



SWOV-director Fred Wegman:

Research programme 2007-2010 completed successfully

You are reading a special issue of Research Activities in which we look back on some of the results that were achieved in SWOV's research programme 2007-2010 which has recently been terminated.

The overview, as a matter of course I hazard to say, is far from complete. That would be impossible. We do hope, however, to give you an idea of the diversity in research activities that SWOV has carried out during the past period. We have tried to order this overview on topic on the one hand – man, road, vehicle, legislation – and the type of activities on the other – SWOV for the region, as a road safety assessment office, as an advisor, as a scientific institute, and in international activities.

We expect that this will help you to easily find those subjects that you are interested in. For more extensive overviews and for the sources we have used I wish to refer you to our website (www.swov.nl), our library (library@swov.nl) or our information department (info@swov.nl).

New approach

I will also use the opportunity to inform you that Research Activities will no longer be

published three times per year, but will come out twice: once in spring and once in autumn. Most of these issues will focus on one specific theme. As I have indicated, the theme of the present issue is a retrospective of the activities in the SWOV research programme 2007-2010. However, you need not go without the short articles about topical issues and recently accomplished research that you were accustomed to find in Research Activities. These articles can be found on our website and will be part of our monthly electronic newsletter. If you have not yet subscribed to this free newsletter, you can do so via info@swov.nl. ■

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QUOTE

'When engaged with road traffic - treat other people the way you would want to be treated.'

Balázs Tokár
Global Road Safety Partnership, Hungary

SWOV and international activities

For practically all its existence SWOV has been active internationally. This was also the case during the past four years. International activities are two-way traffic. On the one hand, SWOV brings forward its own knowledge and its own vision, thus trying to aid other countries and colleague-professionals in taking a step forward in their efforts to improve road safety in their own country. Many see Dutch road safety policy and research as a stimulating and motivating example. On the other hand, we learn from research, ideas, and approaches in other countries and, wherever possible, make use of it to enrich research and advice for Dutch policy making. Furthermore, international cooperation enables research that would be out of reach at a national level, where content, technical facilities or finances are concerned. This chapter will present some examples of European research SWOV has been involved in during the last research programme.

PROLOGUE: Naturalistic Driving in Europe

The PROLOGUE project studies the usefulness and the feasibility of a large-scale European Naturalistic Driving study. In a Naturalistic Driving study drivers and the traffic situations they find themselves in are observed with small cameras and several sensors that are installed inside their own vehicle. The monitoring is done during the everyday trips and without a test instructor being present. The instruments remain in the car for a minimum of several weeks, and sometimes for several months to

a year. This way, participants forget that they are being observed which gives a good idea of their 'natural' traffic behaviour. This is not only useful information for road safety purposes, but also if we want to know more about the environmental effects of traffic or about, for example, dynamic traffic management. SWOV is in charge of this project in which nine partners are involved.

For several years, the United States have gained experience with the Naturalistic Driving method and the results there are promising.

Therefore, the USA has started a large-scale study involving 3,000 drivers. Canada will probably join in with this study. The international component makes it possible to look for cross-cultural differences and similarities in traffic behaviour and also allows making use of joint technical facilities like, for instance, data storage, management and analysis. SWOV is also involved in two other European studies that make use of Naturalistic Driving techniques: INTERACTION which studies distraction caused by operating equipment while driving, and the DaCoTA project which will be presented later.

Naturalistic Driving techniques are rarely used for purposes other than studying car driver behaviour. In the PROLOGUE project, however, the other Dutch partner Netherlands Organization for Applied Scientific Research TNO and SWOV have found that Naturalistic Driving techniques in combination with permanent cameras at specific locations have a clear added value for studying cyclists in interaction with motorized vehicles, especially concerning recording drivers' viewing behavi-





our. PROLOGUE will be rounded off in mid 2011 and will hopefully lead to the start of a larger study.

SafetyNet and DaCoTA: knowledge combined

In the SafetyNet project, which was carried out from 2004 to 2008 and was led by Loughborough University (UK), SWOV, together with 21 other institutes and organizations worked on the development of the European Road Safety Observatory ERSO. In this observatory all road safety knowledge is brought together and made available to everyone. The project first focused on the structure and design of this European knowledge database, and, using available knowledge, the first data was entered. SWOV made an important contribution and has, among others, supplied an overview of the available knowledge about alcohol and drugs, speed, speed enforcement, fatigue, novice drivers, elderly road users, cyclists and pedestrians, and motorized two-wheelers.

SafetyNet was also occupied with devising internationally comparable road safety measures. Examples are a joint definition of ‘Safety Performance Indicators’ and detailing internationally similar data collection and analysis methods. Making this information available in the observatory provides better insight in a country’s safety situation. For example, it allows identification of the factors that contributed to a country’s fast or not so fast road safety development and prevents re-inventing the wheel.

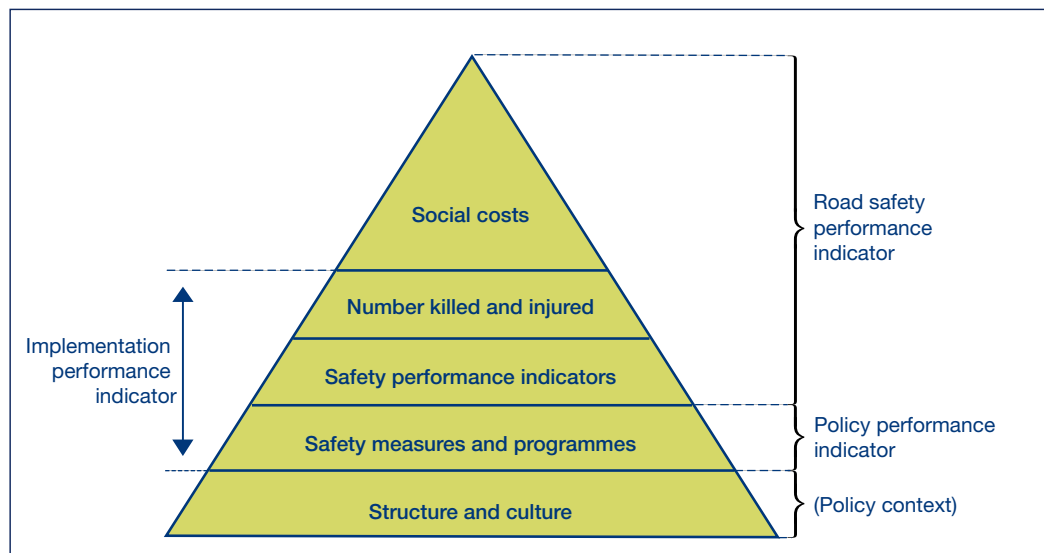
SafetyNet has come to an end late 2008. Early in 2010 a start was made with its follow-up DaCoTA. Once more with Loughborough University in charge and together with many other institutes SWOV has been working on supplementing ERSO and the development of new methods and techniques to make similar international data possible. Within this project SWOV is in charge of the subproject that wants to find out how Naturalistic Driving techniques can be used to gather representative Europe-wide data about, for instance, speed behaviour, use of alcohol, seat belts and mobile phones, and the conditions in which this is done. This type of data is an important indication of a country’s road safety and its developments. Exposure could possibly also be measured this way.

SUNflower: towards a composite road safety index

The usefulness of comparable data was illustrated by the SUNflower-project and the follow-up projects SUNflower+6 and SUNflowerNext. These European projects were initiated and led by SWOV. The last of this series of projects was concluded in 2008. Initially SUNflower investigated the road safety developments in Sweden, the United Kingdom and the Netherlands – the ‘SUN’ countries; afterwards the comparison was extended to include six countries in South and Eastern Europe. Among other things, the SUNflower projects have given the road safety pyramid a central place in our thoughts and made us aware of the importance of the organizational structure in a country and its culture like, for instance policy strategies, available budgets, institutional frameworks as well as the quality of the safety programmes and measures. The SUNflowerNext project therefore reached the conclusion that, if we wish to define one composite road safety indicator for a country or region, we should not just look at the safety indicators, the top three layers of the pyramid, but also consider the organizational frameworks in the bottom two layers. Such composite indicators are currently being developed in the earlier mentioned DaCoTA project.

SUPREME: overview of effective measures

SWOV’s international activities are not just focused on research and acquiring more knowledge. They are also aimed at taking stock of what knowledge is available and to translate that knowledge into concrete applications. An example of this is the European Road Safety Observatory ERSO, which was described above. Examples of other projects where this is or was the case are PEPPER, which made an overview



SWOV and many more international activities

During the past research period, SWOV was once more involved in a large number of international working groups and advice groups. Furthermore, SWOV was frequently asked for input and advice about road safety policy and road safety research, for example by Ireland, Australia and the United States.

SWOV was also a member of different European cooperatives:

- Forum of European Road Safety research Institutes - FERSI
- European Conference of Transport Research Institutes - ECTRI
- HUMAN centered design for Information Society Technologies, Virtual Centre of Excellence - HUMANIST
- International Traffic Safety Data and Analysis Group - IRTAD

SWOV regularly contributed to the work of international organizations like the International Transport Forum of the OECD, the World Bank and the World Health Organization.



of the available knowledge about efficient police enforcement, and ERASER which set out to provide road authorities with concrete handles for the 'self-explaining' design of their roads.

SUPREME is another project that clearly focused on concrete practical applications. It gathered, analysed and described the best road safety measures from the EU Member States. The project set out to provide an accessible overview of information about these successful measures and the possibilities for their implementation in other European countries or on a European scale. Several measures which have their basis in the Netherlands were also included in the overview; some examples are the Sustainable Safety vision, the hierarchic monofunctional road categorization and the seat belt campaign 'Goochem, the armadillo'. All EU countries and Switzerland and Norway were represented in the project that was led by

the Austrian Kuratorium für Verkehrssicherheit KfV. SWOV described the best examples from different countries in the field of crash analysis and in-depth research in a so-called thematic report. Furthermore, SWOV was responsible for composing a handbook for measures at a national level and a handbook for measures at a European level. The national handbook is available in twenty languages.

The OECD International Transport Forum

The International Transport Forum (ITF) of the Organisation for Economic Co-operation and Development (OECD) is an intergovernmental organisation with 52 Member States that wants to provide guidance to international traffic and transport policy. The information as regards to content is provided by, among others, OECD working groups consisting of experts from different countries. During the

past research period SWOV was represented in three working groups. In 2008, one of these working groups published the report entitled *Towards zero: ambitious road safety targets and the safe system approach*. This report discusses, among other things, the road safety targets that different countries have set and how countries can considerably improve road safety by using the so-called 'safe system' approach. The 'safe system' approach was also the subject at a High Level seminar that was organized by OECD/ITF in 2008 and where SWOV had important input. At present, SWOV is active in a working group on the safety of motorized two-wheelers and a working group on the international transferability of road safety measures. The International Traffic Safety Data and Analysis Group (IRTAD), which is presently chaired by SWOV Managing Director Fred Wegman, is a permanent OECD/ITF working group. This working group is the international platform for road safety analysis and has 60 members from 33 countries, among which countries from Asia, South America and Africa. The group periodically publishes research reports; in 2009 and 2010 the IRTAD Annual Report was published about the general road safety trends and trends in individual Member States. Another report was published about linking casualty data from police files with hospital data. ■

SWOV and its European projects

In the period 2007-2010, SWOV participated in a considerable number of European projects that were (partly) financed by the EU:

- SUNflower, methods and measures for international comparison, 2001-2008
- SafetyNet, European Road Safety Observatory, 2004-2008
- SUPREME, European overview of effective road safety measures, 2006-2007
- PEPPER, overview of knowledge about effective police enforcement, 2006-2008
- CAST, design and assessment of public information campaigns, 2006-2009
- DRUID, prevalence and risks of alcohol and drugs in traffic, 2006-2011
- INTERACTION, use of equipment inside the vehicle, 2008-2012
- PROLOGUE, use and feasibility of 'Naturalistic Driving', 2009-2011

- SARTRE 4, opinions of road users, 2010-2012
- BESTpoint, effective demerit points systems, 2010-2012
- DaCoTA, knowledge for road safety policy, 2010-2012

Financed by ERA-Net Road SWOV is in charge of the international projects:

- ERASER, on 'Self-explaining roads', 2010-2011
- RISMET, on crash models for the safety of roads, 2009-2011

More information about these projects can be found on the SWOV-website www.swov.nl under Research/International. There you can also find links to the original websites and several publications.

SWOV and the roads

Taking part in traffic is a complex task with an ever present risk of a crash with (very) serious consequences. Traffic risks are closely related with the layout and function of roads and how they are used. What type of layout evokes which behaviour and results in which safety level? How can the road layout protect vulnerable road users? And how can we make sure that the implemented road layout is of the best possible quality? With answers to these questions SWOV wants to assist road designers, road authorities and planners in making considered choices in the construction or adaptations of roads and road networks. The Sustainable Safety principles functionality, recognizability, homogeneity, predictability and also forgivingness of roads and roadsides, have an important role in the research. In the research programme 2007-2010, SWOV studied, among others, cyclist safety in Zones 30, quality assurance in road management, route choice, and roundabouts.

Infrastructure and cyclist safety

In the period 1995-2007, the number of seriously injured pedestrians and cyclists in crashes with motorized vehicles on access roads with a 30 km/h speed limit increased by more than a factor of 20. The increase was greater for cyclists than for pedestrians. The increase is related with the strongly increasing number of Zones 30. SWOV analysed these types of crashes and established that measures like a credible speed limit on 30 km/h roads and safe crossing facilities can save a considerable number of cyclist and pedestrian casualties.

Blind spot crashes

Every year blind spot crashes take lives; the casualties are mostly vulnerable road users. SWOV research resulted in a number of recommendations that can reduce the number of blind spot crashes considerably. One of the most important of these recommendations is to use infrastructural and traffic measures (e.g. moving the halt line or the give-way road-marking) to physically separate cyclists and lorries at locations where lorries can turn right. Other possibilities are a behavioural code for cyclists which tells them where they should or should not be in relation to the lorry and providing the lorry driver with an extra check by installing a front view mirror or camera.

Route choice: safe from A to B

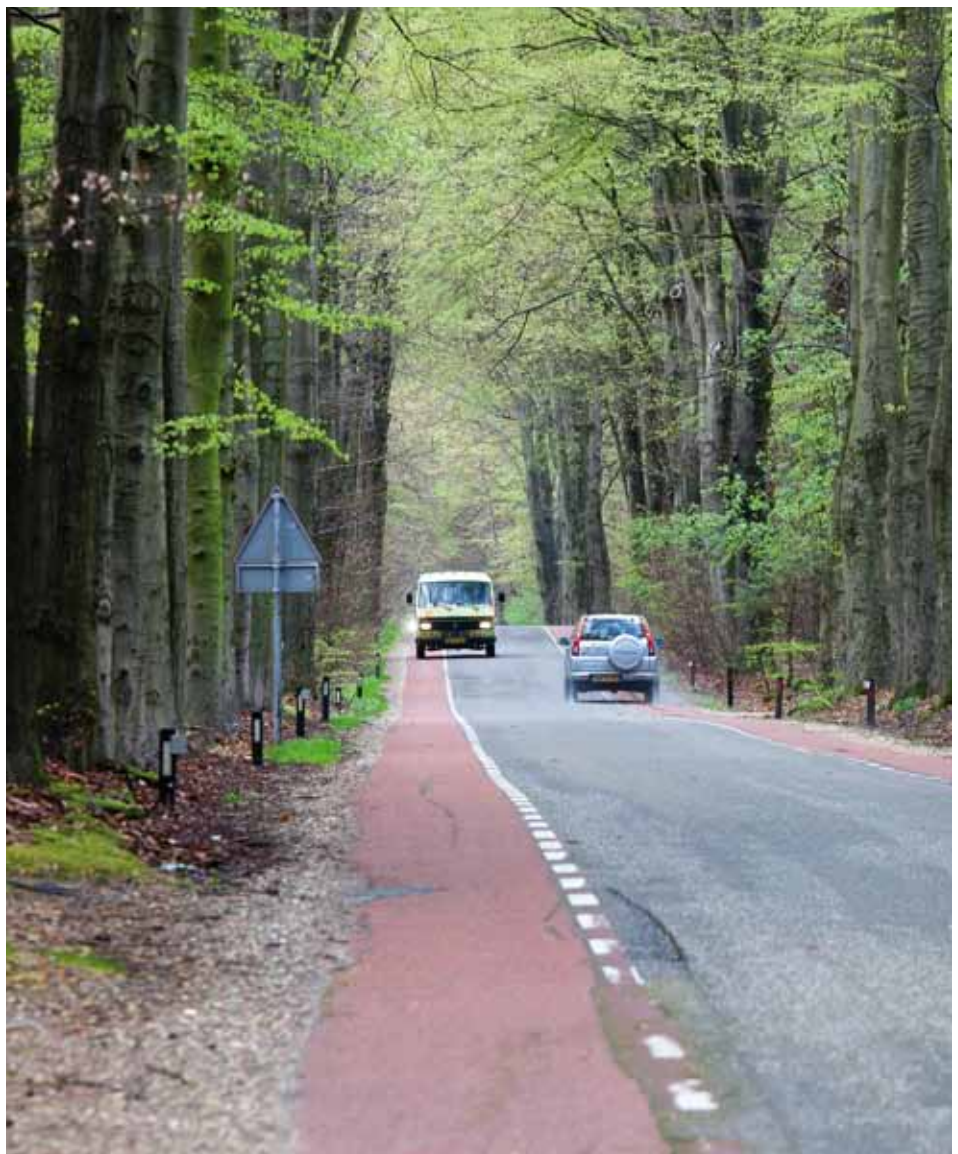
The road network has been devised to travel from A to B and, from the viewpoint of accessibility, it must be possible to do this fast. At the same time, the journey must also be safe. This means not only that the roads should have a safe design, but also that road users travel the longest possible part of their journey along the safest road categories.

A SWOV survey has confirmed that drivers choose their route mainly on time and distance: the fastest route and the shortest route are

mentioned most frequently as the main reason for choosing a certain route. Familiarity with the route comes in third place. A route's safety, however, does not appear to be very important in route choice. This means that the fastest route must also be the safest route if we want drivers to choose a safe route. In the research

programme 2007-2010, SWOV has investigated how this can be realized and what the road safety effects will be. Microsimulation models were used to investigate how adaptations to the road network will affect how the road network is used, with special focus on route choice and, consequently, on safety.

It is not easy to establish whether a changed use of the road network has the desired road safety effect; often the number of crashes is too small. Two additional criteria were therefore developed to enable conclusions about the road safety effects. The first of these criteria is what is called the 'route score', a Sustainable Safety score of a route from A to B along different road sections and intersections. The second criterion refers to the so-called conflict indicators which were added to the microsimulation model that was used. These conflict indicators use 'time-to-collision', the time passing until a collision were to take place if neither of the





vehicles were to brake or change course, to describe the severity of conflicts between vehicles at and near intersections. This indicator proved to be a good predictor of the number of registered crashes at intersections. A relation was also found between the route score and the conflict indicator. The study also showed that in the area that was studied the fastest route and the most frequently chosen route are by no means always the safest route. The study also found that the safety criteria for route choice could be included in the software for navigation systems.

The study into route choice and road safety has resulted in a PhD thesis which SWOV researcher Atze Dijkstra has successfully defended at the University of Twente in May 2011.

Need for quality assurance in road management

There are many guidelines and handbooks for road design and road management, some of which deal with the safety of the infrastructure. However, this is no guarantee for a safest possible road. For example, it is not always possible to follow the guidelines accurately. Sometimes they are deviated from intentionally

or unintentionally. A quality assurance system is required to ensure that road safety is given a more explicit position in road design. Quality assurance covers all activities that contribute to the quality of a product or concept. In its latest research programme, SWOV studied the possibilities for initiating a quality assurance system in the Netherlands, in conjunction with the recently implemented EC Directive 2008/96/EC on road infrastructure safety management.

While this European Directive is limited to the quality of the main road network in the EU, the SWOV study focused on the Dutch regional road network and regional road authorities. The main purpose was to determine how regional road authorities presently include road safety in their work processes and whether, for example, they use quality assurance instruments to improve the safety level of their roads. A second purpose was to establish the ideas of road authorities about a Dutch quality assurance system.

For a well-documented and transparent quality assurance system, it is wise to explicitly distinguish between the various phases of road design and (re)construction: orientation, possible solution, pre-design, design, specifications and

conditions, realisation, use and maintenance. For each of these phases the Plan-Do-Check-Act or PDCA cycle must be activated. The C for Check is of major importance for quality assurance. This means that it must regularly be checked whether a chosen solution meets the safety requirements. Different quality instruments can be used here.

SWOV formulated a number of concrete recommendations to ensure that solid quality assurance is incorporated in the work processes. A road authority, for example, should appoint a number of people who possess the required road safety knowledge. All choices that are made in an infrastructural project and which could have a road safety effect should be properly documented, as is the case for the guidelines that have been used. Road safety should be used as an assessment criterion more explicitly in prioritizing projects. Finally, it is important that a quality assessment system agrees with existing work processes. In practice this will mean that such a system is partly made-to-measure with a central position for the overall goal, i.e. offering support in making, weighing and arguing choices that are relevant for road safety. A quality assurance system

will then lead to a more systematic approach and will therefore result in an (even) better awareness of aspects that are relevant for safety.

Two thousand new roundabouts

In the last few decades the number of roundabouts in the Netherlands increased enormously. Especially during the Start-up programme Sustainable Safety, which was carried out from 1997 to 2002, many roundabouts were constructed, often as a replacement for an intersection. Some data can illustrate this: in 1998 there were 1440 roundabouts in the Netherlands and in 2005 their number had increased to 3450, more than twice as many.

Many international before-and-after studies have been carried out into the safety effects of reconstructing intersections into roundabouts. And although the precise effects that were found differ, the decrease of the numbers of casualties is generally substantial. Overall, these studies, including those in the Netherlands focus on roundabouts that were constructed to replace particularly dangerous intersections. These studies are likely to result in an overestimation of the road safety effects.

SWOV therefore decided to perform a study on all roundabouts in the Netherlands to get a more reliable estimate of the road safety effect of the reconstruction of intersections into roundabouts in the Netherlands. The study looked at the roundabouts that were constructed in the Netherlands during the period 1999-2005 and their effect on fatalities and serious road injuries. To assess the safety effect, crash



data before the reconstruction and the crash data of the new situation were analysed.

The results of the SWOV study were to a large extent similar to the results of other studies, but it was the first study that by investigating a

larger number of roundabouts could establish a statistically significant effect for fatalities. For 2006, for example, the decline for fatalities was 76%. This is a decrease of 12 road fatalities in the Netherlands in comparison with the situation before the reconstructions. ■

Selected publications

A procedure to test the safety level of road design elements. A. Dijkstra & R. Louwse (2010) In: Proceedings of the 4th International Symposium on Highway Geometric Design, 1-5 June 2010, Valencia, Spain, Harwood, D.W.; García García, A., 2-5 June 2010, Valencia. 14 pages. Universidad Politecnica de Valencia, Valencia.

Assuring road safety quality in the road design process, the Dutch perspective and citing two case studies. G. Schermers, Z. Kenjic, H. Moning, & R. van der Drift (2010) In: Proceedings of the 4th International Symposium on Highway Geometric Design, 1-5 June 2010, Valencia, Spain, Harwood, D.W.; García García, A., 2-5 June 2010, Valencia. 12 pages Universidad Politecnica de Valencia, Valencia.

Effects of roundabouts on road casualties in the Netherlands. T. Churchill, H. Stipdonk & F. Bijleveld (2010). R-2010-10. SWOV, Leidschendam.

Safety effects of route choice in a road network: Simulation of changing route choice. A. Dijkstra & H. Drolenga (2008). R-2008-10. SWOV, Leidschendam. [Dutch with an English summary]

A quality assurance system for road safety in road design and road management; Materials for a manual. J. Mesken, W. Louwse, M. van de Veen & N. Beenker (2010). R-2011-2. SWOV, Leidschendam. [Dutch with an English summary]

Fact sheets

- Bicycle facilities on road segments and intersections of distributor roads
- Crossing facilities for cyclists and pedestrians
- The high risk location approach
- Types of junctions
- Mobility on Dutch roads
- Network Management and Sustainable Safety
- Recognizable road design
- Risk in traffic
- Functionality and homogeneity
- Measuring (un)safety of roads
- Shoulders on rural access roads
- Zones 30: urban residential areas
- Safe road shoulders
- Functionality and homogeneity
- The road safety of motorway tunnels

SWOV and regional activities

Road safety policy in the Netherlands is to a large extent the responsibility of regional authorities. Provinces and municipal regions make every effort to contribute to a further reduction of the number of road casualties. SWOV aims to support them in this and therefore seeks cooperation with regional partners.

Ready-for-use instruments

Drawing up and underpinning traffic and transport plans in regional road traffic policy and giving road safety an important place is a complicated task. In the past research period SWOV carried out a number of projects to support the regional partners in this task. A few examples are introduced below.

Inventory and analysis

SWOV made an inventory and analysed the methods and instruments that are available to policy makers and road authorities for drafting a road safety (action) plan. The study not only resulted in a description of the methods, it also indicates which methods can be used in a certain policy making phase, for which purpose and by whom they can be used, and what is required for their use. Special attention has been given to the scientific quality of the methods.

Safe speeds and credible limits

Together with several provinces, the Dutch Ministry of Transport and a consultancy firm, SWOV developed a method that offers support to road authorities in attaining safe speeds and credible speed limits. The method is not only

helpful in analysing problems related to safe and credible speeds, it also provides guidance for concrete decisions about the measures that can be taken. These are measures related to adapting the limit, adapting the road layout and elements in the road environment, or to extra police enforcement. The method has been trialled on the secondary road networks of two Dutch provinces and a municipal region. This has resulted in several starting points for future speed policy. The data that has been collected to develop the method is presently being used for further study of the concept 'credibility', more in particular of characteristics that influence credibility.

VVR-GIS 3.0

To assist road authorities and policy makers in drawing up and substantiating traffic and transport plans, SWOV developed VVR-GIS 3.0: the Regional Road Safety Explorer in a GIS environment. VVR-GIS 3.0 is an instrument to make calculations for regional packages of road safety measures and compare them. Using the outcome, the regional authority can determine whether a plan is feasible and whether it meets the regional road safety targets. As VVR-GIS 3.0 also carries

Selected publications

Safety assessment of routes in a regional network. A. Dijkstra & P. Marchesini (2010)

In: Proceedings of the European Transport Conference 2010, 11-13 October 2010, Glasgow, page 13

Supporting drivers in forming correct expectations about transitions between rural road categories. A. Stelling-Konczak, L.

Aarts, C. Duivenvoorden & Ch. Goldenbeld (2011).

In: Accident Analysis and Prevention, Vol. 43, Nr. 1, pages 101-111.

Methods and instruments that can be used as a basis for road safety policy. L. Aarts

(ed.) (2010). R-2011-03. SWOV, Leidschendam. [Dutch with an English summary]

Fact sheets

- VVR-GIS 3.0: support for investment decisions

out a cost-benefit analysis, the user can determine which plan is most cost-effective. The data that is required for using VVR-GIS 3.0 is sometimes not available in sufficient detail. SWOV therefore developed a calculation method which requires less detailed data: the Regional Road Safety Explorer 2009 (VVR-2009). ■



SWOV and the law

For a safe traffic environment it is necessary that road users keep to the traffic rules. Legislation in itself cannot prevent the rules from being broken, be it accidentally or on purpose; public information and enforcement are required to this end. In the research programme 2007-2010, SWOV has specifically focused on the use of alcohol and drugs in traffic, on driving without a valid licence, and on traffic enforcement in general.

Enforcement essential for safety

In recent years, much has been achieved by intensified enforcement on a number of spearheads: helmet wearing, seat belt wearing, red light running, use of alcohol, and speeding. Now the time has come to see how improvement of the enforcement quality and efficiency can lead to further road safety gains. In the past research programme SWOV has therefore mapped out research questions about traffic enforcement, investigated which knowledge is already available, and identified the knowledge gaps that can benefit from further research.

By studying relevant policy documents in the area of traffic enforcement and by interviewing active road safety professionals, many questions about police enforcement were identified. The questions that could not sufficiently be answered with the available knowledge or could not be answered at all were identified as 'knowledge gaps'. The most important issues are:

- offences and characteristics of offenders in relation with the occurrence of crashes;
- possibilities offered by new techniques, like automatic number plate recognition;
- quality of specific enforcement methods and combinations of methods;
- methods to reduce unwanted behaviour of specific target groups like heavy drinkers or frequent speeders, without these methods having undesired effects on the overall risk of being caught;
- a better picture than there is now of the involvement of alcohol in crashes;
- the best way to develop information-controlled enforcement, e.g. in speed enforcement.

Alcohol in traffic

In the area of drink driving, SWOV made an inventory of the preventive use of alcolocks in Europe, North America and Australia and advised on the introduction of the alcolock in the Netherlands. Furthermore, SWOV

has done much research within the European DRUID (DRiving Under the Influence of alcohol, Drugs and medicines) project. DRUID is a large consortium that, among other things, investigates the (relative) risks of driving under the influence and methods that can be used to test on drug use.

Within the DRUID project SWOV carried out a large-scale case-control study in the Netherlands. The study investigated the prevalence of alcohol, drugs and medicines in traffic and the extent to which serious road injuries have used such substances. SWOV was also in charge of a study which tested drug testers on their accuracy and correctness when used in practice and their usefulness for the police. The results of the project are expected late 2011.

Driving without a valid licence

In the Netherlands, there is increasing interest in drivers without a valid licence. To facilitate good policy making in this field, SWOV investigated the size of this group and the extent to which this group is responsible for road crashes.

The study focussed on driving while the licence has been revoked, because on this issue reliable data is available. In the Netherlands, there are approximately 16,000 disqualifications from driving per year. Because part of these disqualifications stretches over the turn of the year, about 25,000 drivers are disqualified each year for a longer or shorter period of time. Taking the duration of the disqualifications into account, this means that at any given moment approximately 9,000 drivers are disqualified in the Netherlands. These are mainly holders of the B licence, the driving licence for passenger cars, vans and minibuses. The SWOV study indicates that a share of the disqualified drivers occasionally do still drive a vehicle. Annually, around 5% of the disqualified drivers are in fact apprehended while driving. In a recent survey 12% admitted to having driven a motorized vehicle while being disqualified.

Does driving without a valid licence also affect road safety? SWOV found that drivers without a valid licence may have a 2.5 times higher risk than drivers who possess a valid licence. Only very few crashes, however, would be prevented if disqualified drivers were to participate in traffic no longer. In the end, they are only a very small group. The number of crashes that could be saved, therefore amounts to a maximum of only one thousandth of the total number. ■

Selected publications

The effects of drink-driving checkpoints on crashes: A meta-analysis. Erke, A., Goldenbeld, Ch. & Vaa, T. (2009). In: Accident Analysis and Prevention, vol. 41, nr. 5, pages 914-923.

Analytical evaluation of the RapidSTAT®, DRUG Test 5000 and ORATECT III devices for the detection of drugs of abuse and benzodiazepines in oral fluid. Houwing, S. & Mathijssen, R. (2009). In: Protocol of 'Workshop on drug driving detection by means of oral fluid screening', 23 August 2009, Geneva. Deliverable D 3.2.1 of the DRUID project. European Commission, Brussels.

Effects of persuasive communication and group discussions on acceptability of anti-speeding policies for male and female drivers. Ch. Goldenbeld, D. Twisk & S. Houwing (2008). In: Transportation Research Part F: Traffic Psychology and Behaviour, vol. 11, nr. 3, p. 207-220.

Driving without a valid licence in the Netherlands. M. Vis, Ch. Goldenbeld & B. van Bruggen (2010). R-2010-13. SWOV, Leidschendam. [Dutch with an English summary]

Fact sheets

- Alcolock
- Driving under the influence of alcohol
- Driving under the influence of drugs and medicines
- Speed cameras: how they work and what effect they have
- Effects of police enforcement of protection devices and moped helmet use and red light running
- Police enforcement and driving speed
- Demerit points systems
- Penalties in traffic
- Rehabilitation courses for road users

SWOV and road safety assessment

SWOV started the Road Safety Assessment Department in 2003. The SWOV Road Safety Assessment Department carries out road safety explorations, performs outlooks and makes road safety analyses. The Road Safety Assessment Department makes use of the available data and checks this for validity and usefulness. Data files from different sources are also linked for research purposes. Furthermore, the Road Safety Assessment Department develops models that can be used to analyse road safety developments in the past and perform outlooks. Below is a selection of the different types of research carried out by the Road Safety Assessment Department in the past four years.

Serious road injuries

Until 2009, in the Netherlands a serious road injury was generally considered to be the same as an inpatient: a road crash casualty who has been admitted to hospital for a minimum of one night. However, it became clear that not all inpatients were indeed seriously injured. The Dutch Minister of Transport then decided to follow a SWOV proposal to take the real injury severity of inpatients into account from that moment on, and to only consider a road casualty as a serious road injury when he or she has been admitted to hospital with a minimum injury severity of 2 on the international Maximum Abbreviated Injury Scale (MAIS). Using this new definition of a 'serious road injury' SWOV re-analysed the developments in relation with the seriously injured road injuries during the past period. The analysis indicated that since 1993 the number of serious road injuries has shown a downward trend, but that from 2006 onward an increase is visible. The increase during the last years of the investigated

period can be observed for most crash types, for most regions of the Netherlands and for all injury severities. It is striking that the number of serious road injuries in non-motorized vehicle crashes shows an upward trend for the entire period 1993-2008.

Maximum of 500 road fatalities

When the Dutch *Strategic Road Safety Plan 2008-2020* was being drafted by the Ministry of Transport, the question arose whether the number of approximately 800 road fatalities in Dutch road traffic could not be brought down faster than originally targeted, and if so, how. Prompted by the Minister's statement that a target of 500 road fatalities in 2020 sounded quite good, SWOV investigated the feasibility and calculated that the number of fatalities in 2020 would be an average of around 500 fatalities in any case, even with 'unchanged policy'. SWOV then investigated how applying supplementary Sustainable Safety measures and excluding dangerous behaviour and relatively

hazardous mobility could achieve a further reduction in road fatalities.

SWOV's calculations showed that with an extra set of measures and the foreseen developments in vehicle technology a maximum of 440 road fatalities in 2020 is attainable. A maximum number of 350 road fatalities in 2020 could even be achieved with a more ambitious road safety policy focusing on the speedier construction of a sustainably safe infrastructure, limiting dangerous behaviour like alcohol and speeding, and on reducing the relatively dangerous mobility of young novice drivers. Presently, SWOV is making a new forecast for 2020 which will be used by the Ministry of Transport to revise its *Strategic Road Safety Plan*.

Mapping developments

On a regular basis, SWOV analyses recent road safety developments. Such a road safety balance draws a picture of the road safety developments and gives insight in the influencing factors. The effects of (road safety) policy that has been carried out are given special attention. For (parts of) the road traffic process, quantitative relations between the development in time of exposure and risk on the one hand, and road safety development on the other, are investigated.

In *De top bedwongen (The summit conquered)* SWOV drew up the balance for road safety in the Netherlands during the period 1950-2005. The study not only gave an overview of the development of the numbers of road casualties, it also investigated the development of the factors that have an influence on crashes. The study indicated that the developments regarding the numbers of fatalities show a peak around 1970 for most transport modes and for all age categories. It also transpired that after a period characterized by a downward trend, the number of road fatalities showed a sharp decline in 2004. This extra decrease did not occur for all age groups of casualties. In the years after 2004 the total number of road fatalities has decreased somewhat further. The extra decrease in 2004 is now likely to be of a permanent nature.

Ten years after the beginning of the Start-up Programme Sustainable Safety, the report *Ten years of Sustainable Safety* which was drawn up in 2009, described the state of affairs concerning the implementation of Sustainable Safety measures and their safety effects. The study





shows that during the period 1998-2007 the number of fatalities as well as the fatality rate decreased by an average of 5% per year. These decreases were larger than in the preceding period. It must be observed, however, that the decrease in the number of serious road injuries remains behind considerably, and that the causes are yet to be found. The balance also indicated that measures that were taken during the period 1998-2007 as part of Sustainable Safety and the measures that were in agreement with the vision, have in all probability contributed to the decrease of the number of road fatalities and injuries. The measures that were implemented have in 2007 resulted in a decline of 300 to 400 road fatalities in the

Netherlands, a decrease of more than 30%. The measures appear to be cost-effective; the benefits are higher than the costs by a factor of almost four. The implementation of Sustainable Safety can therefore be called successful, not in the last place because the Ministry of Transport, the police, municipalities, provinces and all other road safety professionals took it to hand enthusiastically.

Great benefits

Improving road safety requires spending money on the prevention of crashes and road injuries. This expenditure gives an indication of the current efforts for safety improvement and how these efforts relate to the size of road safety as

a social problem. Furthermore, information about the road safety expenditure is necessary for making cost effectiveness and cost benefit analyses, and for comparison with the expenditure in other policy areas.

In the past research programme SWOV investigated how much is annually spent on road safety, which parties are responsible for the expenditure, and which preventive measures the money is spent on. The study indicated that in 2007 the road safety expenditure in the Netherlands amounted to 2.3 to 3.1 billion euros, or 0.4% to 0.5% of the gross domestic product. A large part of the expenditure specifically on road safety went to vehicle safety (1.2 billion euros). Another relatively large sum was spent on enforcement (approximately 600 million euros) and infrastructure (approximately 350 million euros). Expenditure for public information and education (not including the driver training) was lower (approximately 70 million euros), as was expenditure for research, advice, and policy (13 million euros). With approximately 1 billion euros, government is responsible for the major share of the expenditure for road safety.

Compared to the costs that are due to road crashes in the Netherlands (approximately 12 billion euros in 2007) the expenditure for the prevention of road crashes is relatively low. This indicates that the costs that are saved by taking effective (extra) road safety measures can be higher than the costs of the measures themselves. This is confirmed by cost-benefit analyses of road safety measures. ■

Selected publications

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Serious road injuries in the Netherlands in 1993-2008: road casualties admitted to hospital with a MAIS score of at least 2. M. Reurings (2010). R-2010-15. SWOV, Leidschendam. [Dutch with an English summary]

Fact sheets

- Utilization of information on costs and effects
- Road crash costs
- Cost-benefit analysis of road safety measures
- The valuation of human losses of road deaths
- Road crash casualties in the Netherlands
- Risk in traffic

SWOV as an advisor

Next to acquiring new knowledge, the second major task for SWOV is making sure that knowledge finds its way to those who can use it, i.e. to everyone who is professionally involved in traffic and road safety, especially in the Netherlands, but also in other countries. SWOV therefore offers advice, invited as well as uninvited, regarding those subjects about which it has knowledge available. In the 2007-2010 programme SWOV advised about, among others, the status of the Segway, the effects of an alcolock programme and about the road safety effects of different types of 'pay as you drive'. Other research and advice in this period was on topics like lowering the age for the A1 motorcycle licence, the licence on probation, including hazard perception the driving test and accompanied driving.

Lower age motorcycle licence unsafe

In 2013, a new European Directive will be in force that sets the minimum age for obtaining the A1 motorcycle licence (up to 125 cc) at 16. Member States, however, are free to set the minimum age at 17 or 18. At present, the minimum age for riding a motorcycle in the Netherlands is 18. SWOV has investigated what road safety consequences a lowering of the minimum age could have and presented the conclusions to the Dutch Ministry of Transport. The SWOV study found that if the minimum age were to be lowered to 16 or 17, it would have a negative road safety effect. The most important reason was that this would lead to more 18 and 19 year old motorcyclists in comparison with the present number, since part

of the people who possess a motorcycle at the age of 16 or 17, will continue to use it at 18 and 19 years old. A (small) reduction in casualties will be the result of this new group of 18 and 19 year-olds who will have a lower casualty rate because they have gained experience at a younger age.

Licence on probation

On 30 March 2002, the licence on probation was introduced in the Netherlands: a simple demerit points licence which applies during the first five years after having passed the driving test. The licence on probation applies for everyone who passes the driving test, but more than three quarters of those who pass their test for the B licence are younger than 25. In the research programme 2007-2010, SWOV

investigated whether the effect of the licence on probation can also be seen in the crash data. Data was used from the six-year period before the introduction of the licence on probation and data from the six-year period after its introduction. Furthermore, SWOV investigated whether the accompanying demerit point system has a deterrent effect on these novice drivers. The study indicated that the number of serious crashes per 1,000 licence holders among young drivers (many of whom have a licence on probation) has not decreased more than that of older drivers. Therefore, based on this crash data, there is no support to the conclusion that the probationary licence in the Netherlands in its present form has a positive effect on the road safety of novice drivers. Nor does the distribution of demerit points indicate that the licence on probation has had a deterrent effect.

Hazard perception in the driving exam

Hazard perception is an essential skill within the driving task which seems to be rather poor in young novice drivers. Hazard perception is more than just being aware of danger. It also involves assessing the extent of the danger and knowing what action to take to avert it. Hazard perception seems to develop gradually by experiencing dangerous situations and being frightened.





In the past research period, SWOV has carried out research to determine whether and how hazard perception can be measured. SWOV has developed two tests: an animated test and a photograph test. In the animated test the subjects were shown animated films in which the picture was frozen for a couple of seconds a number of times. In these intervals the subjects have to indicate by clicking the mouse which locations and directions they want to pay special attention to, because a hazardous situation may evolve. In the photograph test the subjects are presented with photographs that have been taken from the driver's viewpoint. Based on the danger that is or is not present they have to indicate whether they would brake, release the accelerator, or do nothing. Both tests indicated that drivers with a low test score indeed have a higher crash rate.

Hazard perception has now become a permanent part of the theory exam for the B licence; for practical reasons the photograph test is used.

Accompanied driving good for road safety

Late 2008, the Dutch Minister of Transport announced the introduction of accompanied driving as part of the driver training in the Netherlands, initially as a pilot. This pilot is now planned to start by the end of 2011. The system allows youngsters to get their B licence by passing the standard driving test at the age of 17 rather than the current 18. In the period until their 18th birthday, they can only drive while being accompanied by an experienced driver. The accompanying driver must meet certain requirements regarding the years of driving experience and driving behaviour. In the past research period, SWOV defined the setup of a sound evaluation study. It has been decided that SWOV will also carry out this study.

Already at earlier occasions, SWOV looked at the international experiences with accompanied driving, its effectiveness in reducing the number of crashes, and the expected effectiveness for the Netherlands. Based on these experiences, SWOV concluded that accompanied driving can be an effective measure to lower the novice drivers' crash rate, also in the Netherlands. The effects are very much determined by the number of hours that is driven accompanied, by the variation in the trips and the conditions, and by the quality of the accompanying driver. Novice drivers can safely increase their driving experience by accompanied driving as a supplement to the professional driver training.

SWOV stresses that the introduction of accompanied driving in the Netherlands should not put an end to considering other measures to reduce the high risks of novice drivers. SWOV, for example sees accompanied driving as a first step towards a graduated driving licence. In a graduated licence system, novice drivers can drive in increasingly risky situations as they gain more experience. For example, bans on driving at night or in the company of age peers during the first phases of independent driving will further reduce the number of crashes involving novice drivers.

Thinker in Residence

In 2010, the Premier of South Australia, Mike Rann, invited SWOV Director Fred Wegman to become 'Thinker in Residence'. The Thinker in Residence programme brings an international expert on a specific subject to South Australia to come to an innovative approach together with the community. As a leading expert in the field of road safety, sustainably safe road traffic in particular, Fred Wegman was asked to give input about road safety innovation in South Australia. The results will be used as a contribution to the South Australia road safety strategy that is to be drawn up. Fred Wegman accepted the invitation and spent two periods in South Australia setting out to bring new ideas into the state and translate them into practical solutions to improve the lives of the people who live there. ■

Selected publications

Sustainable Safety: the safe system approach of the Netherlands. L. Aarts, & F. Wegman (2010). In: Behavioural Research in Road Safety 2008, Eighteenth Seminar, pages 1-15. Department for Transport, London.

Assessing conceptions of cost-benefit analysis among road safety decision-makers: misunderstandings or disputes? K. Veisten, R. Elvik & C. Bax (2010). In: Impact Assessment and Project Appraisal, Vol. 28, Nr. 1, pages 57-67.

Improving the effectiveness of road safety campaigns: current and new practices. A. Hoekstra & F. Wegman (2011) In: IATSS Research, Vol. 34, Nr. 2, pages 80-86.

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Road safety effects of lowering the minimum age for the A1 motorcycle licence to 16 or 17. Y. van Norden & C. Schoon (2009). R-2009-16. SWOV, Leidschendam. [Dutch with an English summary]

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Fact sheets

- Accompanied driving
- Category A1 (to 125 cc) of the new motorcycle driving licence
- Driver training in steps
- Young novice drivers
- Demerit points systems
- Hazard perception in traffic
- Training hazard perception

SWOV and the road user

Individuals play a key role in the traffic system which consists of 'man', 'vehicle' and 'road'. Road and vehicle need to meet the human capabilities and must offer the users protection. Education must prepare people to fulfil their traffic task safely, both for themselves and for other road users. Human behaviour is an important factor in road safety: several types of behaviour are known to increase the risk of a crash. SWOV studies traffic behaviour and the risks that go with it in different ways and from different angles. Some of the areas that SWOV studied in its programme 2007-2010 are social forgivingness, state awareness, subjective safety, and intelligent technologies in relation with the road user.

Social forgivingness, state awareness, subjective safety

Social forgivingness and state awareness are new principles in the updated Sustainable Safety vision. Both relate to the role of the human being in traffic. Because there are always road users who commit errors or lack skills, other road users need to allow for this by displaying an attitude of social forgivingness. At the

same time, every road user must be aware of his own skills or the lack thereof: state awareness. The concept 'subjective road safety' refers to personal feelings that people have about road safety or, somewhat broader, to their concerns about road safety for themselves or others. In the past four years SWOV carried out several studies to give these relatively new concepts a more detailed interpretation. The findings were used as a basis for recommendations that will improve road safety.

Two SWOV researchers obtained their PhDs on subjects that are related to this category of research. Maura Houtenbos studied interactive driving behaviour at intersections and Saskia de Craen had calibration in young novice drivers as a subject for her PhD.

The road user and new technologies

There are more and more appliances inside the vehicle to assist the driver in driving comfortably, safely and economically. This raises the question whether these systems do indeed improve safety and reduce harmful emissions, and whether they decrease or rather increase congestion.

Lorries

In the past research period SWOV made an estimate of the road safety effects of several crash prevention systems for lorries on motorways in the Netherlands. Directional Control, a system that can prevent a vehicle from skidding or limits the consequences if it does, is likely to have a positive road safety effect. This is also the case for Advanced Cruise Control, which keeps a set speed that is automatically reduced if the headway to the vehicle in front becomes lower than a chosen value. The literature suggested that the other systems that were investigated could have a positive behavioural effect, but the measurements did not confirm this.

Passenger vehicles

SWOV also carried out a literature study to assess the safety effects of several intelligent vehicle systems for passenger cars: Electronic Stability Control, Intelligent Speed Assistance, the Lane Departure Warning System, Advanced Cruise Control, navigation systems, eCall, the alcolock programme, daytime running lights, and seat belt reminders. All these intelligent vehicle systems seem to have a small or large positive road safety effect. As yet little is known about possible overlap of effects or interaction between the different intelligent vehicle systems; this requires further research. ■





Colophon

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Hansje Weijer

Editors:

Ingrid van Schagen, Han Tonnon,
Hansje Weijer

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Peter de Graaff, Den Haag
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SWOV Institute for
Road Safety Research,
PO Box 1090, 2260 BB
Leidschendam, The Netherlands

T + 31-703173333

F + 31-703201261

E info@swov.nl

I www.swov.nl

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The SWOV website contains a wealth of information about a variety of road safety topics. SWOV fact sheets are all available in English. The library has extensive possibilities to search for international road safety literature and publications.

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Fact sheets

- State awareness, risk awareness and calibration
- Social forgivingness
- Subjective safety in traffic
- Young novice drivers
- Training hazard perception

SWOV as a scientific institute

Making a contribution to improving road safety with the knowledge from scientific research. This is the task which SWOV has set itself from its foundation and which has not changed over the years. This task can only be fulfilled if SWOV is and will remain an independent, scientific institute. SWOV sets out to raise its scientific level in a number of ways.

Knowledge

Not only in the Netherlands, but also worldwide SWOV has the reputation of being an independent and high-quality research institute. Acquiring scientific knowledge is and will remain one of SWOV's two main tasks. SWOV carries out its own research, but it goes without saying that it also looks at research that has been done by other institutes, both in the Netherlands and in other countries.

Scientific workshop

In November 2009, SWOV organized an international workshop with *Scientific Research on Road Safety Management* as a theme. The growing interest in policy-related road safety research and the complex nature of this type of research gave SWOV reason to organize an event for researchers and policy makers to exchange their experiences with this type of research. During the workshop presentations were held about methods and results both of ex-ante assessments, e.g. outlooks and cost-benefit analyses, and of ex-post assessments of road safety programmes. Approximately fifty researchers and policy makers from different countries participated in to the workshop that was held in the old Dutch city of Haarlem. The papers that were written for the workshop and some more articles about this subject were published in a special edition of the scientific journal *Safety Science* with SWOV's Fred Wegman and Marjan Hagenzieker as guest editors.

Cooperation and exchange

SWOV has the ambition to be a network organization, also in the field of science. During the research period 2007-2010, SWOV initiated new cooperations with other scientific organizations and strengthened existing relationships wherever possible. In the past period a Memorandum of Understanding was signed between SWOV and the Australian Monash University Accident Research Centre (MUARC). This cooperation resulted in a SWOV-researcher working in Australia for a period of eight months and an Australian researcher being active at SWOV for a similar period. There was also a Memorandum of Understanding and exchange of researchers with the Highway Safety Research Centre of the University of North Carolina in the United States.

PhD programme

SWOV has its own PhD research programme in which it facilitates SWOV researchers to obtain their PhD. The research is part of the SWOV research programme and is carried out in cooperation with different universities. The resulting dissertations are being published in the SWOV dissertation series. In the past research programme four SWOV researchers successfully completed their PhD work:

- Ragnhild Davidse wrote her dissertation about how intersection design and the use of in-vehicle instruments can support senior drivers;
- Maura Houtenbos investigated interactive driving behaviour at intersections;
- Frits Bijleveld's dissertation focused on the use of time series analysis within road safety research; and
- Saskia de Craen obtained her PhD on research into calibration in young novice drivers.

Several other PhD studies are still being performed and four of them are expected to result in PhDs in 2011 and 2012.

Professoriates

The PhD programme has strengthened SWOV's cooperation with several Dutch universities. This cooperation was confirmed by the appointments of SWOV researcher Jacques Commandeur and SWOV Director Fred Wegman as professors.

In 2009, Jacques Commandeur was appointed as Professor of Statistical Models for Risk and Safety at VU University Amsterdam. Also in 2009, SWOV Director Fred Wegman was appointed as Professor of Road Safety at Delft University of Technology. Furthermore, SWOV researcher Marjan Hagenzieker was given a part-time appointment as associate professor at Delft University of Technology.

The Parliamentary Advisory Council for Transport Safety PACTS invited Fred Wegman to give the 20th Westminster Lecture in London on 1 December 2009. The title of the lecture was *Putting People at the Centre: How to Improve Road Safety in the 21st Century?* and it gave an account of progress in the Netherlands through the approach known as Sustainable Safety. Furthermore, a comparison was made between progress in the Netherlands and that in Great Britain.

Qanu midterm review

In addition to the SWOV evaluation commissioned by the Ministry of Transport, SWOV itself had its scientific quality assessed. SWOV asked QANU (Quality Assurance Netherlands Universities) to carry out a midterm review. The committee was formed by prof. dr. ir. Rob van der Heijden, dr. Hans Godthelp, and prof. dr. Henk Meurs.

One of the committee's conclusions was that SWOV has a good intellectual climate. Although the research capacity had not increased in recent years, the scientific output grew. The increase was particularly manifest in the number of articles in peer-reviewed scientific journals and by the frequency SWOV articles were quoted. The committee also concluded that scientific ambition is and will remain necessary for SWOV to remain an authority. Given the international acknowledgement of its road safety research, the committee found SWOV's ambition to be among the ten best institutes for road safety research worldwide, well-chosen and realistic. ■

Selected publications

Time series analysis in road safety research using state space methods. Dissertation VU University Amsterdam. F. Bijleveld (2008). SWOV, Leidschendam.

The X-factor; A longitudinal study of calibration in young novice drivers. Dissertation Delft University of Technology. S. de Craen (2010). SWOV, Leidschendam.

Assisting the older driver; Intersection design and in-car devices to improve the safety of the older driver. Dissertation University of Groningen. R. Davidse (2007). SWOV, Leidschendam.

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