.

If water stays on the surface near where it is banked, transverse discharge channels may be the answer.

Supplementary measures

We have now briefly seen how to prevent deep layers of water forming on roads. But there is a danger of skidding even if the film is only thin, especially at high speeds. In order to limit this danger, the road surface must in the first place have good skidding resistance. If its resistance has deteriorated in the course of time there are various ways of restoring it. The best known method is to treat the surface with a bituminous bonding agent and scattering gravel. This may be a complete failure, however, if it is not done carefully or if the weather suddenly changes. Immediately after application, unbonded pebbles moreover may shatter windscreens.
Another drawback is that the useful life of such surface treatment may be greatly reduced by long periods of high temperatures.
The use of synthetic resin as a bonding agent eliminates some of these drawbacks.
Especially if a gravel with a high polishing value is used, a lasting rough, sharp texture results.
Because of the high cost of surface treatment with a synthetic resin binder,

Splashing water obstructs the view for other road users

its use will be limited at present to carefully selected road situations. Intersection surfaces of traffic arteries, for example.
Another way of improving friction is to cut transverse grooves in a cement-concrete pavement. Besides increasing friction between tyre and surface, the grooves improve the reflection properties of the (wet) pavement surface.
Lastly, experiments are at present being made with thin layers (2 to 3 mm) of porous asphaltic concrete.

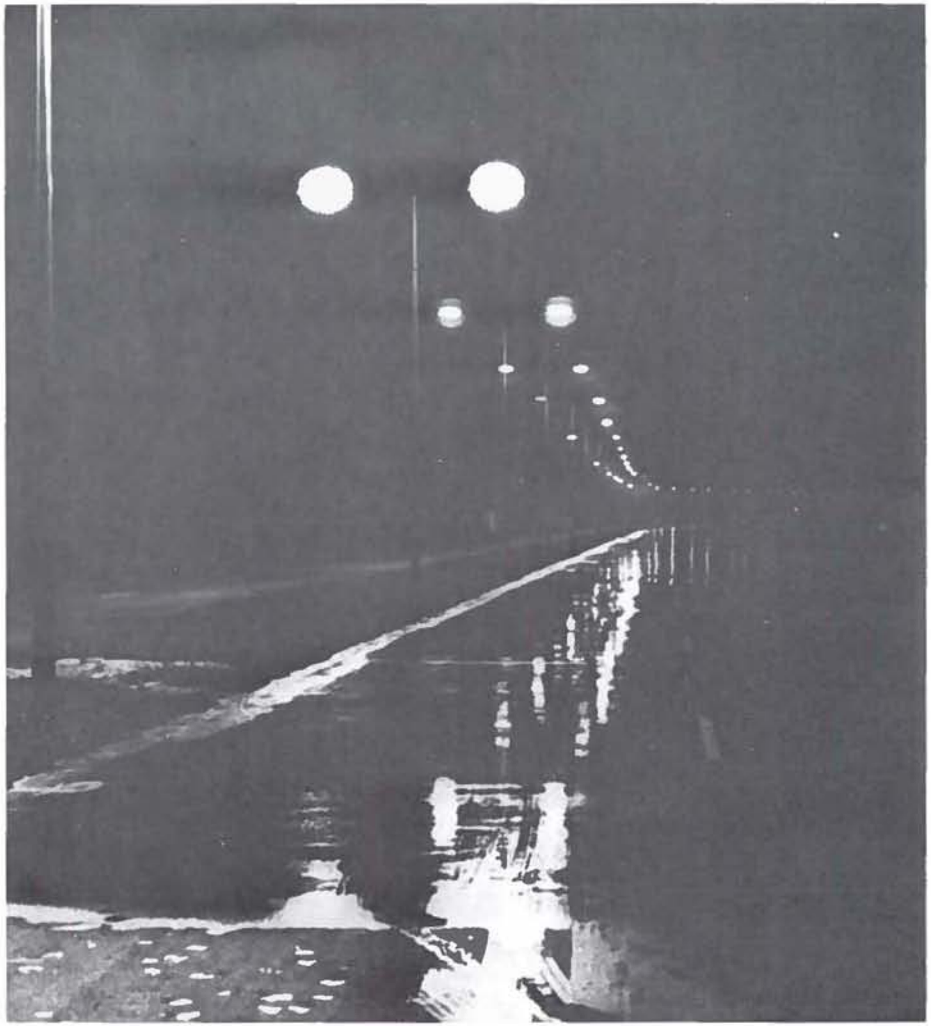
When the road is wet not only the pavement, but also the provision of information to the road user must be good. Clear traffic signs, demarcation and markings will enable drivers to predict a road situation ahead. In many cases this will obviate the need for sudden braking or steering. To make markings properly visible on wet roads, thermoplastic materials can be used; care must be taken that they do not stop rainwater running off. Especially on inclines, a large amount of water can collect against such markings and then run down the slope. At such places the markings should consist of painted strips, unless the thermoplastic is applied as a broken line.

Tyres and brakes also play a part in skidding accidents. Especially the tread and type of tyre are important. Since 1976 in The Netherlands there has been a legal minimum tread of 1 mm. Checks by SWOV in 1976 showed that about 1½% of cars had one or more tyres with too shallow a tread.
It should be possible to adjust the brakes so that the wheels cannot lock. Otherwise the braking distance is lengthened. If the rear wheels lock, the car becomes unstable as well.
If the front wheels lock, the car gets out of control and basically runs straight ahead. All these problems can be solved with the recently marketed electronic anti-locking system. It approximates the ideal braking behaviour of vehicles in all conditions. Especially in the case of motor lorries it is necessary for the available braking power to be used as effectively as possible, as it is one-third to one-half less than that of private cars. The reason is that a lot of natural rubber is used for lorry tyres because it can withstand higher temperatures than synthetic rubber. But the anti-locking system is still very expensive. Nor have the maintenance problems been overcome for wide-scale use.
A partial solution is that of the existing braking power limiter. This limits the braking power of wheel depending on load or deceleration. There is then a choice between locking front of rear wheels, a choice between stability and steerability. The EEC directives, which also apply to this country, have opted for stability. Especially on a wet road, therefore, if the brakes are applied hard the front wheels must lock first, and this is what happens in principle. But after some time, the limiter becomes defective, decreasing its useful effect.
To avoid this, the limiters could be adjusted less 'critically'. Their inspection and adjustment would also have to be simplified in order that this could be done at the same time as routine maintenance.
Research regarding auxiliary brakes for lorries has shown that their use on wet roads causes quite a lot of problems.
If the service brake fails to function in any way, the driver must be able to rely on the auxiliary brake. But tractor-trailer combinations in particular are difficult to keep on a straight course if the auxiliary brake is applied. Twisting and jack-knifing can easily cause a combination to run off the road.
It is therefore advisable, in addition to the existing statutory requirements for deceleration, also to lay down standards for maintaining a straight course when auxiliary brakes are applied.

Preventing accidents on existing roads

For effective accident prevention on wet roads there should be standards for:
– road-surface skid resistance;

– variations in skid resistance by time and place;
– decrease in friction between tyre and surface with increasing speed;
– depth of water film on the road.
At present there is only a standard for skid resistance, and it applies only to national highways. A pragmatic approach will thus have to be chosen.
The Provincial Public Works Department of Noord-Brabant appreciated this. Following upon a SWOV report on skid resistance of Noord-Brabant roads, the Department developed a method for counteracting wet-weather accidents. This, in brief, is as follows.
A computer is used to trace locations in the provincial roads system where there have been many wet-weather accidents in the past. Ultimately, twelve road sections were selected, together representing only a small percentage of the total length but accounting for over a third of all wet weather accidents. In order also to trace locations not particularly dangerous in the past but liable to become so in the future, lists were drawn up of road sections which did not satisfy the skid-resistance requirements for national highways.
Based on skid-resistance figures, traffic density, number of accidents and pavement type, a selection was also made from these sections. Next all sections selected by reference to accident or skid resistance data were inspected.



In practically all cases there proved to be a combination of various adverse factors:

- insufficient skid resistance;
- unclear course of road;
- existence of entries and exits;
- mixing of slow and fast traffic;
- discontinuities in road pavement;
- poor water removal to the verge.

Concrete measures for improvement were indicated for a number of locations in the provincial roads system.

The Province of Noord-Brabant considers the results of this approach to the problems so important that a 'wet-surface programme' is to be drawn up each year. Out of the roads appropriation, 5 to 10 million guilders a year will be provided for carrying out this programme.
As the Noord-Brabant approach might produce fruitful results in other provinces as well, SWOV and the Provincial Public Works Department of Noord-Brabant passed their knowledge on to the Traffic Engineering Course 1979 of the ANWB, the Dutch automobile association.
Besides this, SWOV has produced a brochure on wet-weather accidents and countermeasures, specially for road authorities.

Wet-weather accidents I: Risk-governing factors, and recommendations to road authorities. L.H.M.Schlösser & J.Doornekamp. R-79-27. (Only in Dutch.)

Wet-weather accidents II: Measures relating to roads. A.G.Welleman. R-79-28. (Only in Dutch.)

Wet-weather accidents III: Road administration in Noord-Brabant. D.Stoelhorst, Provincial Public Works Department Noord-Brabant. R-79-29. (Only in Dutch.)

Wet-weather accidents: What can roads authorities do about them? SWOV brochure. 1979.

Auxiliary brakes for trucks: Research into the behaviour of a tractor-semi-trailer combination during emergency braking. Ad hoc working party on 'Emergency brakes'. R-76-18.

Braking power distribution: Experimental and analytical investigation of the relationship between braking power distribution, deceleration and course stability of cars and motor lorries; Summary of research reports. Working Party on 'Tyres, Road Surfaces and Skidding Accidents', Sub-committee II. R-78-33. (Only in Dutch.)

Experimental multifactor research into factors influencing available friction between tyres and wet roads; Second stage: Functional requirements for road surfaces.
Working Party on 'Tyres, Road Surfaces and Skidding Accidents', Sub-committee I. R-78-34. (Only in Dutch.)

Experimental multifactor research into factors influencing available friction between tyres and wet roads; Third stage: Lorry types.
Working Party on 'Tyres, Road Surfaces and Skidding Accidents', Sub-committee I. R-78-35. (Only in Dutch.)

Road safety in Noord-Brabant

Single-vehicle accidents

Research into road safety in Noord-Brabant being conducted by SWOV at the request of the Noord-Brabant Provincial Council and the Ministry of Transport and Waterways went a step further in 1979. A study of single-vehicle accidents was completed. Such accidents consist of a vehicle running off the road and hitting a stationary object or running into the water. In comparison with the rest of The Netherlands there are many such fatal accidents in Noord-Brabant.

165 locations on national and provincial highways outside built up areas, the sites of single-vehicle accidents, were investigated. For all these locations, accident, road and obstacle characteristics were collected. Frequency tables were prepared with a computer for the road and obstacle characteristics. These show that at many of the dangerous locations obstacles are too close to the edge of the road. Many such obstacles are trees. By reference to examples for various types of roads SWOV shows how these locations can be made safer in the future. The concrete measures road authorities must take depend on the local situation and the type of accident. If there have been mainly single vehicle accidents one can choose for countermeasures concen-

In Noord-Brabant there are many trees close to the roadside

trated on reducing their severity. If there are many other accidents too, accident prevention measures are more suitable. As to the latter, however, the results must be awaited of the correlation research at present being carried out by SWOV in Noord-Brabant, in which correlations are being sought between accident, road and obstacle characteristics.

The most effective measure to reduce the severity of single-vehicle accidents mentioned by SWOV is movement or removal of obstacles. This will often be impossible, however, because they serve a useful purpose. They may be needed, for instance, to guide traffic or give a certain measure of protection to people on cycle or footpaths alongside the carriageway. If the obstacles are trees, environmental considerations will play a part. Another possibility is to use lighting columns, roadside telephone pillars, signposts and so on designed to be low-aggressive for private cars. When hit, such obstacles will break off at the base or slip of from its foundation and cause little danger to car occupants. If there are dangerous obstacles only here and there along the roadside, they can be shielded. If none of these measures provides the answer, it will have to be considered whether to shield the entire danger zone with a guiderail structure. Rijkswaterstaat (Public Works Department) has issued guidelines for countermeasures on motorways. A working party of the Committee on Guidelines for Non-Motorway Design (RONA) is working on guidelines for other roads. Definitive results are not expected in the near future, though some provisional designs have been drawn up. Pending definitive guidelines several bodies have formulated the basic principles of their policy.

As funds and manpower to deal with all dangerous locations are not available, priorities will have to be set. These can be based on traffic densities and accident rates. If there are several suitable measures to improve safety at a given location the road authorities will have to make the choice. In principle, they can base this on cost-effectiveness analysis. But such an analysis is difficult in practice because it is not known even approximately what most measures contribute to road safety. To obtain more knowledge about this, it is advisable to evaluate the effect of measures to be taken before long.

Road-surface skid resistance

With reference to the SWOV report published in 1978 on skid resistance of Noord-Brabant roads, the Provincial Public Works Department has evolved a method of counteracting wet-weather accidents.
This method and the 'wet-surface programme' it has led to are discussed in detail under the heading 'Safe driving on wet roads'.

Road safety in the Province of Noord-Brabant V: Investigation of single-vehicle accidents in Noord-Brabant. R-79-36. (Only in Dutch.)

Wind problems on the Moerdijk bridge

In July 1978 SWOV was asked to make an advisory report on the question of when wind on the Moerdijk bridge was liable to drive traffic out of lane. The General Board of Roads and Waterways asked this in view of its decision to recommend a speed of 70 kilometres per hour if the wind became dangerous. Road users would see this recommended speed on automatic lighting signs on the bridge approaches.
One reason for this wind-related recommended speed was a number of accidents that had happened during high winds while the rebuilt bridge was provisionally opened.

Traffic on the bridge is about 15 metres above water level. The road carried by the bridge is part of a motorway and consists of two three-lane carriageways, each lane being 3.60 metres wide. The design of the bridge is one reason why road users hardly realise they are driving high above the water at a given moment. On high-level roads in flat surroundings – on bridges, dikes and dams – winds are usually extra hard. On the Moerdijk Bridge, they may become 2.5 times as strong as on the roads leading to it, and may cause trouble to traffic.
The hindrance can be increased by lorries and buses because, while overtaking, they cut off crosswinds and produce air displacements while moving, inducing air currents around

The Moerdijk Bridge

them. At the front of the vehicle these take the form of a bow-wave and at the rear that of a wake. Other, wind-sensitive vehicles – such as some types of small delivery vans and cars towing caravans – can be brought off their course by the combination of wind, wind cutt off and air displacement. The approximate extent of this with winds from different directions and of different velocities can be calculated for various driving and overtaking speeds.

To determine the wind at which a speed of 70 km per hour on the Moerdijk Bridge should be recommended, it was assumed that road users would keep to the speed limits applicable there of 80 km per hour for lorries and 100 km per hour for most lighter vehicles.
Going by the lane-width, the maximum permissible deviation by lighter vehicles was put at 0.80 metre. Next, SWOV calculated the wind velocity and direction at which greater deviations were likely.

The system of the Traffic Engineering Division of Rijkswaterstaat on the Moerdijk Bridge has meanwhile become operational. The wind velocities and directions calculated by SWOV were tabulated and stored in the memory of the microprocessor. Velocity and direction of the wind on the Moerdijk Bridge are measured continuously and compared with the data tabulated in the microprocessor.
The speed of 70 km per hour is recommended when the measured data have exceeded the tabulated data four times within half a minute. The speed is also recommended if the measured data are once greater than 1 3/8 times the tabulated data. This latter switching criterion has been chosen to allow for sudden increases in wind velocities, for instance in thunder storms.
The recommendation is maintained for 8½ minutes. This avoids rapid switching on and off which might lessen the credibility of the recommendation among road users. If, during the last half minute of this period, the tabulated data are exceeded at least twice, the duration of the recommendation is extended (from time to time) by one minute.
Experience gained in practice may necessitate adjustment of these switching criteria.
SWOV advised measuring the wind in the middle of the bridge; it is strongest there, not only because it is the highest level but also because cross-winds are slowed down there least. To prevent passing traffic influencing the measurements, the meters could be fitted about 12 m above the road surface (i.e. several times the height of a lorry).

Wind-related recommended speed for road traffic on the Moerdijk Bridge.
P.I.J. Wouters. R-79-20. (Only in Dutch.)

Rear-seat safety facilities

SWOV made an advisory report for the Permanent Contact Group on Road Safety (PCGV) regarding seat belts or kiddies' seat in the rear of cars. Data were collected on the existence of the safety facilities, their use and the saving in numer of lives if their use were made compulsory.

Not much is known about the existence or use of belts or kiddies' seat in the back of cars. The data must be regarded as an indication. They were obtained from a number of investigations suggesting that 13 to 20% of rear-seat places occupied had safety facilities. Between 6 and 11% of rear-seat passengers used a safety facility.
The existence of rear-seat safety facilities is closely related to rear-seat occupants' ages. There are many more in the case of children. In over half the cases the facilities are probably children's seat belts or kiddies' seats. The proportion worn by babies between 0 and 1 year is about 85%. Over 12 years the percentage is practically nil.

In order to achieve the same percentage for rear seats as for front seats, about 90%, a total of 7,000,000 belts or kiddies' seats would have to be fitted. Occupancy of rear seats may vary from small children to adults, and this will have to be taken into account in providing the facilities. If wearing is made compulsory by the same procedure as for front seats, whereby seat belts are required only for newly marketed cars, it is likely to take ten years to reach the 90% figure.

Calculation of the saving in terms of casualties was based on fatal casualties only. Assuming the wearing rate on rear seats becomes the same as on front seats (70% outside built-up areas and 50% inside), and if the same effectiveness is assumed (60% less risk of being killed in an accident), and if the annual number of car deaths remains between 1000 and 1100, a reduction in the number of road deaths of 50 to 55 can be expected. With a wearing rate in the rear of 50% outside built up areas and 35% inside, the estimated reduction is about 30 to 35 deaths a year. 90% of this reduction will be outside built-up areas.

Rear-seat safety facilities in cars; Review of existence and use of safety facilities (seat belts, children's belts, etc.) on rear seats of private cars in The Netherlands and the potential saving in numbers of lives if use is made compulsory. A.Blokpoel, J van Minnen, L.T.B. van Kampen. R-79-35. (Only in Dutch.)

Traffic and road-safety data

To be able to ascertain what risks various road-user categories run in traffic, safety data (for instance number of accidents and their severity) are inadequate. It is only when they are related to road usage data that useful information is required.
This can be illustrated as follows: If in a given year 1000 motorists and 400 cyclists are killed, a motorist seems at first sight to be more at risk than a cyclist. But when it is known that the average motorist covers ten times the mileage of a cyclist this completely changes the picture. In terms of distance, four times as many cyclists as motorists have been killed.
SWOV is constantly seeking ways and means of improving the quality of road usage data and safety data.

Road usage data

The extent to which most categories of road users take part in traffic is not precisely known; and certainly not if the categories are subdivided, say by sex and age. This makes it difficult to say which categories should receive most attention in road safety policy. With a view to remedying this, SWOV started with the 'Risk research for Road Users in The Netherlands' (ROVIN) in 1975. Firstly, it was examined whether it was possible to collect data on road usage.

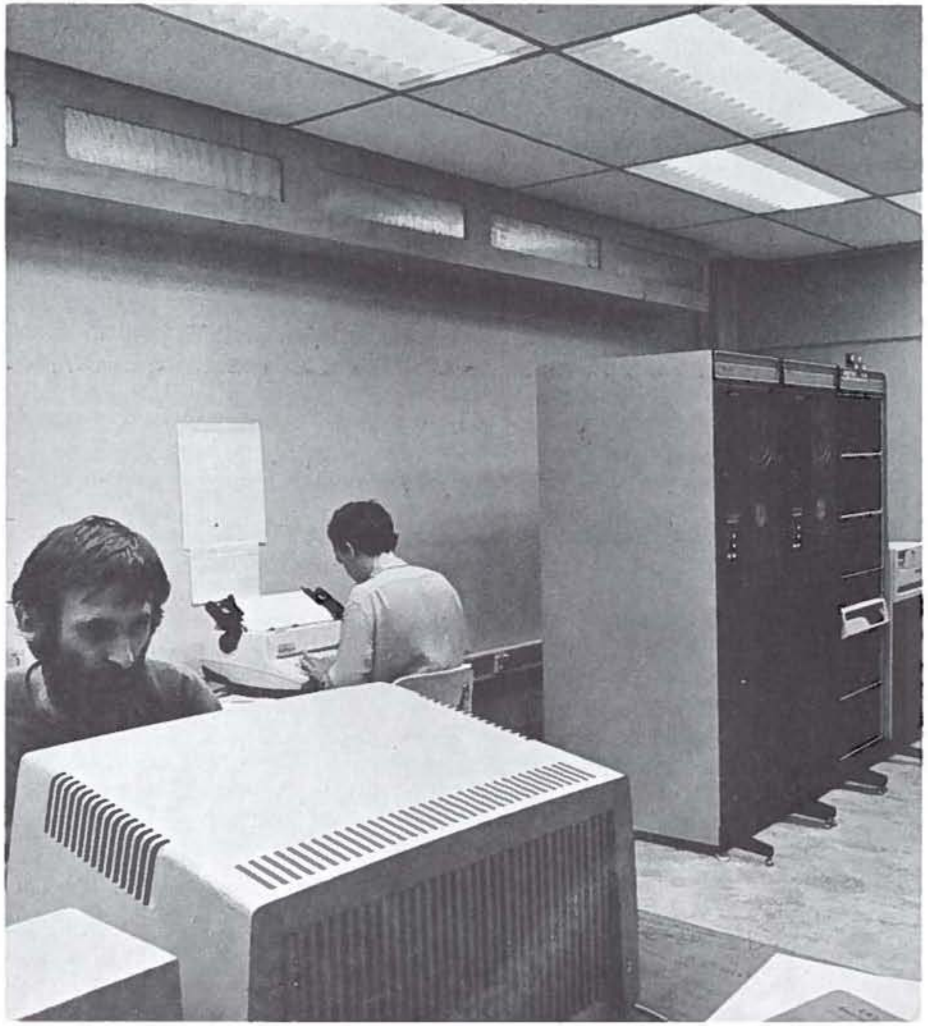
The results led to research into the 'National Travel Survey' started by the Central Bureau of Statistics (CBS) in 1978. The CBS collects the necessary information from home interviews. This procedure was chosen because traffic counts hardly allow any information to be collected on distances travelled or demographic characteristics. A draw-back of home interviews is that foreigners visiting The Netherlands are left out of account. So that a general idea could nevertheless be obtained of this, SWOV commissioned research from a Dutch market research agency. Foreigners leaving the country at a number of major frontier posts were asked: 'How many kilometres did you cover with this vehicle during your last visit to The Netherlands?'. This question – plus several incidental questions – was put only to car and lorry drivers. Besides the interviews, which were based on a sample, counts were also made to establish how many foreigners left The Netherlands. In this way, it was possible to calculate that in September 1975 foreign vehicles accounted for between 2.5 and 5% of total traffic output by such vehicles in The Netherlands. The percentage for the year as a whole is not likely to vary much from this. Comparison with data from CBS and Shell surveys show that Dutch cars abroad have twice the mileage of foreign cars in The Netherlands. Dutch lorries abroad even do five times the mileage of foreign lorries here. It had been assumed until recently that Dutch drivers abroad covered about the same mileage as foreigners did in this country.

Safety data

The Central Bureau of Statistics regularly published figures on road accidents in The Netherlands and the number of casualties. Road accident victims who die of their injuries more than thirty days after are not, however, recorded as road deaths. This is due to international agreements on the definition of 'road deaths' which the CBS adheres to.
In order, however, to obtain the fullest possible picture of the number of road deaths every year, SWOV estimated how many people die more than thirty days after. The CBS figures were compared for this purpose with hospital data from the Medical Records Association (SMR). The SMR covers about 90% of all admissions to general and teaching hospitals in this country. From this comparison, SWOV concluded that the number of injured persons dying over thirty days after the accident is about 3% of the road deaths recorded by the CBS. The same percentage is given in a United Nations publication 'Statistics of Road Traffic Accidents in Europe 1975'. The UN arrived at this estimate following an enquiry among a number of member states.

Every quarter SWOV prepares an overall specification of trends in road safety. The results are supplied to the Road Safety Directorate of the Ministry of Transport and Waterways. SWOV bases its specification, inter alia, on first estimates of the number of fatalities made by CBS for the Road Accident Statistics. In the past, these estimates sometimes had to be corrected later, which of course detracted from the value of SWOV's specification. Possibilities were therefore examined of making the first estimates more reliable. This proved quite possible by using provisional road accident figures from the CBS's Cause of Death Statistics. These are based on information supplied by the medical profession, while the information for the Road Accident Statistics comes from the police and judicial authorities.
SWOV therefore recommended the CBS to examine how the Cause of Death Statistics might be used for the first estimates of road traffic deaths. This might cause some delay, but on the other hand the first estimates would be more accurate. Hence the SWOV specifications will be more reliable too. The CBS has meanwhile followed up SWOV's recommendation and is now

using Cause of Death Statistics for the first estimates of number of road deaths.



Mileage driven by foreign cars and lorries in The Netherlands. Description and results of traffic research among foreigners in The Netherlands for estimating the mileage driven in The Netherlands by vehicles carrying a foreign registration, relatively to the mileage of vehicles bearing a Dutch registration. (Full report.) R-78-37. (Only in Dutch.)

Non-recorded road deaths; Estimated number of traffic casualties dying of their injuries more than thirty days after accident. (Full report.) M.W.Maas. R-79-10. (Only in Dutch.)

Number of road deaths as per Cause of Deaths Statistics as an estimate of number of road deaths as per Road Accident Statistics. A.Blokpoel. R-79-25. (Only in Dutch.)

Methods and techniques

SWOV pays considerable attention to further development of methods and techniques for analysing traffic safety data. Most sciences have specific problems of establishing relationships between data that can clarify certain phenomena. This applies likewise to road safety research. The subject of traffic safety is a complex one involving many factors. Any description of a road safety problem amounts to a complicated structure of interrelationships between various factors. Some data moreover are difficult to incorporate in a model for analysis. Both these aspects are dealt with below.

Traffic safety

Traffic safety involves factors such as road users, roads, vehicles, weather and other conditions, and traffic flows. Some of these factors are usually of importance in tracing the causes of an accident. Each factor in turn has a number of characteristics. In the case of a driver, for instance, it may be important to know his age, sex, whether he has been drinking and the degree of fatigue. Accidents also have various characteristics, such as severity and place of injury, and the circumstances under which they occurred.
An endeavour used to be made to separate certain factors of characteristics from the complex and examine them in isolation. Nowadays there is a growing opinion that it is hardly ever possible to tackle road safety problems by examining isolated aspects individually, since interrelationship between the factors and their characteristics are also very important. For example, a road that has not enough skidding resistance causes a danger of skidding especially in bends, particularly during heavy rain that obstructs the view, while poor markings also adversely affect drivers. This is a fairly simple example; there are nearly always combinations of many more characteristics augmenting or weakening one another. More and more research is being carried out into these interrealationships. In this respect, road safety research has much in common with most social-scientific investigations. Thus a number of techniques used in social scientific research for simple definition of relations between large numbers of characteristics and hence to discover structures in relationships are also suitable for road safety research.

The nature of data

An additional complication in road safety research is that besides quantitative data, data of a qualitative nature also have to be used. The outcome of a collision between two road users depends, for instance, on speed of travel and angle of impact, but also on qualitative factors such as choice of vehicle and use of seat belts. To establish relationships between such data, they have to be classified. Recent developments have led to methods and techniques that were used for quantitative data now being used for qualitative data as well. SWOV has used these techniques, inter alia for seat-belt research and the Noord-Brabant project.
Information on qualitative data is often presented in the form of contingency tables. A number of recent developments are important also in analysing these; they were made good use of in investigations into drinking and driving, wearing of seat belts and wind effects. During an international study week devoted to contingency table analysis, SWOV reported its experience. The report on this study week, organised by a NATO research institute in Urbino, Italy, contains an article reviewing the above-mentioned developments. The report will be published in the course of 1980.
We would also mention that the Data Theory Department of Leiden State University has drawn up a syllabus for a postgraduate course on non-linear regression analysis. That Department and SWOV have developed a number of computer programmes making these analyses directly applicable to road safety research.

SWOV and the OECD

Other problems

Besides these problems of analysis techniques, some problems of a more methodological nature arise in road safety research. They relate to planning of research, the choice of research data and the mode of sampling. There are also safety factors forming a problem in themselves because they are difficult to define and are used differently, such as traffic conflicts, feelings of unsafety, traffic behaviour, exposure.
The Methods and Techniques Department is examining together with the other research departments how to tackle these methodological problems.

Method for the analysis of contingency tables in road safety research. Contribution to NATO Advanced Study Institute: Contingency table analysis technique for road safety studies, SOGESTA Conference Center, Urbino, Italy, 18-29 June 1979. S. Oppe. R-79-24.

Two research groups of the OECD, the Organisation for Economic Co-operation and Development, working on road safety issued publications in 1979. The group on 'Traffic Safety in Residential Areas' issued its final report, and that on 'Road Safety at Night' issued national analyses based on accident statistics. The chairmen of both these research groups are members of SWOV.

Traffic safety in residential areas

The nature of traffic safety problems in residential areas is the same in many countries, and solutions are being sought in the same direction. But the way countermeasures are carried out differs considerably.
Experience, viewpoints, opinions and research results have been exchanged in the OECD research group.
Many questions arise regarding residential areas. Not only of traffic safety, but also of children's play areas, noise, greenery, accessibility of houses and amenities, facilities for public transport and other services, and so on. To sum up, this is a question of quality of life, of which road safety forms part. Great attention is therefore paid to the ideas, opinions and feelings of the residents, as regards road safety: feelings of not being safe are a factor in themselves, quite apart from the question of how many accidents really happen.

Traffic safety expressed in terms of accidents present a number of differences in residential compared with other areas. The proportion of children and old people in the total number of accidents is greater than elsewhere. Pedestrian accidents happen mainly near parked cars. Moreover, accidents are spread throughout the entire area, and the so called black spots are seldom found. This necessitates an integrated approach; little is to be expected of location-related countermeasures. Only physical planning measures and road structure modifications have a major effect on safety. They are fairly simple to effect in designing new areas, but more difficult in old neighbourhoods. In new ones, the traffic function has usually been much better subordinated to living and sojourning functions than in old ones.

In the 'sixties, traffic safety measures in designs for new neighbourhoods were aimed mainly at the strictest possible separation of different traffic categories, and a hierarchical road system (from residential street to access street). They have had a demonstrably positive effect.
In the 'seventies there was growing criticism of these measures because they were said to make the neighbour-

hood dull. More and more, the quality of life as a whole was taken as the criterion instead of traffic safety alone.
Sojourning functions, such as playing, strolling, recreation, became the focal point. In a residential precinct ('woonerf'), for example, the opposite of segregation was employed: all categories of traffic are mixed, on strict conditions. In Britain, on the other hand, preference is for cul-de-sacs or (short) loop-shaped streets. Of great importance is this mixing of traffic is the reduction of speeds. This has to be brought about by physical countermeasures. Straight road sections must not be too long.
The width of the street also has an effect. Speed humps are used in some countries. Another possibility is to change the axis of the road. Different rules can be made for parking so that some service vehicles can get close to the houses.
A number of conclusions relating to new neighbourhoods can also be applied to existing neighbourhoods with simple technical countermeasures. Non-local traffic must be excluded as much as possible by means of cul-de-sacs, one-way traffic, local access routes. The remaining road users must be made to behave 'suitably', for instance by stimulating speed reductions, arranging streets so that they meet the needs of pedestrians rather than moving vehicles, by regulating parking. From the viewpoint of democratic decision-making, and to have the best chances for effective countermeasures, public participation must be set up.

Road accidents at night

Statistical accident analyses were made by the participating countries for the OECD research group on 'Road Accidents at Night'. The group drew up general guidelines for these. At the time, most countries did have accident statistics up to 1976. It was decided to work out the 1975 data in detail.
In the description the customary problem arose that too little is known about the mileage covered by a category of road users at a given moment. The difference in absolute numbers of accidents as between daytime and nighttime is partly determined by the increase and decrease in the numbers of road users and the distances they cover.

The Dutch description says that despite this limitation it can be gathered from available statistics that more accidents happen per mile at night than in daytime. It cannot be said how great the difference is.
On average, nighttime accidents are more serious. There are more deaths per fatal accident, probably because the number of private cars in overall traffic is greater. Cars carry on average more persons than other vehicles except buses; but there are very few casualties among bus passengers. At night, proportionately more people also die on the spot, perhaps because help is generally later in coming. The proportion of nighttime accidents in the total is increasing, although there was a sharp fall in 1975. This was related to the new Dutch Act on drinking and driving of 1 November 1974, which causes a big reduction in drinking by drivers. Drinking has increased again, however, and as far as is known the increase is continuing unabated.
At nighttime, fatal accidents involve fewer cyclists than other categories. Young people have a bigger proportion than old people. This applies especially to motor cyclists and motorists.
Rain forms an additional hazard in combination with darkness, especially for the must vulnerable road users, such as cyclists and pedestrians.
A higher age also increases the accident risk in rain and darkness. Black ice and snow apparently do not form a bigger problem than in daytime. Nighttime fog is more dangerous outside built-up areas than inside.
An increased accident risk during fog was noted only among young motor cyclists and young motorists.
Alcohol-related accidents happen

Narrow sections and bends in the road reduce speeds

especially in the small hours of Saturday, Sunday and Monday. This applies to all categories of road users, but especially to young motorists.

Traffic safety in residential areas. A report prepared by the OECD Road Research Group TS-2. (F.C.M.Wegman, J.H.Kraay a.o.). OECD, Paris, 1979.

Road accidents at night in The Netherlands; A national analysis according to official road accident data. Contribution to OECD Research Group TS-3 on improving road safety at night. S.Harris, M.A. R-79-17.

Published in 1979

Reports 1977

+ Vision tests as road safety measures. Paper presented to Congress Verkehrsmedizin, Heidelberg, 20-22 May 1977 and also to Symposium Illuminating Engineering Research Institute (IECI), München, 29-30 June 1977. Dr. D.A.Schreuder. R-77-43. SWOV, Voorburg, 1977. 4 pp.
+ Appendices 1-9 by Drinking by motorists, SWOV (P.C. Noordzij, A.A.Vis & J A.G Mulder), Publication 1977-2E. SWOV. R-77-44 .SWOV, Voorburg, 1977. 40 pp.
+ Integration of motor traffic in residential areas: Requirements for lighting of residential areas. Contribution to IV World Transportation Engineering Conference, Mexico City, 2-6 October 1977. Dr.D.A Schreuder. R-77-45. SWOV, Voorburg, 1977 .20 pp.

Reports 1978

+ Ademanalyse. Een alternatief? Ing J A G.Mulder & drs. P.C.Noordzij. R-78 31 . SWOV, Voorburg, 1978. 20 blz . Artikel in: Het tijdschrift voor de politie 41 (1979) 5 :240 t/m 249 *
+ Autogordels vast en zeker .tekst 2de herziene versie van de gelijknamige gezamenlijke uitgave van de Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV en Veilig Verkeer Nederland (VVN) . SWOV . R 78 32 . SWOV, Voorburg, 1978 . 22 blz *
+ Remkrachtverdeling, Experimenteel en analytisch onderzoek naar de relatie tussen de remkrachtverdeling, de remvertraging en koersstabiliteit van personenauto's en vrachtauto's. Samenvatting van de research-rapporten van Subcommissie II van de Werkgroep Banden, Wegdekken en Slipongevallen. (ir.L H M Schlösser) . R 78 33 . SWOV, Voorburg, 1978 . 80 blz *
+ Experimenteel multifactoronderzoek naar factoren die de beschikbare wrijvingskrachten tussen banden en natte wegdekken beïnvloeden; Tweede fase: Functionele eisen aan wegdekken + Bijlagen. Werkgroep Banden, Wegdekken en Slipongevallen, Subcommissie I. R-78-34 I t/m III. SWOV, Voorburg, 1978. 34 + 143 + 95 blz.*
+ Experimenteel multifactoronderzoek naar factoren die de beschikbare wrijvingskrachten tussen banden en natte wegdekken beïnvloeden, Derde fase: Vrachtautobanden. Werkgroep Banden, Wegdekken en Slipongevallen, Subcommissie I. R 78-35. SWOV, Voorburg, 1978 . 143 blz.*
+ Hulpremmen voor vrachtauto's; Onderzoek naar het gedrag van een trekker-opleggercombinatie tijdens het uitvoeren van een noodremming . SWOV (ir L.H.M.Schlösser). R-78-36. SWOV, Voorburg , 1978. 62 blz .
+ Verkeersprestatie van buitenlandse personenauto's en vrachtauto's in Nederland :Beschrijving en resultaten van een verkeersonderzoek onder buitenlanders in Nederland t.b v .een schatting van de verkeersprestatie in Nederland van voertuigen met een buitenlands kenteken in relatie tot de verkeersprestatie van motorvoertuigen met een Nederlands kenteken .SWOV. R 78-37. SWOV, Voorburg, 1978 . 107 blz *

Reports 1979

+ Jaarverslag 1978 . Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV . R 79 1 . SWOV, Voorburg, 1979 . 117 blz *
+ Rapporten, brochures , publikaties en artikelen in 1978 . R 79 -2. SWOV , Voorburg, 1979 . 17 blz.

+ Course holding by cyclists and moped riders. J. Godthelp (IZF-TNO) & P.I.J. Wouters (SWOV). R-79-3. SWOV, Voorburg, 1979. 40 pp., ill.
+ Public and vehicle lighting in residential areas. Paper presented to the Chartered Institution of Building Services CIBS Annual Conference 1979, Harrogate, 19-23 May 1979. Dr D.A. Schreuder. R-79-4. SWOV, Voorburg, 1979. 21 pp.
In: The Chartered Institution of Building Services Annual Conference 1979, Harrogate, 19-23 May 1979, pp. M1-M8. CIBS (1979).
+ De Nederlandse band geprofileerd. Ir L.H.M. Schlösser. R-79-6. SWOV, Voorburg, 1979. 14 blz.
Artikel in: Banden 25 (1979) 3: 30-39.*
+ Urban planning, traffic planning and traffic safety of pedestrians and cyclists. Report presented to the 1979 Road Research Symposium on Safety of pedestrians and cyclists, OECD Headquarters, Paris, 14-16 May 1979. F.C.M. Wegman. R-79-7. SWOV, Voorburg, 1979. 34 pp.
+ Data requirements for traffic safety research and policy. Report presented to the 1979 Road Research Symposium on Safety of pedestrians and cyclists, OECD Headquarters, Paris, 14-16 May 1979. P.C. Noordzij. R-79-8. SWOV, Voorburg, 1979. 33 pp.
+ Review of traffic conflicts technique studies. M. van den Hondel & J.H. Kraay. R-79-9. SWOV, Voorburg, 1979. 112 pp.
+ Niet-geregistreerde verkeersdoden; Schatting van het aantal verkeersslachtoffers dat meer dan 30 dagen na het ongeval overlijdt ten gevolge van het opgelopen letsel. M.W. Maas. R-79-10. SWOV, Voorburg, 1979. 20 blz.*
+ Drie procent van de verkeersdoden wordt niet geregistreerd. (Verkorte versie van R-79-10). M.W. Maas. R-79-11. SWOV, Voorburg, 1979. 13 blz.
Artikel in: Verkeerskunde 30 (1979) 5: 203 t/m 204.*
+ Verkeersconflicten als uitgangspunt voor een methode van verkeersveiligheidsonderzoek; Een overzicht van de mogelijkheden en beperkingen van de conflictmethode. J.H. Kraay, soc.drs. & S. Oppe, psych.drs. R-79-12. SWOV, Voorburg, 1979. 24 blz.
Artikel in: Verkeerskunde 30 (1979) 5: 226 t/m 229.*
+ Efficiënt verkeersveiligheidsonderzoek door middel van multidisciplinaire samenwerking. Lezing ter gelegenheid van de opening van de Grote Botsingssimulator van het Instituut voor Wegtransportmiddelen (IW-TNO), Delft, 22 maart 1979. Ir. E. Asmussen. R-79-13. SWOV, Voorburg, 1979. 13 blz.
+ Efficiënter verkeersveiligheidsonderzoek met botsingssimulator IW-TNO. (Verkorte versie van R-79-13). Ir. E. Asmussen. R-79-14. SWOV, Voorburg, 1979. 13 blz.
Artikel in: Verkeerskunde 30 (1979) 7: 323 t/m 325.
+ De verkeersveiligheid in stadscentra en verblijfsgebieden. Ir. F.C.M. Wegman. R-79-15. SWOV, Voorburg, 1979. 11 blz.
Artikel in: Verkeerskunde 30 (1979) 7: 319 t/m 321.
+ Efficient road safety research through multidisciplinary co-operation. Address at the opening of the Full Scale Crash Facility at the Research Institute for Road Vehicles TNO, Delft, 22 March 1979. E. Asmussen. R-79-16. SWOV, Voorburg, 1979. 12 pp.
+ Road accidents at night in The Netherlands; A national analysis according to official road accident data. Contribution to OECD Research Group TS3 on Improving Road Safety at Night. S. Harris, M.A. R-79-17. SWOV, Voorburg, 1979. 43 pp.
+ Automobilist onder invloed, zijn alcoholgebruik en zijn gevaar. Bijdrage aan het ISMW Symposium Gezondheid en gedrag; Het alcoholgebruik en de sociale gezondheidszorg, Groningen, 7 juni 1979. Drs P.C. Noordzij. R-79-18. SWOV, Voorburg, 1979. 21 blz.*

+ De verkeersonveiligheid in Nederland. Consult aan de Directie Verkeersveiligheid t.b.v. de vergadering van de Ministers van de kerndepartmenten voor de verkeersveiligheid op 4 mei 1979. SWOV. R-79-19. SWOV, Voorburg, 1979. 15 blz.*
+ Een windafhankelijke adviessnelheid voor het wegverkeer op de Moerdijkbrug. Consult t.b.v. de Hoofddirectie van de Waterstaat. SWOV (drs P.I.J.Wouters). R-79-20. SWOV, Voorburg, 1979. 52 blz.*
+ De ontwikkeling en de toepassing van de conflictmethode alsmede de internationale samenwerking en verkeersveiligheidsonderzoek. Bijdrage Symposium Gedragsobservatie en -beïnvloeding van kruisende verkeersstromen, Haren (Gr.), 7 juni 1979. Drs.J.H.Kraay. R-79-21. SWOV, Voorburg, 1979. 24 blz.*
+ Toelichting op het onderzoekprogramma van de SWOV. R-79-22. SWOV, Voorburg, 1979. 18 blz.*
+ Globale analyse van de geraamde verkeersongevallencijfers over geheel 1978. SWOV. R-79-23. SWOV, Voorburg, 1979. 15 blz.*
+ Methods for the analysis of contingency tables in road safety research. Contribution to NATO Advanced Study Institute: Contingency table analysis technique for road safety studies, Sogesta Conference Center, Urbino, Italy, 18-29 June 1979. S Oppe. R-79-24. SWOV, Voorburg, 1979. 15 pp.
+ Het aantal verkeersdoden volgens de doodsoorzakenstatistiek als schatting voor het aantal verkeersdoden volgens de verkeersongevallenstatistiek. Consult ten behoeve van de Permanente Contactgroep Verkeersveiligheid (PCGV) (Subgroep Statistiek). SWOV (A Blokpoel). R-79-25. SWOV, Voorburg, 1979. 18 blz.*
+ Globale analyse van de geraamde verkeersongevallencijfers over het eerste kwartaal van 1979. Consult ten behoeve van de Permanente Contactgroep Verkeersveiligheid (PCGV) (Subgroep Statistiek). SWOV. R-79-26. SWOV, Voorburg, 1979. 16 blz.*
+ Ongevallen op nat wegdek I; Risicobepalende factoren en aanbevelingen aan de wegbeheerder. Ir.L.H.M.Schlösser en ir.J.Doornekamp. R-79-27. SWOV, Voorburg, 1979. 22 blz.
  Artikel in: Verkeerskunde 30 (1979) 10: 500 t/m 505.*
+ Ongevallen op nat wegdek II; Maatregelen aan de weg. Ir.A.G.Welleman. R-79-28. SWOV, Voorburg, 1979. 24 blz.
  Artikel in: Verkeerskunde 30 (1979) 11: 552 t/m 555.*
+ Ongevallen op nat wegdek III; Het wegbeheer in Noord-Brabant. Ir D.Stoelhorst, Provinciale Waterstaat Noord-Brabant. R-79-29. SWOV, Voorburg, 1979. 15 blz.
+ De veiligheid van het wegverkeer; Stellingname van de Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, t.b.v. SMO boek 11: Auto weg of autoweg. Ir.E.Asmussen & ir F.C.M.Wegman. R-79-30. SWOV, Voorburg, 1979. 5 blz.
  In: Auto weg of autoweg? SMO boek 11, blz. 69 t/m 72. Stichting Maatschappij en Onderneming, Scheveningen, 1979.*
+ Current research projects on traffic conflicts technique studies. M.v.d.Hondel & J.H.Kraay. R-79-31. SWOV, Voorburg, 1979. 34 pp.
+ Fysiologische verblinding veroorzaakt door sportveldverlichting. Dr ir D.A.Schreuder. R-79-32. SWOV, Voorburg, 1979. 15 blz.
  Artikel in: Polytechn. Tijdschr. (elektrotechniek/elektronika) 34 (1979) 12: 734 t/m 737.
+ Nederlanders leggen in het buitenland meer kilometers af dan buitenlanders hier. F.J.de Bruin, M.W.Maas & S.Harris, M.A. R-79-34. SWOV, Voorburg, 1979. 16 blz.*

+ Beveiligingsmiddelen op achterbanken van personenauto's; Overzicht van aanwezigheid en gebruik van beveiligingsmiddelen (autogordels, kindergordels, etc.) op achterbanken van personenauto's in Nederland en de mogelijke besparing in aantallen doden bij een wettelijke verplichting tot dragen. Consult aan de Directie Verkeersveiligheid ten behoeve van de Permanente Contactgroep Verkeersveiligheid (PCGV), Subgroep Statistiek. SWOV (A.Blokpoel, J.van Minnen & ir.L.T.B.van Kampen. R-79-35. SWOV, Voorburg, 1979. 42 blz.*
+ De verkeersonveiligheid in de provincie Noord-Brabant V; Onderzoek met betrekking tot enkelvoudige ongevallen in Noord-Brabant. SWOV (Projectteam Noord-Brabant). R-79-36. SWOV, Voorburg, 1979. 118 blz.*

Publications, brochures, periodicals 1979

+ Profieldiepten van personenautobanden in Nederland; Bevindingen bij een aantal metingen in november 1976. SWOV (A.Blokpoel, S.Harris, M.A., H.P.Scholtens & ir. L.H.M.Schlösser). Publikatie 1979-1N. SWOV, Voorburg, 1979. 50 blz.*
+ Systeemonveiligheid; Een inventarisatie van de toestand. Bijdragen voor het Symposium 'Universitair Onderwijs en Onderzoek in Veiligheid', Aula TH Delft, 11 oktober 1978. Ir.E.Asmussen. Publikatie 1979-2N. SWOV, Voorburg, 1979. 39 blz., geill.*
+ Ontnuchteringsmiddelen; Een literatuurstudie naar de werkzaamheid en toepasbaarheid van diverse stoffen om de gevolgen van ethanolgebruik tegen te gaan. Drs. G.van den Brink & drs.J.J.de Gier, apothekers (R.U. Utrecht). Publikatie 1979-3N. SWOV, Voorburg, 1979 38 blz.*
+ De SWOV in 1978. SWOV (Afdeling Voorlichting). Brochure. SWOV, Voorburg, 1979. 36 blz.
+ SWOV in 1978. SWOV (Information Department). Brochure. SWOV, Voorburg, 1979. 32 pp., ill.
+ Publikaties, rapporten en artikelen 1962-1978 Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV. SWOV (Afdeling Voorlichting). Brochure. SWOV, Voorburg, 1979. 44 blz.
+ Ongevallen op nat wegdek; Wat kan de wegbeheerder eraan doen? SWOV (Afdeling Voorlichting). Brochure. SWOV, Voorburg, 1979. 20 blz.

+ SWOV-schrift 1 (september 1979). SWOV, Voorburg, 1979. 8 blz.
+ SWOV-schrift 2 (december 1979). SWOV, Voorburg, 1979. 8 blz.

Other articles 1979

- Systeemonveiligheid; inventarisatie van de toestand. Ir. E.Asmussen. In: Universitair Onderwijs en onderzoek in veiligheid. Eindverslag Symposium 11 en 12 oktober 1978, Aula TH Delft, blz. 23 t/m 38. Symposiumbureau Academische Opleiding Veiligheid, Delft (1979).*
- Eisen te stellen aan de verkeersverlichting. Dr.ir.D.A. Schreuder (R-78-20). In: NSVV congresdag Verlichting en energiegebruik, gehouden op 18 april 1978 in het Hilton Hotel te Rotterdam, blz. 16 t/m 22. N.V. Noord-Nederlandse Drukkerij, Meppel (1979).*
- Systeemonveiligheid: inventarisatie van de toestand. Ir.E.Asmussen. In: Stichting Weg Bulletin 13 (1979) 3: (79) 10.1 t/m (79) 10.12.*
- Water nuisance and road safety. A.G.Welleman (R-78-5). In: OECD 1978 Symposium on Road Drainage, Bern, 22-24 May 1978, pp. 82-95. OECD, Paris, 1978.

- The use of multiplicative models for analysis of road safety data. S Oppe (R-78-18). In: Accid. Anal. & Prev. 11 (1979) 2 (June): 101-115.
- Lighting and public health. D A Schreuder. In: Hobson, W. (ed.). The theory and practice of public health, Fifth edition, pp. 98-129. Oxford University Press, Oxford, 1979.
- The introduction of a statutory BAC limit of 50 mg/100 ml and its effect on drinking and driving habits and traffic accidents. P C.Noordzij (R-77-28). In: Johnston, I R. (ed). Proceedings Seventh International Conference on Alcohol, drugs and traffic safety, Melbourne, 23-28 January 1977, pp. 454-470. Australian Government Publishing Service, Canberra, 1979.
- Beheersing van 'systeemonveiligheid. Ir.E.Asmussen (R-78-14 en R-78-27). In: Bedrijfsveiligheid; Handboek voor principiële en praktische veiligheidskunde, par. 2.3.1., blz. 1 t/m 26. Kluwer, Deventer, 1979.*
- De ontwikkeling van de verkeersonveiligheid (+ afbeeldingen en tabellen). Ir E Asmussen. In: SPVV-Cursus Verkeersveiligheid 1979/1980, Syllabus 1b, 31 blz. SPVV, Delft, 1979.*
- Samenhang tussen beleid en onderzoek, Het ongeval als kansverschijnsel, Het bepalen van aandachtsgebieden, Onderzoek van aandachtsgebieden gericht op maatregelen. Dr.P H Polak, In: SPVV-Cursus Verkeersveiligheid 1979/1980, Syllabus 2c, 4a, 4c, 4d, resp. 30, 7, 22 en 10 blz. SPVV, Delft, 1979.*
- Alcomobilisme, Effect van een nieuwe wetgeving op alcoholgebruik bij verkeersdeelname. Dr.D.W.Steenhuis, Dr D van Ooyen, Drs P.C Noordzij. Gouda Quint BV, Arnhem, 1979, 91 blz.*
- Traffic safety in residential areas; A report prepared by an OECD Road Research Group (TS 2) (F C M Wegman, chairman, J H Kraay, a.o.). OECD, Paris, 1979.

* Out of print or replaced by revised version, only to be borrowed from SWOV Library.
\+ Available at request from the Information Department SWOV.

If not on our mailing list please let uw know.

Institute for Road Safety Research SWOV
P O Box 71, 2270 AB Voorburg The Netherlands

This brochure has been compiled by the Information Department SWOV.

Photographs by Fotopersburo Jos van Leeuwen, 's Gravenhage (cover front); Studio Verkoren, 's Gravenhage (pp 3, 7, 9, 17, 23, cover back); Anefo B.V., Amsterdam (p. 11); Aerocamera – Bart Hofmeester, Rotterdam (p. 19).