1st FERSI Scientific Road Safety Research-Conference

Berichte der Bundesanstalt für Straßenwesen

Mensch und Sicherheit Heft M 185

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Reports on the 1st FERSI Scientific Road Safety Research-Conference at September 7/8th 2005 at BASt, Bergisch Gladbach, Germany

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Die Hefte der Schriftenreihe **Berichte der Bundesanstalt für Straßenwesen** können direkt beim Wirtschaftsverlag NW, Verlag für neue Wissenschaft GmbH, Bgm.-Smidt-Str. 74-76, D-27568 Bremerhaven, Telefon (04 71) 9 45 44 - 0, bezogen werden.

Über die Forschungsergebnisse und ihre Veröffentlichungen wird in Kurzform im Informationsdienst **BASt-Info** berichtet. Dieser Dienst wird kostenlos abgegeben; Interessenten wenden sich bitte an die Bundesanstalt für Straßenwesen, Referat Öffentlichkeitsarbeit.

Impressum

Bericht zum Arbeitsprogramm 04 416
1st FERSI Scientific Road Safety Research-Conference

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Telefax: (0 22 04) 43 - 674

Redaktion
Referat Öffentlichkeitsarbeit

Druck und Verlag
Wirtschaftsverlag NW
Verlag für neue Wissenschaft GmbH
Postfach 10 11 10, D-27511 Bremerhaven
Telefon: (04 71) 9 45 44 - 0
Telefax: (04 71) 9 45 44 77
Email: vertrieb@nw-verlag.de
Internet: www.nw-verlag.de

ISSN 0943-9307
ISBN 978-3-86509-661-6

Bergisch Gladbach, Februar 2007

Kurzfassung – Abstract

1. FERSI – Scientific Road Safety Research-Conference

Im September 2005 wurde erstmals eine FERSI Scientific Road Safety Research Conference durchgeführt. Mit der Konferenz sollten Resultate und Bearbeitungsstände der gemeinsamen europäischen Forschungsprojekte der FERSI Mitglieder präsentiert werden. Darüber hinaus sollten die Ergebnisse wichtiger nationaler Forschungsprojekte eingebunden sowie den Projektbearbeitern Gelegenheit zum internationalen „Networking" gegeben werden.

Dr. Wolfgang HAHN, Leiter der Abteilung Straßenbau und Straßenverkehr beim Bundesministerium für Verkehr-, Bau- und Wohnungswesen unterstrich in seiner Eröffnungsrede die Notwendigkeit einer in Europa koordinierten Verkehrssicherheitsforschung, um gemeinsam zu einer Verbesserung der Straßenverkehrssicherheit zu gelangen.

Aus Sicht des Leiters des Referates „Sicherheit im Straßenverkehr" der DG TREN, Dimitrios Theologitis, besteht die zentrale Aufgabe der zukünftigen europäischen Verkehrssicherheitsforschung in der Entwicklung und Verbreitung von „Best Practices". Auch er betonte, dass die Verkehrssicherheitsprobleme in Europa auch in Zukunft nur durch eine enge Zusammenarbeit der EU-Mitgliedsländer im Bereich der Forschung und durch die Umsetzung der dabei erzielten Forschungsergebnisse zu lösen seien.

Im Anschluss an die Eröffnungsreden stellten Rune ELVIK, TOI (Norwegen), Marc GAUDRY, INRETS (Frankreich), David LYNAM, TRL (United Kingdom) und Dr. Rudolf KRUPP, BASt (Germany), in ihren Vorträgen herausragende Forschungsergebnisse im Bereich der Straßenverkehrssicherheit vor.

Die sich an diese erste Vortragsrunde anschließenden Workshops waren entsprechend der Themenschwerpunkte „Daten, Strategien und Kommunikation", „Verhalten und Aufklärung" sowie „Technische Anwendungsmöglichkeiten" unterteilt. Jeder Themenschwerpunkt wurde durch 4 nacheinanderfolgende Workshops abgedeckt. In einer abschließenden Sitzung wurden die wichtigsten Ergebnisse der einzelnen Workshops vom jeweiligen Chairman des Workshops dem gesamten Plenum vorgestellt.

1. FERSI – Scientific Road Safety Research Conference

A FERSI Scientific Road Research Conference was conducted for the first time in September 2005. Results and the status of processing of common European research projects were to be presented to FERSI members at the conference. Moreover, the results of important national research projects were to be included and opportunities for international networking were provided to those working on the projects.

In his opening speech, Dr. Wolfgang HAHN, Head of the Road Construction and Traffic Department at the Federal Ministry for Transport, Building and Housing, stressed the necessity of transport safety research coordinated in Europe to achieve an improvement in road safety based on common needs.

From the point of view of the head of the office "Road Traffic Safety" of the DG TREN, Dimitrios Theologitis, the main task of future European road safety research lies in the development and dissemination of best practices. He, too, stressed that road safety problems in Europe could only be solved in the future through close cooperation between EU members in the area of research and through the implementation of the specific research results achieved in the process.

Following the opening speeches, Rune ELVIK, TOI (Norway), Marc GAUDRY, INRETS (France), David LYNAM, TRL (United Kingdom) and Dr. Rudolf KRUPP, BASt (Germany) presented outstanding research results in the area of road safety in their lectures.

The workshops following this initial round of presentations were divided according to the focus areas "Data, Strategies and Communication," "Behaviour and clarification" as well as "Technical Application Possibilities." Each focus area was covered by 4 workshops conducted one after the other. The most important results of the individual workshops were presented to all conference participants by the respective chairman of the workshop in a concluding session.

Contents

Patric Derweduwen (IBSR), Chairman of FERSI

With this conference, the FERSI offers a forum to exchange information between researchers on the results of our European research projects, to debate on scientific issues and to disseminate knowledge among FERSI Members and also beyond to our research partners. This conference also illustrates the close collaboration of FERSI with other institutions and particularly with ECTRI and PRI which we thank for their support.
First, four outstanding scientific presentations will outline main challenges to road safety research that will inspire the discussions during the workshops. All 12 workshops are gathered in three general topics. A first topic focuses on data, strategies and communication and covers the themes of data management and analysis, the measurement of road safety attitudes, and the safety strategy and planning. A second topic is dedicated to driver behaviour and safety education, including the themes of training and licensing and the problematic of the use of alcohol and drugs and the fitness to drive. A third topic looks into the technical applications and covers the road infrastructures, ITS and HMI, the speed management and the enforcement. Each presentation is open to discussion and the conclusions of the workshops will presented in a final plenary session.

Workshops

	General topic: Data, strategies, communication	**General topic: Behaviour and education**	**General topic: Technical applications**
Session 2	Workshop 1:	Workshop 2:	Workshop 3:
Wednesday, September 7th, 2005, 13:45 – 15:45	Data management	Driver behaviour	Road infrastructure safety
Session 3	Workshop 4:	Workshop 5:	Workshop 6:
Wednesday, September 7th, 2005, 16:00 – 18:00	Road safety attitudes	Safety education	ITS and HMI
Session 4	Workshop 7:	Workshop 8:	Workshop 9:
Thursday, September 8th, 2005, 9:00 – 11:00	Safety strategy and planning – part 1	Driver education and training	Enforcement
Session 5	Workshop 10:	Workshop 11:	Workshop 12:
Thursday, September 8th, 2005, 11:15 – 13:15	Safety strategy and planning – part 2	Alcohol and drugs	Speed management

The 1st FERSI Scientific Road Safety Research Conference is supported by

Wolfgang Hahn
State Secretary of Federal Ministry of Transport, Building and Housing,
Germany

Accident research as the basis for road traffic safety policy in Europe

Dear Mr Kunz, Mr Derweduwen,
Ladies and Gentlemen,

It is a pleasure for me to open today the First FERSI Scientific Road Safety Research Conference.

Since FERSI was founded more than ten years ago this Forum of European Road Safety Research Institutes has shown a remarkable development. Representing now the national road safety research institutes of twenty European countries FERSI has become an important platform and a valuable partner for road safety policy making in Europe. With this conference you have reached another milestone and I congratulate you, Mr Derweduwen, and the former Chairman of FERSI, Mr Kroj, under whose chairmanship this conference was planned, and all other FERSI members for their initiative for such a remarkable event.

Moreover, it is a particular pleasure that this event takes place at BASt, in the German Federal Highway Research Institute which is as a subordinated administration part of the German Ministry of Transport, Building and Housing. BASt does not only give to us useful scientific advice for our national transport policy based on its own research programme activities but is nowadays also involved in many European research activities. BASt has participated in EU research projects since 1994 when the 4th Framework Programme begun. It is remarkable that 26 of the 34 European research projects in which BASt has participated deal with road safety topics.

Mr Kunz, we are looking forward that BASt will continue its reliable and successful co-operation with all these other well-known European research institutes of FERSI, that you all will continue to develop and accumulate the knowledge we need in Europe to establish guidelines, standards or laws for the improvement and consolidation of traffic safety.

Why is it necessary to invest so many efforts in transport research and here in particular in road safety related research?
In the era of globalisation our economies which are based on the division of labour, need highly efficient mobility. The accessibility of the European regions largely depends on high-quality infrastructure and an efficient transport industry which is both a challenge and an opportunity. According to current predictions there will be a large increase in distances travelled by 2015; this will be caused by a number of factors, including European integration and the eastward expansion of the European Union.

The main task of a modern transport policy is to ensure that we maintain this high level of mobility in Europe. Such a policy has to be based on the principle of sustainability and has to balance economic, ecological and social requirements. The mobility of the society will in future continue to be an important prerequisite for progress, prosperity, growth and employment. Mobility means individual freedom and flexibility and therefore has to be the central aim of the European transport policy.

On the other hand, in 2003, more than 35,000 people died in the European Union (Gilt für EU 15. Im selben Zeitraum starben in EU 25 mehr als 46.000 Menschen) as a result of road accidents and more than a million got injured. Road accidents are the main cause of death in the age group below 45 and cause more deaths than heart disease or cancer in that group. One person in three will be injured in a road traffic accident at some point in their lives. The total cost to society in Europe has been estimated at more than € 160 billion per year, which corresponds to 2% of Europe’s Gross Domestic Product.

Improvements in road safety are therefore one of Europe’s most urgent tasks. In order to meet this challenge road safety is one of the main parts in the European transport policy, for example documented in Commission’s White Paper “European Transport policy for 2010: time to decide”.

Increasing mobility will only be accepted in society if traffic safety increases at the same time and the general climate on the roads improves noticeably. Therefore the aim should be to maintain and improve safety as mobility increases.

The European Union set itself an ambitious goal namely to halve the number of people killed between 2000 and 2010; this by way of integrated action taking account of human and technical factors and designed to make the Trans-European Road Network safer. Some European countries are already following a sufficient fatality reduction path, among them France and Germany, but the development of traffic safety differs very widely between the EU-member countries.

Improving traffic safety requires not only governmental action but also needs each individual to show responsibility and the willingness to make their own contribution to achieving greater traffic safety. Traffic safety programmes should aim at perceiving traffic safety as a task for all social forces. The implementation of such programmes and their effects on traffic safety should be under constant observation and should be adapted to current developments in traffic safety to further optimise the results.

Additionally, the European member states address their specific road safety priorities with own safety programmes. As Mr Kunz mentioned before, the German Ministry of Transport, Building and Housing for instance has five priorities in its Programme for More Safety in Road Traffic:

- improving the traffic "climate",
- protecting weaker road users,
- reducing young drivers' accident risk,
- reducing the potential for danger presented by heavy goods vehicles and
- increasing road safety on rural roads.

Research in the field of road safety is a necessary prerequisite for the implementation of potentially successful road safety measures. It is essential to translate the knowledge based on research into action which will save human lives. No one would disagree that the successful reduction of fatalities in the past has been enabled by road safety related research results, for example due to the progress made in the identification of drunk driving, urban speed reductions and improving passive car safety. But the potentials to increase road safety due to investments in research are far from being fully exploited.

On a European level the main objective of the current 6th Framework Programme is the creation of a true "European Research Area", aiming at more focused and integrated research. One of the seven thematic priority areas of this programme is "Sustainable development" including transport research and road safety. In the coming 7th Framework Programme "Transport and Aeronautics" is one of the nine high level themes. The improvement of safety and security will be one of the main aims of the 7th Framework Programme. The creation of technology platforms for the different industrial sectors of surface transport, such as the European Road Transport Advisory Council in road transport, is an important element to reach the main objectives of the priority and to achieve a higher degree of integration in research.
When we consider, so far, the results reached and even if we anticipate the results which could be expected from road safety related research carried out under the 6th European Framework Programme, there are still urgent research tasks in the field of road safety which should be addressed within the 7th European Framework Programme.

Road safety related research as the basis for road traffic safety policy in Europe should address all three "pillars" of road safety:

- encourage or enforce road users to improve their behaviour,
- make vehicles safer and
- improve road infrastructure.

Starting with the human factor or the question how we can influence the human behaviour in road traffic positively, a good example of a successful European research project where many European research institutes co-operate intensively is the SARTRE survey. SARTRE is an acronym for „Social Attitudes to Road Traffic Risk in Europe". Within this survey more than 24,000 European citizens have been asked about different aspects of traffic safety, for example about driver behaviour, seat belt wearing, enforcement, drinking and driving and speeding. The results of this huge project provide researchers and practitioners - especially politicians - with information about attitudes, knowledge, perceptions and experiences concerning traffic safety topics. It gives them the chance of evaluating the range of acceptance towards regulations and countermeasures and gives information about underlying social and cultural factors which are responsible for differences in attitudes and behaviour.

An example of a German research project, which might provide other countries with basic knowledge is the FRAME project, which focuses on the possible influence of illness and medication with respect to accident risk, driving behaviour and mobility of the elderly. It was proven that the risk of being involved in a car accident for elderly people suffering from more than one illness is 2.6 times higher than the same risk for healthy people.

Medicines and drugs as well as alcohol will continue to stay in the focus of road safety related research. In 2006 DRUID, a challenging EU-project about driving under the influence of drugs, alcohol and medicine, is to be launched. This comprehensive integrated project - as far as I know the biggest research project ever launched in this field in Europe - deals with the scourge of drink-driving and is going to find answers to questions concerning the use of drugs or medicines which affect people's ability to drive safely. DRUID will bring together the most experienced organisations and researchers throughout Europe, involving more than 20 member states. Amongst others, reference studies about the impact on fitness to drive due to the consumption of alcohol, illicit drugs and medicines will be conducted. This will give new insights to the real degree of impairment caused by psychoactive drugs and their actual impact on road safety. As a result it will become possible to generate recommendations for the definition of analytical and risk thresholds. Furthermore an appropriate classification system of medicines affecting driving ability is going to be established and a framework to position medicines according to a labelling system will be created. These are just a few of the many aspects covered by DRUID. All in all this integrated project will fill the gaps of knowledge and provide a solid base to generate harmonised, EU-wide regulations for driving under the influence of alcohol, drugs and medicine.

Without any question, international experiences and knowledge have an influence on the national road safety policy making. The latest German initiative regarding drink driving demonstrates this. Based on good experiences and results reached in Austria and Spain with alcohol-limits in road traffic close to zero the German Minister of Transport, Building and Housing, Manfred Stolpe, proposed to his European colleagues in April this year that driving after the consumption of alcohol should be totally prohibited for all novice drivers.

Beyond the influence of medicines, alcohol and drugs further problems caused by human behaviour have to be addressed. The problem of the above-average accident risk of novice drivers has to be attacked further on more intensively. Research activities in this area are therefore of high importance to support the development and improvement of effective counter-measures.

Scientific work in the area of driver training and education is directed to three major problems:

- the identification of the specific problems of new drivers in traffic and, by this, the identification of qualification needs,
- the development of appropriate forms of learning and teaching and
- the assessment of the effectiveness of measures as well as the development of know-how for improving them.

By compiling and summarising the up-to-date-knowledge EU-research projects contribute substantially to a dissemination of state-of-the-art-approaches in driver training and education. During the last years, German researchers could learn from and contribute to some of these projects, among them the EU-projects GADGET and BASIC.

Lessons from European experiences and results gained from international research co-operation also influence transport policy making in Germany. The reception of international evaluation results on approaches of an extended practical learning phase for novice drivers has led to the development of an own German model of accompanied driving in August 2003. Meanwhile this approach has been launched as a model project in the majority of the German federal states.

In Europe and throughout the world major innovations in the driving license examination can be observed, e.g. the introduction of the Hazard Perception test in the English and Australian driving license examination. The transport policy in Germany, too, strives for ambitious goals in this area. As a result of BASt's research activities concerning the optimisation of the theoretical driving license examination suggestions for extensive improvements of the existing theory test were provided. On this basis a project group was established this year, which develops an optimised theory test. By the use of computer technology, multimedia and scientific methods the capacity and the goodness of the theory test shall be enhanced. This will serve an improved preparation of new drivers. BASt plans an international symposium on these issues in 2006.

Together with the human behaviour road infrastructure and vehicle technologies are essential factors for road safety, too.

Active as well as passive vehicle safety measures play a most important role in improving road safety. An increasing number of vehicles is equipped with advanced driver assistance systems helping the driver to cope best with different and critical driving situations.

The tremendous progress in vehicle safety during two decades is based primarily on the three following measures, namely seat belts, stiff passenger-compartment and airbags. The high standard of passive vehicle safety has been achieved by establishing and updating a bundle of regulations on European and world wide level and by assessment of vehicles within Euro NCAP. Currently it becomes evident that also active vehicle safety contributes and will contribute considerably to reducing accidents and fatalities.

Vehicle stability control systems like ESP improve vehicle safety substantially.

BASt is involved in several projects and international committees aiming at further improvement of vehicle technology with regard to the protection of all road users.

Together with 14 partners, thereof 5 FERSI members, BASt is working on the EU Commission's IMPROVER project which focuses on the following four areas:
Sports Utility and Multi Purpose Vehicles; light goods vehicles; cruise control; harmonisation of traffic signs and road markings.
These sub-projects also include cost/benefit analyses.

BASt concentrates on its involvement in all currently active European Enhanced Vehicle-safety Committee working groups. Important topics are for example:

- the compatibility between vehicles in accidents,
- the protection of the pedestrian in car accidents,
- head restraints and whiplash injuries,
- in-depth accident studies.

This activities result in several EU funded projects.

VC-COMPAT is one of those projects evaluating the compatibility of cars and trucks in accidents.

BASt also contributes to the EU-funded CHILD project which deals with advanced methods for improved child safety in cars. A second project on child protection is NPACS (New Programme for the Assessment of Child Seats). Here the objectives are to develop a test procedure for universally usable child restraint systems.

BASt is involved in Euro NCAP regularly testing vehicle models at BASt's facility in accordance with the Euro NCAP test protocols. So far, Euro NCAP has tested almost 300 vehicle models in at least three crash test configurations in each case. Pedestrian safety is also assessed.

BASt is actively involved in the European Commission's e-Safety initiative and chairs the working group on "Human-Machine-Interaction" dealing with the updating of safety requirements for HMI.

The EU funded project AIDE is devoted to the development, design and assessment of a sophisticated Human-Machine-Interface for advanced in-vehicle assistance systems and information systems, and for modelling driver behaviour. The aims of the project are to increase the efficiency and consequently also the safety benefit of advanced driver assistance systems.
BASt also was involved in the SpeedAlert project which was coordinated by ERTICO. Within this project a concept of an intelligent speed management system with a warning function was developed and recommendations for a possible implementation were given.

Besides the mainly EU funded work BASt also initiates and carries out own research projects dealing with topics related to the road safety programmes. These are for example investigations about

- driving stability systems for motorcycles,
- improvement of active and passive lighting systems,
- emergency exit systems of coaches,
- user-related incorrect use of driver assistance systems or
- age-specific support requirements through driver assistance and driver information systems.

Altogether automotive engineering has achieved a significant reduction in road traffic accidents, injuries and fatalities. Promising new technical developments ensure that this will be the case in the future, too.

The results of infrastructure related safety research are currently used to amend existing guidelines or to set up best-practices in the EU-project RiPCORD-iSEREST. In this project, 17 institutes from 14 countries - 10 of them FERSI members - are currently working together in order to elaborate best practice guidelines in the field of accident analysis and traffic safety. Each of these topics is deemed to have the ability to reduce the death toll on European roads significantly which is of particular importance for the European Safety Policy.

Improving traffic safety begins a long time before a road is planned in detail for traffic. The implementation of "Road Safety Impact Assessment" into the planning process ensures that traffic safety is considered from the very beginning. The design of "Self-explaining Roads" is a second step to reduce the accident potential because wrong perception and estimation of road infrastructure and traffic situations often leads to severe accidents. If accidents occur, "Forgiving Roadsides" will mitigate the consequences of these accidents.

Furthermore, “Road Safety Audits” have proven to be successful in improving traffic safety before a road is opened to traffic. With comparatively little effort, these procedures are not only able to reveal possible safety deficits in single schemes but can in general also lead to safety-awareness of the designers and the amendment of guidelines.
For monitoring and improving traffic safety on existing roads, “Road Safety Inspections” and “Black Spot Management” including the analyses of whole networks are measures which enable traffic authorities to define promising remedial actions. “Road Safety Inspections” were established to detect safety deficiencies in-situ before accidents occur while “Black Spot Management” is meant to come into operation when parts of the road network become comparatively unsafe.

Collecting best practices for these procedures and engineering measures and also the development of telematic applications are ambitious tasks for the FERSI members involved in the project. But combined experience and efforts ought to contribute to successful project work, to improved co-operation, and last but not least to an improvement of road safety in Europe.

Traditional road infrastructure measures will certainly make a contribution to reduce casualties and fatalities. However, high cost of traditional infrastructure construction could sometimes be a restraining factor. The combination of new technologies – such as telematics and driver assistance systems - with innovative infrastructure measures may lead to more cost-efficient solutions to improve road safety in the future.

The EU-project IN-SAFETY is one of the projects researching the potential of such an integrated approach. Some of the FERSI project partners working together in IN-SAFETY are here today. The ambition of the IN-SAFETY project is to assess the safety potential and cost-effectiveness of an implementation of new technologies in combination with road design concepts. The project is focusing on the self-explaining and forgiving road environments, including highways, rural roads and urban environments. At the end of the IN-SAFETY project we could expect policy recommendations for implementation priorities of cost-efficient road environments that will contribute to further road safety enhancements by optimal and balanced use of available resources.

Accident research, however, doesn't serve as a basis for the traffic safety policy only for the open road in Europe. Several disastrous accidents of the last years in European road tunnels made quite clear, especially in connection with vehicle fires, that road users in tunnels are in case of accidents exposed to an increased danger, in comparison with the open road. This additional endangering potential is counteracted with a high safety standard in the tunnel.

To reach a unified minimum standard in European road tunnels for the safety facilities, the European Union provides a corresponding normative frame in the directive 2004/54/EC on minimum safety requirements for tunnels in the Trans-European Road Network. The directive demands the realisation of risk-analysis-procedures for the assessment of security measures which are working preventive as well as in the emergency case of an accident.

In this field accident research supports the development of a suitable risk analytical methodology. The accident research shall make it possible to determine the required damage indicators, such as personal and material damages and also downtimes after accident events.

The imbedding of the accident research in the appropriate international committees like PIARC supports the aim of the directive establishing a unified methodology for the assessment of the safety of road tunnels which is carried out by all member states in Europe.

Please allow me at the end of my short outlook onto these important research activities which are going to build the basis for transport policy making in Europe to leave the ground and to look up to the sky. For coping with the traffic volumes the European transport infrastructure has not only to be modernised and expanded. The German Ministry of Transport, Building and Housing also supports the development of Galileo, the European satellite navigation system. Galileo will open up a large number of innovative possibilities in the field of communication technology, in particular in the transport sector. Galileo and all other state-of-the-art telecommunication and information technologies such as traffic management systems on autobahns play also an important role in preventing traffic congestion, protecting the environment and improving traffic safety.

All these questions and challenges mentioned before are important topics for your conference today and tomorrow. Also in the name of the German Minister of Transport, Building and Housing, Manfred Stolpe, I wish you a fruitful time during this conference, many constructive and stimulating discussions in the workshop sessions, a manifold Trans-European exchange of experiences and knowledge and valuable incentives for your daily research work. Please never forget that those who are responsible for the policy making in Europe depends on the quality of the results of your work.

Thank you very much for your attention.

Outstanding presentations

Rune Elvik
Institute of Transport Economics,
Norway

Laws of accident causation

Abstract

This paper suggests that the influence of a number of important risk factors on road accidents can be described in terms of a few highly general statistical regularities that determine the shape of the relationship between the risk factors and accident occurrence. The statistical regularities are referred to as “laws of accident causation”. The following “laws” are proposed:

1. The universal law of learning, which states that the ability to detect and control traffic hazards increases uniformly as the amount of travel increases. This law implies that accident rate per unit of exposure will decline as the amount of exposure increases
2. The law of rare events, which states that the more rarely a certain risk factor is encountered the larger is its effect on accident rate. This law implies that a risk factor encountered on, for example 5% of all trips, will be associated with a greater increase in accident rate than an otherwise identical risk factor encountered on 50% of all trips.
3. The law of complexity, which states that the more units of information per unit of time a road user must attend to, the higher becomes the probability that an error will made. This law implies that accident rate will increase the more elements of information the traffic environment contains.
4. The law of cognitive capacity, which states that the more cognitive capacity approaches its limits, the higher the accident rate. This law implies that impairments affecting mental functions will have a greater effect on accident rate than impairments affecting physical functioning only.

Instances of all these laws, as well as a discussion of to how the laws can be tested empirically, are given. It is hoped that proposing a few basic mechanisms that can summarise the impact of a number of risk factors will stimulate research that may lead to a more general theory of accident causation.

Key words: accident, causation, scientific law, explanation, empirical testing

Introduction

Attempts at explaining accidents are as old as the scientific study of accidents itself. Bortkiewicz (1898), whose work is often regarded as the start of modern accident research, concluded that accidents occurred at random and were thus inexplicable. Later contributions have attributed accidents to individual proneness (Shaw and Sichel 1971), human errors (Sabey and Staughton 1975, Treat et al 1979), system failures (Perrow 1999), or a desire in road users to seek a target level of risk (Wilde 1982). This paper will not try to review these contributions to the theory of accident causation, nor try to develop a new theory. Its objective is much more limited.

Empirical research has identified a very large number of risk factors that are statistically associated with road accident occurrence, i.e. factors whose presence increases the probability of accidents. In principle, one might try to “explain” road accidents by listing these factors, perhaps adding information on their relative importance. This would at best be only the beginning of a theory of accident causation. A list of risk factors can be informative and useful, but it begs more basic questions, like: Why is factor X a risk factor for accidents? Why does risk factor Y appear to be more important in explaining accidents than risk factor X? What we need is, in other words, an account of mechanisms that explain why a certain factor becomes a risk factor. This paper will propose a few such mechanisms, stated in terms of general (i.e. not restricted to any particular country or road traffic system) hypotheses that are empirically testable. The main question this paper seeks to answer is:

Can the effects of risk factors on the probability of road accidents be explained in terms of a few underlying mechanisms that generate the statistical relationships between risk factors and accidents and determine the shape of these relationships?

Mechanisms underlying risk factors

The number of risk factors that influences accidents is vast. Nobody can enumerate all these risk factors; yet their effects on accidents may display striking regularities. The ability of a road user to recognise risk factors and prevent them from leading to accidents is likely to be strongly influenced by the experiences made when using the transport system. This suggests the following law:

The universal law of learning

The ability to detect and control traffic hazards improves continuously as a result of exposure to these hazards.

Traffic hazards denote any potential risk factor. The term refers, broadly speaking, to anything that can go wrong. Exposure refers to the amount of travel, the number of kilometres covered per month, year or during lifetime. The main implication of the universal law of learning is that road user accident rate per kilometre travelled tends to decline as the number of kilometres travelled increases. This tendency is likely to be most clearly evident among novice drivers, but it is suggested that it applies to all road users throughout life. Learning never ends, because things once learnt may be forgotten and need to be re-learnt later on. The law is a hypothesis only; if it is correct one would expect accident rate to decline uniformly as travel exposure increases.

Exposure to traffic hazards is not uniform. Some traffic hazards are encountered more irregularly or more rarely than others. The more rarely a certain traffic hazard is encountered, the more difficult it is to predict its occurrence, and the less are the opportunities for learning how to control the hazard. This implies the following regularity.

The law of rare events

The more rarely a certain traffic hazard is encountered the greater is its effect on accident rate.

Thus, a traffic hazard encountered on 5% of all trips is expected to be associated with a greater increase in accident rate than a traffic hazard encountered on 50% of all trips. This tendency is likely to apply to environmental hazards (rainfall, snow, wild animals) as well as to highly surprising features of roadway design (unexpected sharp curves, for example). It may even apply to the relative proportions made up by different groups of road users in mixed traffic.

Traffic hazards may be perfectly controllable if they appear one at a time. Modern traffic systems are, however, complex and sometimes present several traffic hazards at the same time, all of which the road user ought ideally to attend to. If a traffic situation becomes very complex, our cognitive capacity may no longer be able to keep up with the task demands, leading to the neglect of certain traffic hazards or an inadequate response to them. This suggests the following law of complexity.

The law of complexity

The more potentially relevant items of information a road user must attend to per unit of time the higher the probability of accidents.

A complex traffic environment is one that, for example, is characterised by dense and mixed traffic, the necessity to make difficult manoeuvres (like turning left across several lanes of opposing traffic) or frequent changes in the cognitive demands placed on road users. Complexity can partly be controlled by road users, by regulating speed or by concentrating more strictly on the driving task. Inherent variability in complexity is, however, likely to exceed the possibilities for compensatory behaviour. Complexity is thus a characteristic of the traffic environment, external to the road user.

The ability to compensate for inherent variations in task demands depends to a major extent on the mental state of the road user. The more the ability to concentrate attention, to make decisions in a short time, and to carry out appropriate action is reduced, the higher become the chances of accident involvement. In short, the more reduced our cognitive capacity gets, the less able we are to detect and control traffic hazards. Thus, the law of cognitive capacity states:

The law of cognitive capacity

The more cognitive capacity approaches its limits, the greater the increase in the rate of accidents.

This implies that impairments affecting mental functions have a greater effect on accident rate than physical impairments, not affecting mental functions. Moreover, the more strongly affected mental functions are, the greater the effect on accident rate.

It is proposed that these four mechanisms describe in general terms the association between a number of risk factors and accidents. In the following, the four mechanisms will be referred to as “laws of accident causation”. The four “laws” are meant as empirically testable hypotheses; thus to the extent they are based on theoretical notions, these need to be translated to operational terms. Some preliminary suggestions about how to do this will be discussed later in the paper.

It is by no means suggested that the four “laws” proposed in this paper are the only mechanisms that may explain the effects of risk factors on accidents. Nor is it suggested that the “laws” are true scientific laws, in the sense of that term in epistemology. In epistemology, a distinction is made between scientific laws and accidental generalisations. The latter category consists of phenomena that have been observed a great many times, but that do not represent invariant relationships the same way a true scientific law does. Thus, fresh water will always freeze when the temperature stays below zero degrees Celsius long enough; but no finite number of observations justifies the claim that “All swans are white” is a scientific law. The “laws” proposed in this paper are definitely of the “white swans” variety: they are to be regarded as hypotheses that must be given up when most observations no longer support them.

Instances of the laws of accident causation

The universal law of learning

Does the rate of accident involvement vary inversely with the amount of exposure? One data set showing this tendency is presented in Figure 1, based on a study reported by Sagberg (1998). Figure 1 shows self reported accident rates for novice drivers (i.e. drivers who have held a licence for less than 18 months) in Norway, depending on their monthly driving distance. There is a remarkable drop in accident rates as the monthly number of kilometres driven increases. This drop is seen both in men and in women. For all monthly driving distances greater than about 250 kilometres, women have a lower accident rate than men. Their mean accident rate is, however, slightly higher than the mean accident rate for men, due entirely to their lower mean monthly driving distance.

Very similar relationships were found by Forsyth et al (1995). One might think that the relationship shown in Figure 1 does not apply to experienced drivers. Most studies find that driver accident rates are fairly stable between the ages of 25 and 65, suggesting that the process of learning has been completed by the age of 25, and that a decrease in performance sets in at about the age of 65. By contrast, Figure 2 shows the results of a study reported by Hakamies-Blomqvist et. al. (2002), in which accident rates for drivers aged 26-40 were compared to accident rates for drivers aged 65 and above.

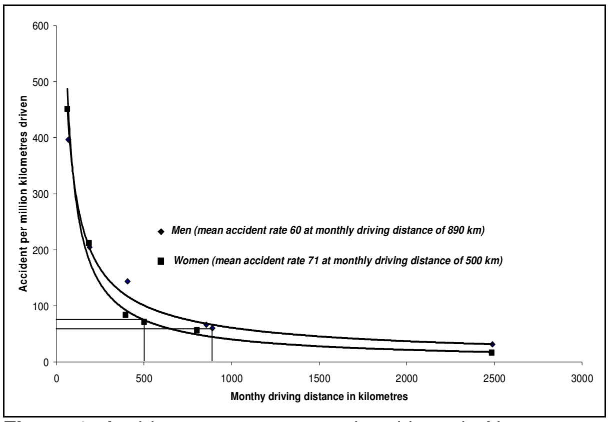

Figure 1: Accident rates among novice drivers in Norway as a function of monthly driving distance. Based on Sagberg 1998.

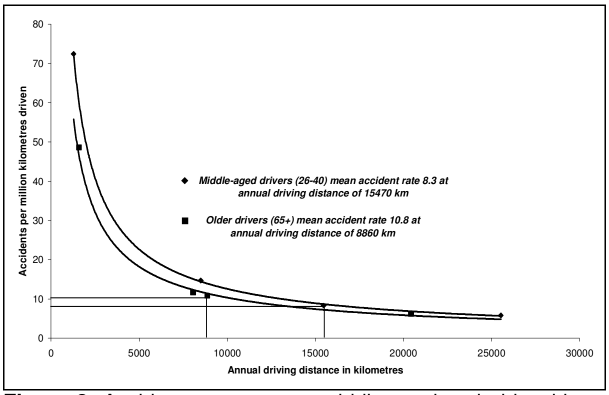

Figure 2: Accident rates among middle-aged and older drivers in Finland as a function of annual driving distance. Based on Hakamies-Blomqvist et al 2002.

Accident rates decline remarkably as annual driving distance increases. This applies to both groups. The shape of the relationship between annual driving distance and accident rate is virtually identical for middle-aged drivers and older drivers. Driving long annual distances is apparently associated with more success in avoiding accidents irrespective of age.

The fact that accident rates drop as annual driving distance increases is consistent with the universal law of learning, but alternative explanations are clearly possible. High-mileage drivers may do a higher proportion of their driving on comparatively safe roads, like motorways, than low-mileage drivers. They may also invest in safer cars, due to the greater need for driving. The high accident rate among low-mileage older drivers may in part be endogenous: drivers who justifiably feel unsafe (for example as a result of past accidents or near-misses) may restrict their driving for that reason.

To really test the universal law of learning, these alternative interpretations must be controlled for. The studies quoted above did not fully control for the confounding factors; yet the relationships they found were very strong and ought to spur further research.

The law of rare events

Accidents tend to come as a surprise. They are never expected to happen. Accidents are, however, more likely to happen when something unexpected or unusual occurs, than when such events do not take place. This is the essence of the law of rare events. Risk factors experienced rarely or infrequently provide fewer opportunities for learning than risk factors encountered more often. Figure 3 shows an instance of this tendency. It shows the relationship between the proportion of wintertime driving performed on snow- or ice-covered roads and the relative accident rate on this type of road surface compared to a bare road. Figure 3 is based on a study by Brüde and Larsson (1980). It is seen that the relative accident rate on snow- or ice-covered roads increases sharply as the proportion of driving done on snow- or ice-covered roads is reduced.

The rarity of snow or ice on the roads of Southern Sweden means that drivers in this part of the country rarely get the opportunity to develop skills for safe driving on snow or ice. Moreover, on the few occasions there is snow or ice, it is likely to come more as a surprise than in Northern Sweden, where snow or ice stays on the road surface during the whole winter. It should be noted, however, that even drivers who are exposed to snow or ice for more than 50% of their wintertime driving do not fully compensate for the reduced friction associated with snow or ice. The accident rate on snow or ice remains about twice as high as the accident rate on bare roads even when more than 50% of exposure is subject to snow or ice.
Another example of the law of rare events is given in Figure 4. It shows the relationship between the length of a straight road section ahead of a curve and the accident rate in curves, depending on the sharpness of the curve (Matthews and Barnes 1988). The accident rate in sharp curves is seen to increase markedly as these curves become less frequent. A similar relationship does not seem to apply to gentle curves.

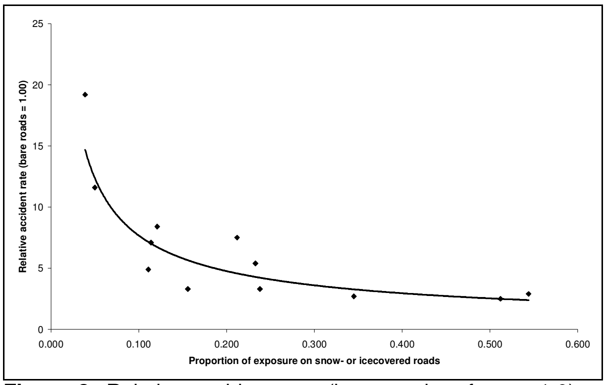

Figure 3: Relative accident rate (bare road surface = 1.0) on roads in Sweden as a function of the proportion of driving on roads covered by snow or ice. Based on Brüde and Larsson 1980.

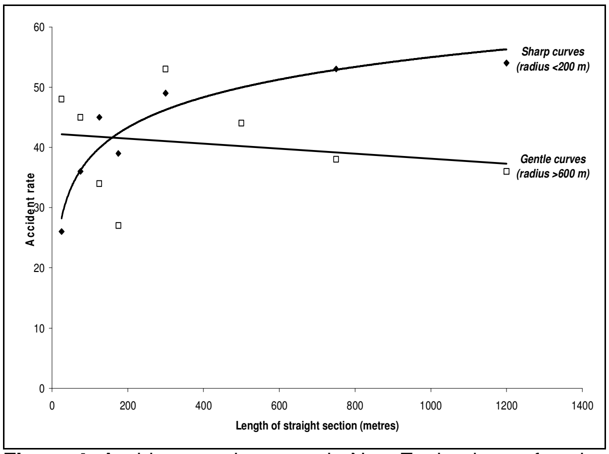

Figure 4: Accident rate in curves in New Zealand as a function of the length of the straight section preceding the curve and curve radius. Adapted from Matthews and Barnes 1988.

The explanation for these relationships is likely to be related to driver expectations and the attendant behavioural adaptation. Drivers have no trouble in safely negotiating sharp curves if they expect there to be a lot of them along a road, as is evidenced in Figure 4 by the low accident rates in sharp curves that have no straight section of road in-between them. If, however, a driver has become accustomed to driving on a straight road, the appearance of a sharp curve violates expectations, and behaviour may be more poorly adapted to task demands than in the case of a long winding road.

The law of complexity

Complexity is both an inherent characteristic of the traffic system and an outcome of driver choices. A driver who adopts small safety margins makes the task of driving more complex than one who allows a greater margin for errors.
An example of inherent complexity is the design and control of junctions. Roundabouts have become very popular in recent years, and for good reasons. A roundabout reduces the complexity of a junction. The theoretical number of conflict points between the traffic movements passing through a junction is greatly reduced, in particular in four leg junctions. Moreover, all traffic inside the roundabout comes from the same direction; one no longer has to keep track of traffic coming from several directions at the same time. Figure 5, based on recent Norwegian studies (Tran 1999, Sakshaug and Johannessen 2005), shows the effects of complexity in junctions on accident rates.

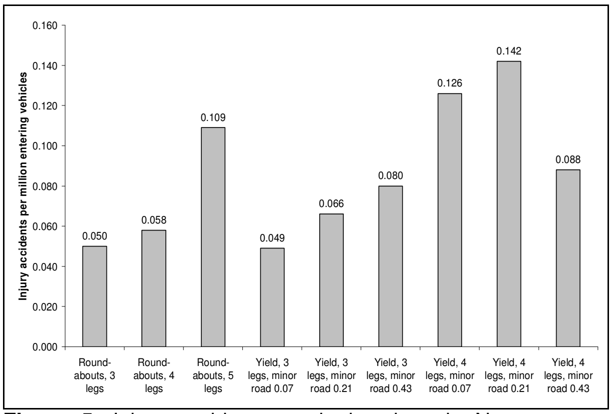

Figure 5: Injury accident rate in junctions in Norway as a function of the type of traffic control, number of legs, and proportion of traffic entering from the minor road. Based on Tran 1999 and Sakshaug and Johannessen 2005.

Accident rates are specified according to the type of traffic control (roundabout versus yield), the number of legs (3, 4 or 5), and, for junctions that are controlled by yield signs, the proportion of vehicles entering from the minor road. Complexity is greater in yield controlled junctions than in roundabouts; it is greater in four leg junctions than in three leg junctions; and it is greater the more traffic there is from the minor road. Broadly speaking, the effects of complexity are as expected; the more complex a junction, the higher its accident rate.

Another example of the effects of complexity is shown in Figure 6. Figure 6 shows the relationship between the number of driveways per kilometre of road entering national roads in Norway and the injury accident rate (Muskaug 1985). The data are old, but the relationship is not likely to have changed very much.

The number of driveways per kilometre gives a fairly good indication of the level of roadside development. The more driveways there are, the more development there will be along the road, in terms of shops, residential areas or industry.

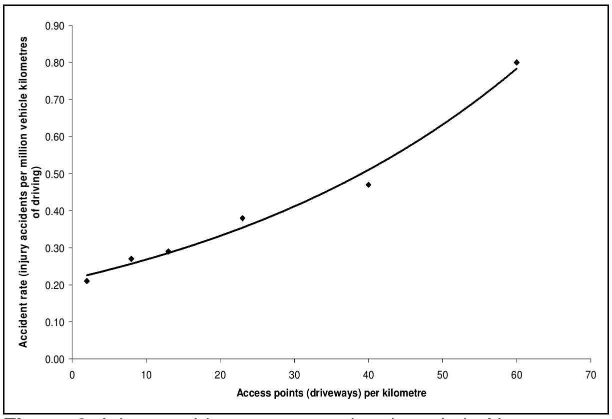

Figure 6: Injury accident rate on national roads in Norway as a function of the number of access points (driveways) per kilometre of road. Based on Muskaug 1985.

The law of cognitive capacity

In normal driving, most drivers will have ample spare cognitive capacity; i.e. cognitive capacity they can spend on other things, like talking to passengers, listening to the radio, or, increasingly, having a conversation on the mobile phone. Most of the time, devoting spare capacity to such tasks does not interfere with the task of driving. This does not mean, however, that reductions in the capacity to perform the driving task, physically or mentally, have no effect on accident rates. The law of cognitive capacity states that the more cognitive capacity approaches its limits (there being no spare capacity that can be devoted to the driving task in case of need), the higher becomes the accident rate.

Underlying this hypothesis is the view that safe driving is to a large extent a matter of mental capacity and less a matter of physical capacity. Physically impaired drivers are able to drive almost as safely as physically fit drivers. As long as these drivers remain mentally fit, they will try to compensate for their physical disability as best they can. Hence, studies have found that various physical impairments are not associated with a large increase in accident rate. However, the more affected the functions of the brain, the larger becomes the effects on accident rate. Figure 7, based on a report by Vaa (2003) shows some examples of this.

It is seen that the increase in accident rate associated with the physical impairments is quite small. Epilepsy, which can lead to losses of consciousness, has a substantial effect on accident rate. The same applies to, for example, Alzheimer's disease and sleep apnoea. The latter disease reduces the quality of sleep and results in chronic tiredness and an increased likelihood of falling asleep during the day.

There is perhaps no clearer case of the effects of reduced cognitive capacity on accident rate than the effects of alcohol. Figure 8 shows the relative accident rate associated with various levels of blood alcohol content (mg/ml) found in various studies. Accident rate is found to increase dramatically as the amount of alcohol in the blood increases. Clearly, once blood alcohol level passes about 0.5 milligrams per millilitre (0.05 %), drivers are no longer able to compensate for its effects to such an extent as to prevent accident rate from increasing.

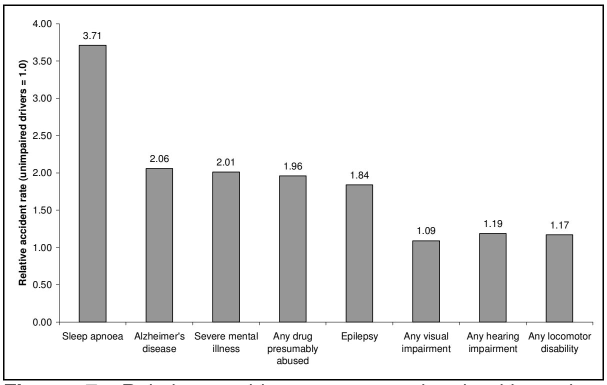

Figure 7: Relative accident rate associated with various medical conditions. Derived from Vaa 2003.

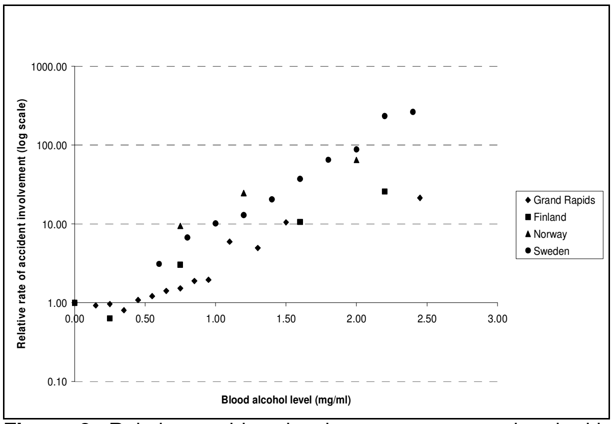

Figure 8: Relative accident involvement rate associated with various levels of blood alcohol content (mg/ml). Based on Elvik and Vaa (2004) and the sources quoted therein.

Discussion and Conclusions

Can the existence and effects of the multitude of risk factors that have been found to contribute to road accidents be understood in terms of a few basic mechanisms? This paper suggests that the existence and effects of many risk factors can be explained in terms of a few highly general mechanisms, which have been referred to as "laws of accident causation".

The mechanisms proposed in this paper are intended both to explain the existence of certain risk factors and to describe the shape of their statistical relationship with accident rates. Examples have been given of all the four mechanisms proposed; these examples have deliberately been chosen to show clearly how each mechanism operates and influences accident rates. For the purpose of this paper, this approach is defensible. If, on the other hand, one wants to test whether the mechanisms apply in general, merely collecting confirmatory instances of each of these mechanisms will not do. On the contrary, every attempt should be made to falsify the proposed "laws of accident causation".

All these "laws" can, in principle, be falsified. The universal law of learning would seem to be falsified if accident rate is found not to decline when exposure increases. On the other hand, if this was to be found, a different mechanism may be operating having a stronger effect on accident rate than learning per se. Perhaps those who drive long distances tend to adopt smaller safety margins, believing that their greater experience allows them to do. This does not mean that learning does not take place, but that highly skilled drivers make use of those skills not to increase safety, but to make driving more fun by employing the skills more actively. It would then be wrong to conclude that the law of learning was falsified; it would be more correct to conclude that it, like so many other social regularities, requires a ceteris paribus clause, whose contents would need to be specified in fairly great detail to test the law.

Likewise, the law of rare events would seem to be falsified if risk factors affecting a small share of exposure are found not to have a greater effect on accident rate than risk factors affecting a large share of exposure. Such a finding would suggest that road users are never taken by surprise, which by any reasonable interpretation ought to qualify as falsifying the law. To falsify the law of complexity, it is necessary to measure complexity. The examples given in this paper did not go into that issue, but referred to characteristics of the traffic environment that are widely regarded as aspects of complexity. Complexity can be measured both in engineering terms (number of traffic signs, number of junctions, number of traffic movements permitted in a junction, etc) and in psychological terms (usually by measuring success in performing a secondary task; the idea is that a drop in performance of a secondary task shows that traffic is more complex). Measuring complexity in engineering terms is probably most relevant to the law as stated in this paper; the psychological measure does not show complexity as such, but driver adaptation to it in terms of devoting a greater share of mental capacity to the driving task. In principle, complexity would not be a problem if drivers fully compensated for it; the law suggests that this does not actually happen. Hence, if accident rate is found not to increase when complexity increases, the law of complexity is falsified.

Finally, reduction in cognitive capacity is also measurable. It can be measured, for example, by giving tasks that require mental resources for their solution, and noting how long it takes to solve the tasks and if the solutions are correct. If it is found that large reductions in cognitive capacity are not associated with an increased accident rate, the law of cognitive capacity is falsified.

The various mechanisms proposed in this paper are related to each other and may perhaps be further reduced to a smaller number of even more basic mechanisms. The main conclusion to be drawn from the research presented in this paper is that the existence and effects of many important risk factors for road accidents can be accounted for in terms of a small number of mechanisms that generate the risk factors by way of limiting the exercise of rationality in the detection and control of traffic hazards.

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The international mystery of peaking yearly road fatalities in 1972-1973

Background: the DRAG approach. Some 20 years ago, we formulated an approach to the modelling of road safety (Gaudry, 1984 (French original); 2002 (English translation)) that decomposed the analysis of road victims into interrelated explanations of road use (demand and risk taking), accident frequency and severity (by category) and used flexible form (Box-Cox) techniques to estimate each system equation. Called DRAG-1 (**D**emand for **R**oad Use, **A**ccidents and their **G**ravity), the first model so specified was then implemented as DRAG-2 by the Quebec Automobile Insurance Board (SAAQ) as its official model to explain and forecast monthly road demand, accidents and their severity, where each system component is defined over Quebec province as a whole. Few other government jurisdictions have demonstrated comparable continuity: working since 1989, professionals now use the most refined version of the model, effectively DRAG-3.

Extension to other countries. This multi-level structure and flexible form equation approach was progressively applied by researchers to California, France, Germany, Norway, Stockholm-County and Stockholm-City. Models and estimation techniques for these 6 countries are presented in a book (Gaudry and Lassarre, 2000), with the detailed national model results found on the site of the French National Institute for Transport and Safety Research (INRETS; www.inrets.fr/labos/DRAG-Book-Ch15.pdf). Since this publication, 3 new one-country models have been under development for Algeria (since 2001), Belgium (since 2002) and Spain (since 2004).

Multi-country-Model approach. After reproducing Smeed's (1949) results with his yearly cross-sectional national data (1938-1946) and ours, we extend Page's (1997) fixed-form time series work and ask, with data (1965-1998) for 11 OECD countries: (i) why did road fatalities reach a maximum in most advanced countries in 1972-1973? (ii) will the same thing happen to countries like Greece? (iii) will the downward trend of road fatalities in OECD countries since 1972 come to a stop and even reverse itself? Our multinational (MnM-DRAG) model is outlined in Gaudry and Gelgoot (draft 2002), along with a comparable multiprovincial model (MpM-DRAG) for the 10 Canadian provinces.

As was the case for previous DRAG-inspired works, accident frequency and severity data are analysed in distinct levels of equations whose mathematical form is determined by the data, not the analyst. Among notable features, the MM-DRAG models attempt to represent the impact of unobserved speed/congestion using asymmetric U-shaped functions of total vehicle-Km, as done since 1994 within the Quebec DRAG-2 model where this endogenous representation of unobserved congestion is decisive for forecasts, notably for certain months, of fatal accidents and of their severity especially.

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What should we expect from a safe road system?

I am going to discuss the type of safety management system we might consider it appropriate to target in the medium term (ie post 2010), and how we might move towards it. This involves thinking about the way an acceptably "safe" system might work, the behaviour required within it, and the use of tighter control within that system. This in turn means a more open public debate about how risk is perceived and the valuation that the public put on reducing casualties.

In Europe some progress is being made toward the overall European Commission target of 50% reduction in fatalities by 2010 compared with 2000. But most of this is coming from the countries with higher fatality levels. The contribution from many countries that already have low fatality rates such as Sweden, UK, and Norway has recently been more limited. Interestingly, the Netherlands, Sweden and UK have all seen a drop in fatality numbers in 2004. Similarly outside Europe fatality numbers in Australia and the USA have remained high in recent years.

The traditional compartmentalism of road, vehicle and driver orientated policies has been replaced by a systems approach, where the need for the various elements to work together is recognised. The best known interpretations of this are the Swedish "Vision Zero" and the Dutch Sustainable Safety programme.

The same basic philosophy underpins the European Road Assessment Programme (EuroRAP). In this programme it is recognised that driving errors will occur and the road is assessed in terms of its ability to accommodate these errors without producing fatal outcomes. Such an assessment requires a view to be taken on how the road design and vehicle design should work together to mitigate injury and how far each should be adapted. It also requires a decision on what behaviour is acceptable from road users - ie what behaviour the system should be designed to mitigate.

The outcome of vehicle to vehicle impacts at different speeds is well researched and the results form the basis for the scoring used in the New Car Assessment Programmes (NCAP). Tests are done and scores defined in relation to impact speeds of 64kph for frontal vehicle impacts and 50kph for side impacts. The aim of road design should therefore be to minimise the situations in which vehicles can impact at higher speeds.

There are two assessment processes: road inspection to rate protection, and risk mapping of historical accident data.

Fatalities on main interurban roads mostly arise from four accident types, head-on crashes, side impacts at junctions, impacts with roadside objects, and accidents involving vulnerable road users. Road infrastructure standards have not traditionally been based on an understanding of the occupant loadings arising from impacts, but have reflected knowledge of the injury outcomes observed with different roadside layouts. Recent tests of vehicle impacts with small diameter posts

in Britain have resulted in a tighter standard being required for protection from impact with these posts. This is particularly pertinent in the light of current experiments with lighter non-energy absorbing structures.
Providing information at this level provides a linkage between casualty reduction targets and traditional site and route assessment practice.

In Britain we have tracked performance over the network by looking at the distribution of roads with different accident rates – and dividing these into five risk groups. Comparing two time periods we can see some overall improvement – not only in the average accident rate for the whole network, but also in reduction in the proportion of routes at high risk.

We have also analysed the British data on the basis of the five main accident types. This shows how distribution of accident types varies between road types, and between different flow levels on the same type of road. We can also use this information to assess how risk will change if we adopt specific measures aimed at one of these accident types – eg median wire rope fences on single carriageway roads.

Some of the ways in which we need to extend thinking about the system model are illustrated in this slide. I will talk later about issues associated with the boundaries for acceptable behaviour. But the scoring is also based only on 4 star NCAP passenger cars. What is the implication when different vehicle mixes are present? Should we consider higher levels of protection if there are higher proportions of trucks in the traffic stream? Also there are key aspects of the condition of the road, which are not included in the visual inspection but which can influence accident occurrence. How do we combine these into the system?

The safety system principles for better road design within EuroRAP take as a starting point that vehicle occupants should be restrained, that they should not be impaired by alcohol, and that they should be keeping within the design speed principles on which the system is based. The same is true for setting standards for the passive safety of vehicles.

But equally important is to consider where the boundary is between behaviour appropriate to the targeted “safe system”, and behaviour that falls outside it. This is strongly driven by drivers’ attitudes and expectations, and is an important consideration for policy makers. Where attitudes are out of step with the proposed system rules, then both education and enforcement policies may be needed, or system rules may need to be redefined.

Risk curves relating to alcohol impairment are well established and similar curves for the risk associated with excess speed have been shown in several countries. It can be seen that the added risk for those who drive at speeds around 20% higher than the average speed is of the same order as the risk level at which alcohol limits are set.

The broader acceptance of speed polices also needs the consequences for safety to be set alongside those for mobility and for the environment. Safety engineers may wish to take the ethical approach that no speed should be allowed at which fatalities can occur. But the effects on other transport policies and on the transport economy must be recognised and a balance sought between potentially conflicting interests. Assessment procedures are currently being developed in Britain for revising speed limits on rural roads, using an approach which minimises total costs.

If there are limits to what can be achieved with education and enforcement, what could be the added role of more direct control of vehicle users? The biggest potential is likely to be from speed control systems. Experiments with voluntary speed control have been conducted in Sweden, Netherlands and Britain. These have shown the practicality and acceptability of the systems among the sample of drivers that have used them. But there remain considerable concerns among the public in general about both the practicality and the ethics of a system of mandatory control. It may well take up to 10 years further work to change these views.

In all three areas already discussed – seat belt wearing, driving while impaired, and speeding – technological solutions exist that could be applied to control behaviour more directly. These need to be integrated into wider systems (for example satellite location systems, which may become widespread for many uses).

The need to manage the effects of new technology is well illustrated by the issues surrounding the use of mobile phones. Some countries are now legislating or issuing advice to drivers not to use hand held phones. The influence of hands free phones is less immediately obvious. A TRL study suggests that impairment of driving ability during a phone conversation can be greater for certain aspects of driving performance than impairment from alcohol, even allowing for the fact that drivers tend to lower their speeds when using the phone.

So far I have been focussing on reducing casualties resulting from behaviour that falls outside that on which the majority of the road and vehicle system is proposed to function. Let us turn now to the issue of trying to ensure that the behaviour on which that system is based is consistent with the behaviour of the large majority of the population. This is dependent not only on the public perception of risk but also the extent to which other objectives are in conflict with that perception.

Whilst a greater degree of control may be one way of achieving this change, it also brings other problems. Once some external control is applied, road users' expectation of safety increases. This affects not only the level of safety they expect, but also the extent to which they see their own actions as being responsible for maintaining that level of safety.

The introduction of external control also has important implications for the managers of the system. In Britain, there is clear evidence of higher expectations of safety from publicly managed transport systems such as rail, than from systems which are based on individual behaviour. These expectations are expressed through the media and through politicians, and can result in pressure for policies which are then based on distorted valuation of the casualties saved by one system compared with another.

In both urban and rural safety situations now there is a need for a close dialogue with representative road user bodies to ensure that safety measures that are introduced are fully understood and accepted. In Europe the DUMAS project explored the processes for doing this for urban safety management. One of the prime objectives of EuroRAP is to look at the safety of the interurban road network from both the road user and road authority viewpoints, and to generate more open dialogue about the level of safety that should be provided within the system.

This raises a number of key questions

- How can the public to influence decisions in positive way
- What levels of safety should the individual expect to be provided
- What does society as a whole consider appropriate to provide
- How are solutions reached that balance these viewpoints
- How should risk be reduced to the levels decided, in a transparent way

How do road users think about risk and what do they perceive it to be? EuroRAP analyses show how different measures of risk yield different messages. These maps relate to central England. The first shows accident density and thus mainly highlights the roads with high flow levels. The second shows the risk per vehicle km, which is the risk to the individual driver. This is the map mostly frequently used by motoring organisations to highlight risk. But increasingly it is being combined with the first map to give a broader picture. But to highlight priorities for action we need first to look at risk in relation to similar roads – a third map, and ideally to assess potential for accident reduction by reducing risk – the fourth map.

Risk assessment calculations are being increasingly used as a means of assessing potential liabilities. Highway authorities face these liabilities just like any other managers, and should ensure they have a good assessment of them. Risk arises from a combination of the probability of an incident occurring and the likely outcome in terms of injury. Authorities may wish to set limits to each of these separately, for example in terms of only accepting one death per million events, or to the combined risk as an overall number of deaths for a given traffic flow. At levels of risk already below such an intolerable threshold, investment in further casualty reduction can be targeted on the basis of benefit/cost criteria commonly used in many countries.

Guidelines are typically recommended by Health and Safety Agencies for levels of risk tolerability that can be applied to a wide range of activities – for both employees and for the general public. The key issues for any transport safety authority are at what level to set the intolerable threshold, and how far they are prepared to invest to reduce risk below this level. One of the problems with current procedures is that a budget for road improvement is often defined in terms of "what can be afforded", and then decisions are taken as to how best to spend it. This leads to piecemeal improvements. A full evaluation of risk, and an assessment of what changes are required to the whole network in order to achieve a targeted lower level of risk, would lead not only to a clearer debate on what society wants to achieve and is prepared to afford, but also to wider mass action programmes where investment can benefit from economies of scale.

In summary, we need to continue to develop the basis of a road and vehicle system that will contain injury levels. And we need to manage behaviour within that system. But this requires more debate on public acceptability of risk, and the role of control systems. We need to define investment budgets that target what we want to achieve not simply prioritise what is available. The biggest challenge for the future may be to ensure that safety policy invokes a positive response from drivers rather than being seen as punitive. Only then will there exist a wide enough consensus to ensure that behaviour is appropriate to the “safe” road system implemented.

Rudolf Krupp
Federal Highway Research Institute (BASt), Germany

Improving road safety by optimising automotive insurance systems

One of the goals of the German Road Safety Programme is to consider whether driver-related insurance components (that means: Bonuses for good behaviour – surcharges for undesirable behaviour) can tap a potential for improving road safety.

BASt therefore initiated and financed a research project to have analysed potential new ways to improving road safety by optimising automotive insurance systems.

I want to report on the results found by a consortium of researchers.
I start by looking into the network of

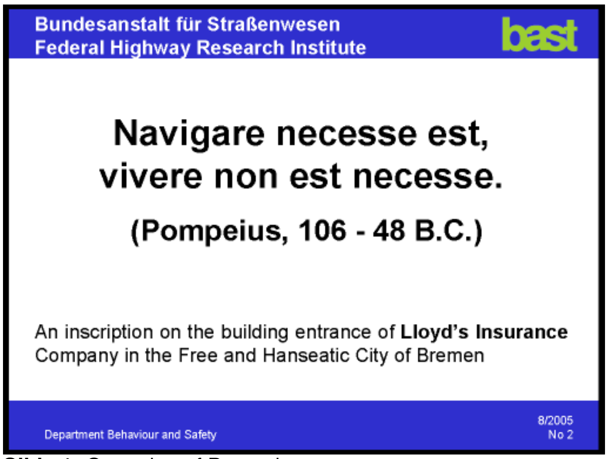
Mobility, road safety, and insurance.

The German „Programme on Improving Road Safety“ launched by the Federal Ministry of Transport, Building and Housing in 2001 begins with the following message in the first sentence:

> „To be mobile means a high degree of freedom and quality of life“.

The main topic of the road safety programme - „Road Safety“ itself - is mentioned later in the programme - not earlier than in the fourth or the fifth sentence. This order clearly shows the relative importance of mobility and safety:

Mobility comes first, road safety follows suit.



Slide 1: Quotation of Pompeius

That mobility takes precedence - this fact is neither the sign of a today’s modern motorised society nor is it typical for a motor car production based economy.

Already two thousands years ago, the Ancient Romans captured it in a nutshell:

“Navigare necesse est, vivere non est!”
In loose translation: “Mobility is a need - Survival is not a need!”, said Pompeius - one of Caesar’s colleagues in the triumvirate.

You may read today this sentence as inscription on the building entrance of Lloyd’s Insurance Company in the Free and Hanseatic City of Bremen.

Three conclusions can be drawn from the content of the sentence and where it can be read:

(1) Mobility - transport of persons and goods - is very essential for quality of life, progress, prosperity, growth and employment.

(2) Mobility entails sacrifices that have to be endured.

(3) Insurance companies have discovered an important business segment between the opposing poles of mobility and accidents.

Let us again look back into the history and analyse the positive role the invention of ship insurance played for the development of ocean navigation.

The risk of a ship disappearing with everyone and everything on board could not be taken on by a single businessman.
The invention of ship insurance made it possible to distribute the risk among many individuals.

This led to an increase in international trade, rise in mobility and thus increased prosperity.
And it was not a surprise that at the same time, more ships sunk and more seamen died than before.

And today in road traffic? Only a few motorists could afford to drive a car without third party liability insurance. As in case of a third party claim of damages they would not be able to balance the claim because of their limited resources. Therefore third party liability insurance has even become mandatory.

Whoever drives a car has to protect himself against third party liability claims. In case of owning a new and expensive car also comprehensive insurance against heavy material damage is often taken out on voluntary basis.

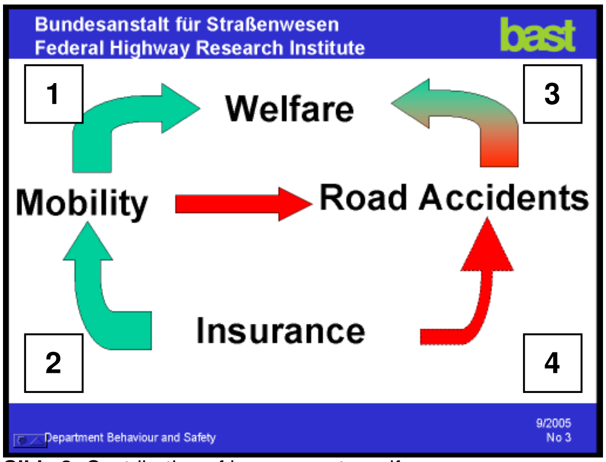
Even pedestrians as well as cyclists are also supposed to insure themselves against third party liability claims.

We resume:

- Economic progress and welfare needs mobility.
- Mobility needs insurance.

Insurance replaces the individual's forgoing of exposure to risk through an economically more favourable distribution of any accident cost among all insurance policyholders. This way, insurance acts as an instrument for augmenting risk exposure by allowing more mobility.
Concerning our goal to improve road safety, insurance confronts us with a paradox:

Without insurance there would be less mobility and therefore, less economic activities and less prosperity.



Slide 2: Contribution of insurances to welfare

- But with insurance, we have more accidents because of larger exposure to risk and welfare losses because of accidents.

Apart from the indirect negative effect, insurance impose on safety by means of quantitative growth of exposure towards risk activities, another negative effect on safety results from the fact that insured individuals do behave more carelessly than uninsured ones do.

Let us go back to the example of maritime insurance mentioned earlier:

An insured businessman dares to navigate into more unknown areas during more unfavourable climate and worse weather than an uninsured single businessman would dare. Such behavioural changes are referred to as „moral hazard". They are inextricably linked together with insurance.

„Moral hazard" can be expected particularly to a strong extent, the better and the more any damages are fully covered by the insurance; and the higher the probability of the damage is influenced by or depends on any careless versus careful behaviour of the insured person.

- Thus, „moral hazard behaviour" reduces the otherwise likely positive effect of increase in risk. In extreme cases it can even lead to non-productivity and negative effects ultimately.

Because of „moral hazard behaviour" some risks can only be insured partially or they cannot even be insured at all, in order to avoid inefficiency.

In car insurance, insurance companies try to protect themselves against careless behaviour:

- First of all by demanding excess from the insured person, especially in comprehensive insurance, a deductible is the rule. Respectively in third party liability insurance in cases of gross fault or even criminal negligence (for example: drunk driving), the claim of third party is fully covered by insurance but the insurance charges the client for reimbursing a part of the claim cost.
- And secondly, insurance companies try to cope with moral hazard behaviour through a bonus/malus system.

In the bonus/malus system, no claims bonuses are granted gradually and step by step after a relatively long period of claim free term of insurance. However, downgrading in the event of damage takes place immediately and at a faster pace.
This creates an incentive for the insured persons to make serious efforts to save a no claims bonus

through careful behaviour once they have achieved it.

How can under these circumstances car insurance be mobilised to give better incentives to improving road safety?

Motivated by international analyses launched by OECD and published in 1990, followed by two OECD-Conferences in Amsterdam and Tallinn as well as a BASt-research project performed by BAUM and KLING from Cologne University, BASt followed up on the topic.

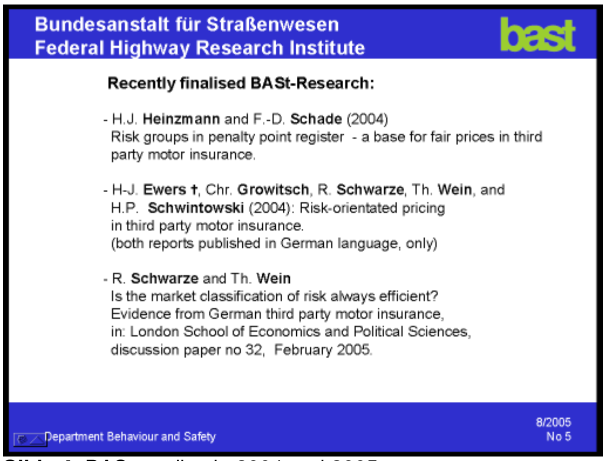
Based on the results found so far and backed by the Federal Transport Minister's Road Safety Programme, we started another research project in which we wanted to have two issues examined:

The question
(1) whether the Central Register of Traffic Offenders says anything about the risk behaviour of the driver, and
(2) whether and how the premiums in German third party car insurance can be classified according to the penalty points in the Central Register.

The project was carried out by a team of researchers from

Federal Bureau of Motor Vehicles and Drivers in Flensburg
Berlin Technical University
University of Luneburg and
Berlin Humboldt University.

Slide 3: Research in the field "Roadsafety and insurance"



Slide 4: BASt studies in 2004 and 2005

Professor EWERS who had drawn up the up the design of the project unfortunately died shortly after the project had started; nevertheless, his team managed the task perfectly.

They approached the problem by analysing motorcar insurance systems all over the world. I have to restrict my report to their findings for Germany.

The insurance industry in Germany had been regulated up to 1994, the year when the European Union launched the Third Non-Life Insurance Directive.

Up to then, the premiums had to be examined and approved by the German Government. The main criteria for premium differentiation in terms of regulation had been:

- horsepower,
- the region in which the vehicle is registered,
- the occupation of the insured car owner (for ex., discounts for civilservants).

Subsequent to the Third European Non-life Insurance Directive, there was complete deregulation of the insurance industry. Ever since then, companies have been free to carry out their risk classifications according to self-selected criteria and offer them on the market.

Analyses performed by WEIN and GROWITSCH showed the following results:

In addition to the old factors just mentioned, the insurance companies have introduced completely new additional criteria. Their goal was to find criteria which allowed a better prediction on road safety related behaviour of their clients, especially new clients whose behaviour is hidden to the insurance company.

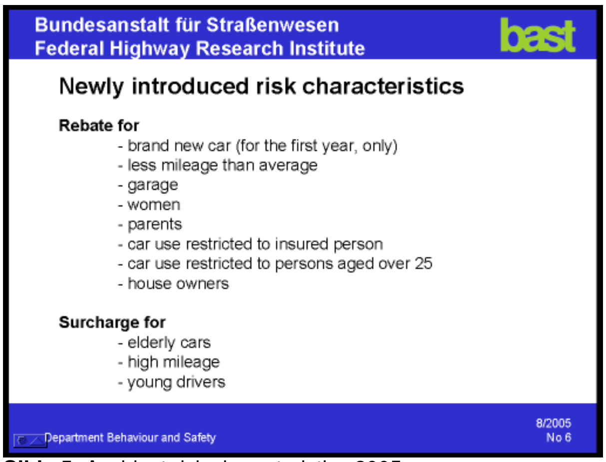
In doing this, they were very imaginative: Discounts were awarded for:

- New vehicles (96 %)
- Low mileage (96 %)
- Garage (96 %)
- Some occupational groups (86 %)
- Women (42 %)
- Parents with children (42 %)
- Driving experience
- Restricted circle of drivers of the vehicle (48 %)
- Home ownership
- First/Second car

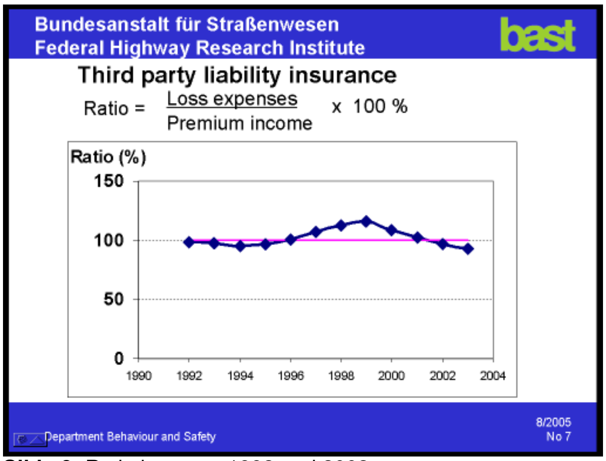
Surcharges were raised for:

- Old vehicles (96 %),
- Particularly high mileage (96 %),
- Young drivers (94 %),
- Drivers other than vehicle owner (48 %).

On the whole, we can conclude that the German insurance companies have used their new freedom of price determination in order to experiment with the new risk classifications. The main reason for the new risk classification was because the average accident rate and accident severeness of the damages were expected to drop and because the insurance companies hoped to lower their premiums as a result of that and win over policyholders from their competitors.



Slide 5: Accident risk characteristics 2005



Slide 6: Ratio between 1992 and 2003

Their expectations turned out to be a disappointment:

The Ratio of cost of claims to the contributions rose from 95 % in 1995 to almost 116 % in 1999. The losses forced the firms to raise the premiums again and to implement additional cost saving activities. As a result, the Ratio has since dropped again below 95 %.

Only a few new types of rate criteria have improved the risk classification. Particularly,

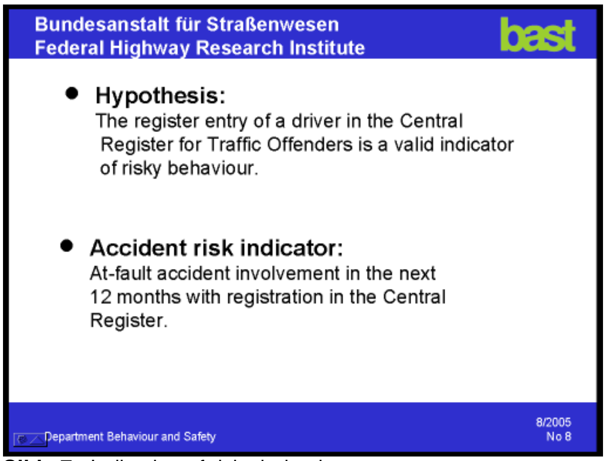
- the annual mileage,
- how old the car is, and
- restricted circle of drivers (no young drivers)

seem to be characteristics that describe the risk of a vehicle well. All other new types of rate criteria had no significant influence on the claims burden of the insurance companies.

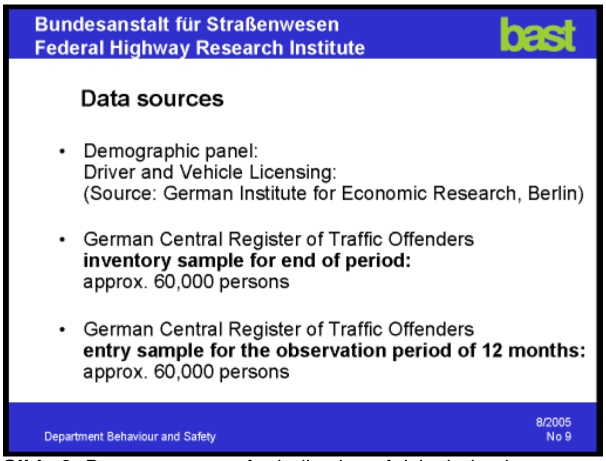
Nevertheless, most of the new additional criteria are still in use even if their impact is arguable as most of the criteria are not appropriate to change the client's behaviour.
In a discussion on the whole purpose of the criteria, I had with a manager from the statistical division of a famous insurance firm, he called the new rather vain criteria "gimmicks".

This leads to the question whether it were better to focus the risk classification on characteristics that could be influenced by the driver himself through safer behaviour on the road.

SCHADE and HEINZMANN approached the question as follows:



Slide 7: Judication of risky behaviour



Slide 8: Data ressources for indication of risky behaviour

The future risk of persons causing damage in road traffic is not only

- as done in the bonus/malus system – predictable from prior accident involvement, but also from prior traffic offences.

This raises the question whether it is possible to predict future accident involvement from the number of penalty points in the Central Register.

The empirical analysis was based on three large samples:

(1) The demographic analysis was based on a representative sample of some 22,000 persons with a private car license.

(2) Some 60,000 persons registered because of former traffic offences were grouped according their demographic status, especially sex and age, as well as the number of their entries in the Central Register registered on a reference day.

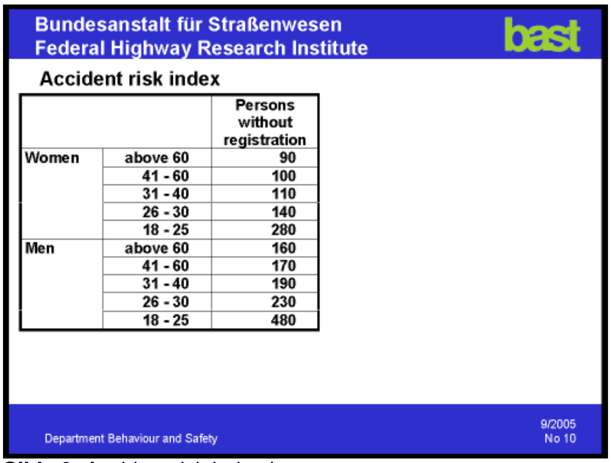
(3) A group of some 60,000 traffic offenders who had been found guilty of causing an accident during a reference period of twelve months – grouped according the same demographic status criteria as the former group.

The analysis of accident involvement within the twelve months period showed the following results:

Firstly, we see the familiar classification from the accident statistics according to sex and age: If we give women between the ages of 41 and 60 a basis index of 100 Dr. Schade used to call this group the “Gold-standard-ladies” – then the risk for young women between the ages 18 to 25 increases by 2.8 times, for men above 60 it increases by 1.7 times and for young men it increases by 4.8 times.

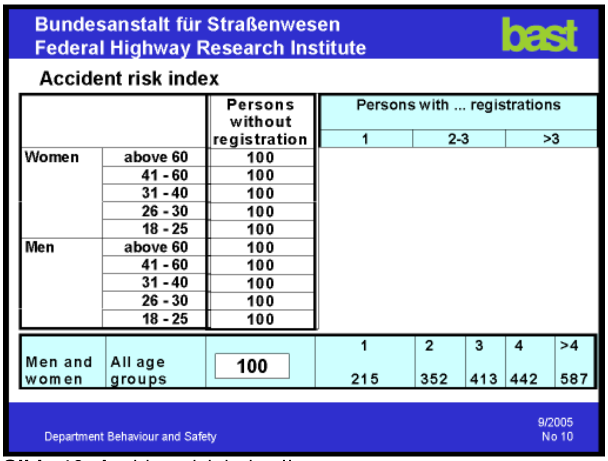
Since an individual can neither change his age nor his sex, the question becomes more interesting as to how the accident probability changes with the number of traffic offences registered in the Central Register.

The key result of the analysis was as follows:



		Persons without registration
Women	above 60	90
	41 - 60	100
	31 - 40	110
	26 - 30	140
	18 - 25	280
Men	above 60	160
	41 - 60	170
	31 - 40	190
	26 - 30	230
	18 - 25	480

Slide 9: Accident risk index I



		Persons without registration	Persons with ... registrations: 1	2-3	>3
Women	above 60	100			
	41 - 60	100			
	31 - 40	100			
	26 - 30	100			
	18 - 25	100			
Men	above 60	100			
	41 - 60	100			
	31 - 40	100			
	26 - 30	100			
	18 - 25	100			

			1	2	3	4	>4
Men and women	All age groups	100	215	352	413	442	587

Slide 10: Accident risk index II

I start with subsuming the result:

- Persons with register entries have a much higher accident risk in the next twelve months than persons without registration - regardless of their sex and age.
- With increasing number of penalty points the accident risk is increased many times over.
- With one entry risk increases by factor 2, with two entries by more than factor 3, and so on.
- And: The more register entries, a person has, the higher her accident risk is!
- And: Drivers with many Register entries do not only have accidents more frequently – They also have more severe accidents associated with personal injury and/or death involving a third party.

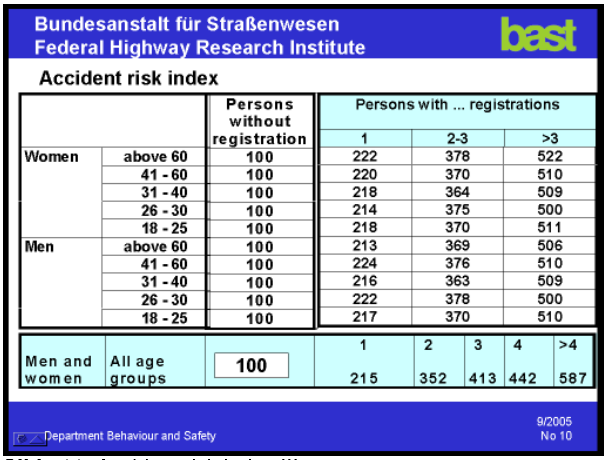
Let me show you some details: If we take “Gold-standard-ladies” again as a first example:

A comparison of these high safety performing women without entries traffic offences with women with one entry shows a risk increasing by factor 2.2, with two entries risk increases by almost four times, and with four or more entries, it increases by five times. This same trend is also shown in all age groups of the women as well as of the men.

Therefore we can trust, the Central Register is a very good source for predicting future accident risk. Whereas, knowing past accident involvements that the insurance companies use as the basis of the bonus/malus system, does not at all increase the prediction accuracy for a given sex and age.

Thus, there arises the need to complement the current bonus/malus system by taking the registrations in the Central Register into consideration.

Years free of registered traffic offences should lead to an additional bonus and entries of penalty points should lead to extra premium. This would have the advantage that penalty free behaviour is rewarded whereas downgrading from bonus to malus does not take place only after an accident has happened but instead earlier before an accident will have happened.



		Persons without registration	Persons with ... registrations		
			1	2-3	>3
Women	above 60	100	222	378	522
	41 - 60	100	220	370	510
	31 - 40	100	218	364	509
	26 - 30	100	214	375	500
	18 - 25	100	218	370	511
Men	above 60	100	213	369	506
	41 - 60	100	224	376	510
	31 - 40	100	216	363	509
	26 - 30	100	222	378	500
	18 - 25	100	217	370	510

			1	2	3	4	>4
Men and women	All age groups	100	215	352	413	442	587

Slide 11: Accident risk index III

Implementation of the findings

It is rather not very easy to transfer the findings into the German motorcar insurance system. This is why the German third party insurance system insures the owner of a vehicle. Whereas, the Central Register of Traffic Offenders describes the penalty point status of an individual driver. And in many cases, both do not match.

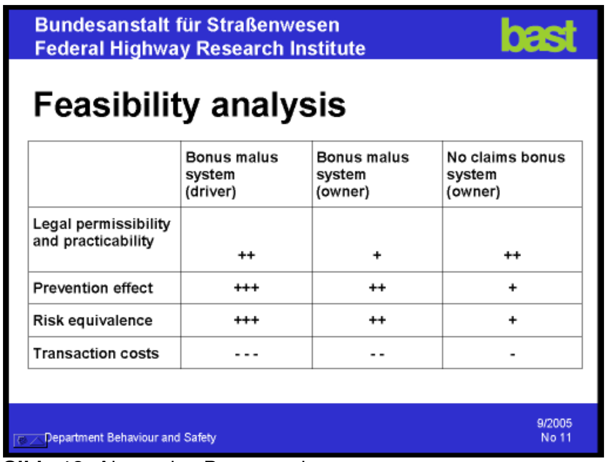
Therefore the researchers from the both Berlin Universities examined the possibilities that exist for implementing the findings into a third party insurance system.

The researchers distinguished three alternative implementation models:

(1) Entry related bonus/malus based on driver’s insurance

(2) Entry related bonus/malus based on owner’s insurance

(3) Entry related no claims bonus based on owner’s insurance



	Bonus malus system (driver)	Bonus malus system (owner)	No claims bonus system (owner)
Legal permissibility and practicability	++	+	++
Prevention effect	+++	++	+
Risk equivalence	+++	++	+
Transaction costs	- - -	- -	-

Slide 12: Alternative Bonus-malus-system

Professor Schwintowski's and Dr. Schwarze's analyses showed that all the systems are legally permissible as independent selection systems in a liberalized insurance market.

An entry-based bonus/malus system is the most efficient in terms of risk equivalence and accident prevention when it is embedded in the driver's liability and it awards a malus after an entry and a bonus in the penalty-point free years.

The embedding of this approach in the existing owner liability reduces the risk equivalence and prevention effect because the improved incentives towards safer behaviour do not in any case directly address the driver of the car but the owner, only.

A system change from owner liability to driver liability is however expensive in terms of transaction cost.
One remark from my personal point of view addressing the colleagues from the ITS research field:

Interesting research approaches by the ITS sector could possibly be addressed with regard to this:
A car insurance based on a combination of owner insurance and driver insurance by means of a SMART-Card that maintains driver-related information and calculates a specific "risk combination premium" for a car driven by a specific driver might be an innovative alternative.

Back to changes with less transaction cost: A simple system of no claims bonus (after years without penalty points at the Central Register) is a weak but nevertheless positive instrument in comparison with the driver or owner liability bonus malus sy-stem.

Its advantage lies in the fact that it can be applied implicitly in the existing owner's liability insurance system.
If we consider the administrative costs, then a simple no claims bonus model is the model that is easiest to implement.

In the current model of the owner's liability, a rebate can simply be given, if the insured person is willing to disclose his Central Register penalty entries to the insurance company – a change from gimmicks to real behaviour indicators, only.

During the insurance policy contract period bonus and malus can be imposed following the claims history as usual but additionally taking Register entries into account.

BASt presented these results to some 50 German insurance firms in April of 2004 - hoping for positive reactions. Precious few firms visited us and asked for more information.

At long last, in May this year, one insurance company, AXA Insurance in Cologne, introduced a discount of 20% for young drivers - provided that they accept an obligation to disclose their Central Register records to the insurance company.

However, whether this leads to a pull effect away from other insurers as well as - if they follow AXA by imitation - to successive improvement of the behaviour-oriented risk differentiation in car insurance, remains to be seen.

The obvious problem is that German insurance companies use the mandatory automotive third party liability insurance as a key to new clients for selling them non compulsory insurance contracts, such as life insurance, household, employment, disability insurances etc. They are not necessarily aiming at making profits in third party automotive liability insurance business.

Therefore AXA Insurance company's innovation will probably not prevail in the competition until when specialised life respectively specialised household insurance firms appear on the market. If they offer cheaper rates than the global all in insurance companies that subsidize their car insurance segment, the competitive pressure could have a stronger effect on car insurance rates.
Maybe the competition will open up a better chance indirectly for the bonus system of the Central Register described here.

Der Bundesgerichtshof, the German Federal Constitutional Court in Karlsruhe, ordered lawmakers in a ruling on the 26th of July, 2005, to tighten the statutory requirement of financial reporting of life insurance companies.

The goal is not only to increase the transparency in the use of premiums but also to share hidden profits justly with the insured persons.

Appropriate tightening measures for the other insurance segments are also underway. That way, there is hope that the subsidization of car insurance could be made more difficult in the future. It would also definitely be a contribution to the internalisation of road traffic costs as called for in the European Union White Book. And any internalisation of external cost is a step to a more efficient balance between mobility and safety by putting more weight on the safety scale.

Many thanks for your attention!

Reports on the

1st FERSI Scientific Road Safety Research - Conference

General Topic „Data, strategies and communication“

Workshop 1

Data management and analysis

Workshop 4

Road safety attitudes

Workshop 7

Safety strategy and planning – Part I

Workshop 10

Safety strategy and planning – Part II

Workshop 1

Data management and analysis

Chairman

Josef Mikulik (CDV) und Paul Wesemann (SWOV)

Vorträge

Aron, M., Cohen, S., Seidowsky, R. (INRETS)

“Accidents analysis on a motorway weaving section”

Bijleveld, Frits, Commandeur, Jacques (SWOV)

“The basic evaluation model for the analysis of time series, and extensions“

Malasek, Jacek (IBDIM)

“Road accident information storage system and cooperation between police and roads administration”

Vis, Martijn (SWOV)

“SAFETYNET”

Winkelbauer, Martin (KuSS)

“RONCALLI (Information platform for traffic relevant information)“

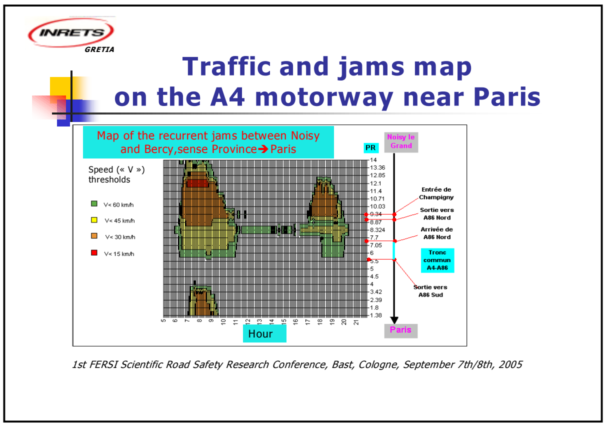
Aron, M., Cohen, S., Seidowsky, R.
INRETS,
France

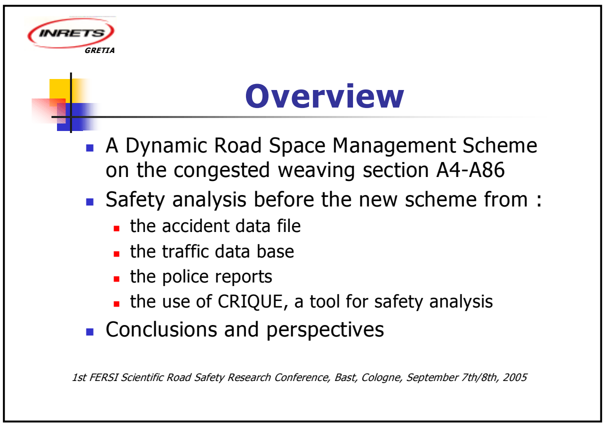
Accidents analysis on a motorway weaving section

In order to reduce the traffic congestion on a French motorway near Paris, a new lane management scheme is tested on a weaving section. The impacts of this strategy will be assessed from the traffic and safety points of view. Here we present this dynamic roadspace management and the safety analysis of the section before its implementation. Some statistical insights are provided in order to prepare the before/after assessment.

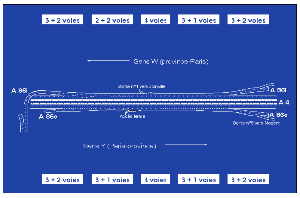
Two hundred accidents are related to traffic characteristics which prevails at the moment of the accident, thanks to the traffic data. The influence of the road characteristics and of the weather conditions are taken into account. Different sources of data, including police reports, are processed with a specific software (CRIQUE), which combines an operational research algorithm for reconstituting missing data with artificial intelligent methods able to cope with imprecise or uncertain information. This leads to the identification of the frequency of different causes of accidents such as traffic jams, lane changing, two-wheels driving between lanes. The accidents are also classed with respect to the nature of the first collision.

Some perspectives for forward analysis are given, including a quantitative model and other sources of information (in particular for a better knowledge of the two-cycles traffic).
These classifications improve the understanding of the accidents; they are crucial for traffic management, and will be the basis for assessing the safety impact of the dynamic road space management.

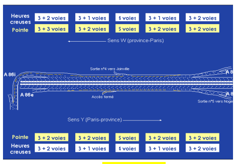




Lanes before/after the new management scheme



Before



After

Peak

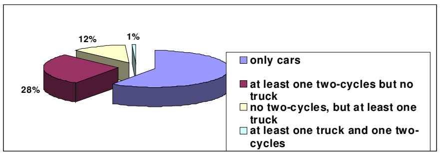
Off-Peak

Safety analysis before the new management scheme

From

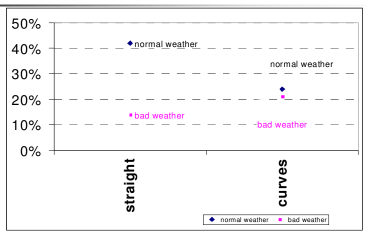
- The accident data File (BAAC)
  - Types of vehicles involved
  - Occurence of curves according to the weather conditions
  - Main contributing factors to the accidents
- The traffic data base : the hourly rate of accident
- The police reports : the information
  - Impact of density, speed of the flow, relative velocity
  - Main contributing factors to the accidents
- The classification software (CRIQUE)

Accident (BAAC) data file : Types of vehicles involved



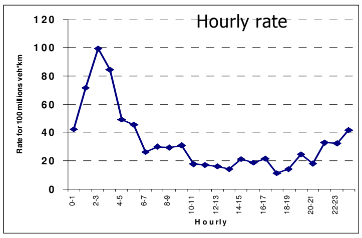
760 accidents (1492 implied vehicles) between 1996 and 2002

Accident (BAAC) data file : Curves and weather conditions



(760 accidents)

Traffic data base : the accident rates (by vehicle-km)



Between 2000 and 2002

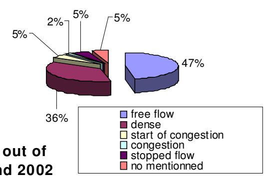
Accident (BAAC) data file : Main contributing factors

- manoeuvers (1/3 of accidents)
- during rain (1/3)
- curves (45%)
- vehicle between lanes (7%)
- secondary accidents (accuracy ??)

Information from the Police Reports

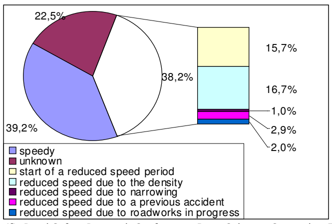
- **Speed and Density of the traffic**
- **Individual speed or relative speed**
- **Second manoeuver, contestation**
- **Impeding vehicle**
- **Loss of control before/after impact**
- **Turn about (« tête à queue »)**
- **Lane used by car**
- **Place of car/driver at the end of the accident**
- **Fall : cause/consequence of accident (50 mentionned)**
- **Sequence of collisions (particularly the first one)**

Accidents distribution related to traffic density



197 Police Reports out of 313 between 2000 and 2002

Speed of the flow at the moment of the accident



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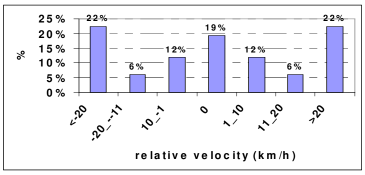
Stated relative velocity between two consecutive vehicles



446 values (two values for the vehicles implied in piled-up collisions)

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Main contributing factors from the police reports

- excessive relative velocity (38% of accidents) linked to congestion or high speed- high density, sometimes during a manoeuver
- excessive speed (6%) (under-estimated)
- manoeuvers during congestion= 1/7 of accidents
- secondary accidents (definition more accurate than in the accident database) (9%)

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CRIQUE tool

CRIQUE: Classification from Rules, Informatic data & Questions

→ **Classify** an event in a pre-definite class

- **Requirements**
  - Informatic data
  - Expert Knowledge
  - Questions to the user
  - Classes
- **Techniques**
  - Collection of additionnal relevant information
  - Missing Data Reconstitution
  - Taking into account umprecision

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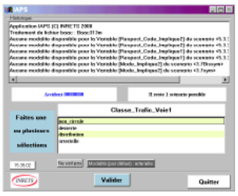
The process

- Data Acquisition
- Iterations with the user
  - Activation of logical rules
  - Selection/elimination of classes
  - Choice of a relevant question
  - Proposition of a default modality by the use of the statistical rules
  - Taking into account the answer



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Two specific questions for the future evaluation

Related to the first collision:

- Are there less **rear-end collisions?**
- Are there more accidents linked to a **lane-change?**

And :

- Is there any variation of the impact of **other contributing factors**?

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Improvement of BAAC within CRIQUE and the Police Reports: Type of the First Collision

	Front	Rear-end	Side	Piled-Up	Multiple	Other	No	Total²	%
Rear-end	.	.	.	.	3	3	.	57	29
Side	.	5	.	.	11	6	.	46	24
Barrier	.	.	.	.	6	16	.	45	23
Fall	.	.	.	.	2	7	.	24	12
Between 2 lanes	.	.	.	.	2	1	.	19	10
Other	.	.	.	.		1	.	4	2
Total	1	47	30	28	24	34	31	195	
%	1	24	15	14	12	17	16		

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Improvement of BAAC within CRIQUE and the Police Reports: Type of the First Collision

	front	Rear-end	Side	Piled-Up	Multiple	Other	Not	total	%
Rear-end	0	32	1	17	3	3	1	57	29
Side	0	5	17	6	11	6	1	46	24
Barrier	1	2	6	1	6	16	13	45	23
Fall	0	1	0	1	2	7	13	24	12
Between 2 lanes	0	7	6	3	2	1		19	10
Other						1	3	4	2
Total	1	47	30	28	24	34	31	195	
%	1	24	15	14	12	17	16		

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CRIQUE Classes related to the Major Cause

								%	Total
Speed or velocity [1] with a lane change	.	.		.	.	.	.	16%	34
Speed or velocity [2] without a lane change			.	.	.	.	.	24 %	51
Lane change [3] without 1,2	.	.	.	.	.	.	.	17 %	36
Fall [4] without 1,2,3		.	.	.	.	.	.	6 %	13
Impeded [5] without 1,2,3,4	.	.	.	.	.	.	.	4 %	9
Isolated [6] with-hand 1,2,3,4,5		.	.	.	.		.	14 %	30
Loss of Control without 1,2,3,4,5,6	.	.	.	.	.	.	.	18 %	37
Total								100%	210

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INRETS GRETIA

CRIQUE Classes related to the Major Cause

	Curve	Rain or Wet	Low Speed Flow	Slow-ing	Twilight	Night	Day	%	Total
Speed or velocity [1] with a lane change	.	.	21	.	.	.	.	16	34
Speed or velocity [2] without a lane change	20	25.	.	.	.	.	.	24	51
Lane change [3] without 1,2	.	.	.	.	.	.	.	17	36
Fall [4] without 1,2,3	9	.	.	.	.	.	.	6	13
Impeded [5] without 1,2,3,4	.	.	.	.	.	.	.	4	9
Isolated [6] with-hand 1,2,3,4,5	21	.	.	.	.	16	.	14	30
Loss of Control without 1,2,3,4,5,6	.	.	.	.	.	.	.	18	37
Total	92	75	62	70	17	76	117	100	210

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INRETS GRETIA

CRIQUE Classes related to the Major Cause

	Curve	Rain or Wet	Low Speed Flow	Slow-ing	Twilight	Night	Day	%	Total
Speed or velocity [1] with a lane change	10	13	21	17	3	8	23	16	34
Speed or velocity [2] without a lane change	20	25	24	22	8	22	21	24	51
Lane change [3] without 1,2	9	11	8	10	1	11	24	17	3
Fall [4] without 1,2,3	9	2	0	2	0	5	8	6	13
Impeded [5] without 1,2,3,4	5	6	0	2	0	4	5	4	9
Isolated [6] with-out 1,2,3,4,5	21	11	0	2	4	16	10	14	30
Loss of Control without 1,2,3,4,5,6	18	7	9	15	1	10	26	18	37
Total	92	75	62	70	17	76	117	100	210

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Conclusions

Simulation of the amenagement

- Accident Data Base+ Police Reports ➔ Safety analysis for the baseline situation
- The tool CRIQUE provided two classifications, addressing
  - The type of the first collision
  - The main causes of accidents

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Perspectives

- Traffic Data Base➔ added risk for different variables : period in the day), traffic, curves, slopes, weather conditions
  - These added risks might be combined in a quantitative model
- More data (surveys on the two-cycles traffic) might be included
- A4-A86 : Before/after evaluation of the accidents using empirical bayesian technique

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INRETS GRETIA

End of the presentation

Thank’s a lot for your attention!

Wir danken Ihnen für Ihre Aufmerksamheit!

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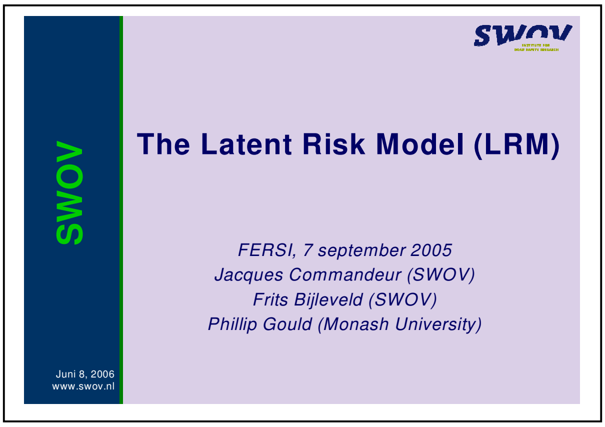
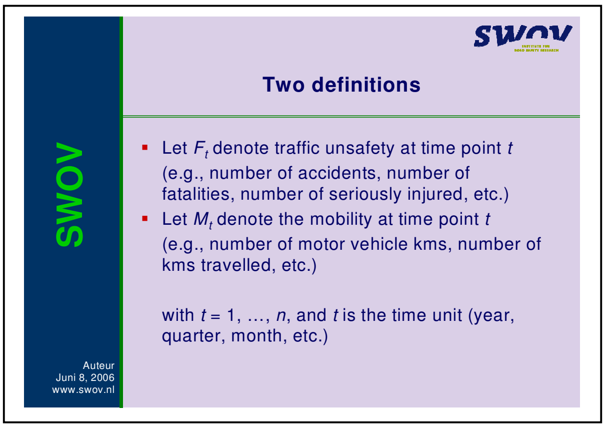
Bijleveld, F., Commandeur, J.
SWOV,
Netherlands

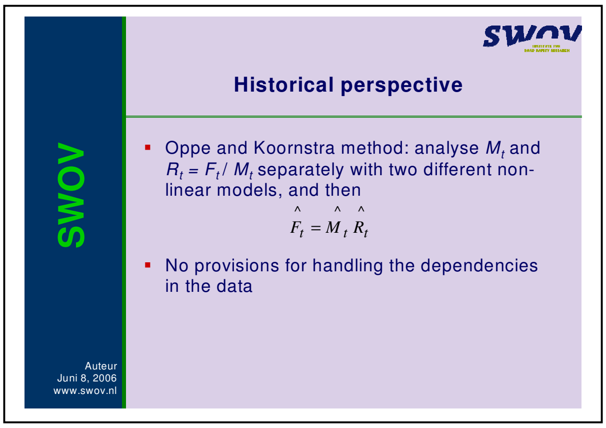
The basic evaluation model for the analysis of time series, and extensions

The Dutch Institute for Road Safety Research SWOV has decided to put more emphasis in its current research program on analyzing, explaining and forecasting road safety. One of the core projects aims at developing models that perform better in explaining and forecasting the development of accident risks than those that were used by SWOV in the past. The basic axiom remains the same: the number of accidents is the product of accident risk (number of accidents per unit of exposure) and the amount of exposure.

In this context a new model has been designed at SWOV based on the so-called state space or structural time series analysis modelling approach that is well equipped for handling the dependencies that arise when the data consists of repeated measurements over time. This new model –called the basic evaluation model- is a bivariate structural time series model where mobility and accidents are the manifest dependent variables, and risk and exposure are derived as latent variables. Details of the model wil be presented, as well as a number of extensions of the model.







Key assumption in LRM

- F_t = exposure$_t$ x risk$_t$ x noise$_t^{(1)}$
- Take the log, and:

  $\log(F_t)$ =
  $\log(\text{exposure}_t) + \log(\text{risk}_t) + \log(\text{noise}_t^{(1)})$

Modeling exposure in the LRM

- We assume the mobility figures to be subject to error (and only to be an *indicator* of the actual exposure):

  M_t = exposure$_t$ x noise$_t^{(2)}$, or

  $\log(M_t) = \log(\text{exposure}_t) + \log(\text{noise}_t^{(2)})$
- mobility is an observed/manifest variable
- exposure is an *unobserved*, *latent* variable (i.e., the mobility *from which the noise has been removed*)

Measurement equations LRM

Summarising so far we have:

- $\log(M_t) = \log(\text{exposure}_t) + \log(\text{noise}_t^{(2)})$
- $\log(F_t)$ =
  $\log(\text{exposure}_t) + \log(\text{risk}_t) + \log(\text{noise}_t^{(1)})$

where risk is also a *latent* variable

Time

- M_t for t = 1, ..., n is a *time series*; the same applies to F_t
- Observations in a time series are repeated measurements over time of one and the same phenomenon, and therefore *not independent*
- The analysis of time series data requires a different approach than cross-sectional data, which often are independent

Measurement equations, and Time

- $\log(M_t) = \log(\text{exposure}_t) + \log(\text{noise}_t^{(2)})$
  $= (a + bt) + \log(\text{noise}_t^{(2)})$
- $\log(F_t)$
  $= \log(\text{exposure}_t) + \log(\text{risk}_t) + \log(\text{noise}_t^{(1)})$
  $= (a + bt) + (c + dt) + \log(\text{noise}_t^{(1)})$

with a and c intercepts, b and d regression coefficients or slopes, and t is time

Time varying parameters

- $\log(M_t) = \log(\text{exposure}_t) + \log(\text{noise}_t^{(2)})$
  $= (a_t + b_t) + \log(\text{noise}_t^{(2)})$
- $\log(F_t)$
  $= \log(\text{exposure}_t) + \log(\text{risk}_t) + \log(\text{noise}_t^{(1)})$
  $= (a_t + b_t) + (c_t + d_t) + \log(\text{noise}_t^{(1)})$

State equations, and Time

$a_{t+1} = a_t + b_t + \text{noise}_t^{(3)}$ (trend exposure)
$b_{t+1} = b_t + \text{noise}_t^{(4)}$ (slope exposure)

and

$c_{t+1} = c_t + d_t + \text{noise}_t^{(5)}$ (trend risk)
$d_{t+1} = d_t + \text{noise}_t^{(6)}$ (slope risk)

If $\text{noise}_t^{(3)} = \text{noise}_t^{(4)} = \text{noise}_t^{(5)} = \text{noise}_t^{(6)} = 0$:
classical linear regression!

Since:

If $\text{noise}_t^{(3)} = \text{noise}_t^{(4)} = 0$ then:

$t = 1$: $a_2 = a_1 + b_1$
$b_2 = b_1$

$t = 2$: $a_3 = a_2 + b_2 = (a_1 + b_1) + b_1 = a_1 + 2b_1$
$b_3 = b_2 = b_1$

$t = 3$: $a_4 = a_3 + b_3 = (a_1 + 2b_1) + b_1 = a_1 + 3b_1$
$b_4 = b_3 = b_1$, etc.

Generally: $a_{t+1} = a_1 + b_1 t$ for t = 1, ..., n, and thus classical linear regression

SWOV

Model type

- This type of analysis is called a multivariate time series analysis by state space methods, (and more specifically: a bivariate local linear trend model)
- Also known as:
  - structural time series analysis
  - unobserved components analysis
- See Harvey (1989), Durbin and Koopman (2001)

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Illustration

Applying the LRM to

- F_t the annual number of single motor vehicle accidents KSI in the Netherlands
- M_t the annual number of kms travelled by cars in the Netherlands
- t = 1985, ..., 2003

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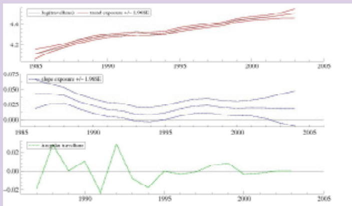
Exposure



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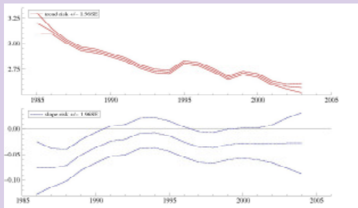
Risk



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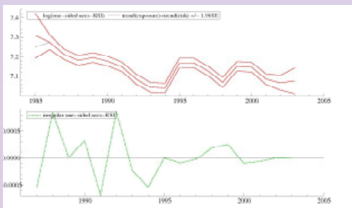
Single car accidents KSI



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Extensions LRM

- fixed explanatory and intervention variables can be added to
- the measurement equation of M_t
- the measurement equation of F_t
- the level of the exposure
- the slope of the exposure
- the level of the risk
- the slope of the risk

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Extensions LRM

- explanatory variables can also be treated stochastically, in the same way that mobility is treated stochastically in the LRM

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Extensions LRM

- Conflict models (transportation modes A an B, e.g., A = motorcycle, B = car):

  M_t^A = exposure$_t^A$ x noise$_t^A$

  M_t^B = exposure$_t^B$ x noise$_t^B$

  F_t^{AB} = exposure$_t^A$ x exposure$_t^B$ x risk$_t^{AB}$ x noise$_t^{AB}$

Extensions LRM

- Relative risk models (if mobility figures are not available):

  $F_t^{rear} = \mu_t^{rear}$ x $noise_t^{rear}$

  $F_t^{front} = \mu_t^{front}$ x μ_t^{rear} x $noise_t^{front}$

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Extensions LRM

- Accident severity models:

  M_t = $exposure_t$ x $noise_t^{(1)}$

  A_t^{KSI} = $exposure_t$ x $risk_t$ x $noise_t^{(2)}$

  F_t^{KSI} = $exposure_t$ x $risk_t$ x $vulnerability_t$ x $noise_t^{(3)}$

  F_t^{K} = $exposure_t$ x $risk_t$ x $vulnerability_t$ x $lethality_t$ x $noise_t^{(4)}$

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Concluding

The Latent Risk Model:

- Takes care of dependencies in time series data
- Simultaneously models traffic (un)safety, exposure and risk
- Handles measurement error in unreliable data
- Models risk as an unobserved latent variable
- Is flexible, and easy to extend
- Can be used to obtain forecasts for traffic safety in the future

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Road accident information storage system and cooperation between police and roads administration

Summary

The paper, written on the basis of research work "An investigation into and modernization of the current SEWiK road accident information storage system for the needs of the Roads Administration" prepared in the Road and Bridge Research Institute, covers:

- Road safety data for Poland
- New pattern of an accident report form
- Procedures for co-operation between Police and Road Administration.

The road safety in Poland is very poor. According to the Polish Road Safety Programme GAMBIT 2005 the number of people killed in road accidents should go down from 6 294 in the year 2000 and 5640 in 2003 to 3 500 in the year 2010 and 2 800 in 2013. The situation has improved since 1997 when number of fatalities was 7 311 but is still very high. Last year 2004 in 51 069 traffic accidents 5712 people have been killed and 64 661 injured.

The need to examine and apprise the information contained in the SEWiK system was found. Modification of the data base was arranged to make possible detailed analysis of the road infrastructure influence on the road safety. Current accident data bases do not permit a precise assessment of the impact of road on traffic safety because they do not contain complete information on roads, their technical features and surrounding. When completing accident report forms, policemen are often unable to give a precise indication of the scene of an accident because many sections of even national and regional roads have no points of reference - and a proper location of accidents is a starting point for an examination of high risk areas. More extensive information on roads made it necessary to produce a new pattern of an accident report form and implement changes to the system of gathering and processing data. The detailed instruction on how to fill in the form and record data was prepared.

The new pattern of an accident report form has two pages. Because of personal data protection reasons all information on accident participants are located on the second page. Such a solution makes it possible to distribute the first page to roads administration and other institutions interested in road safety analysis. The first page of an accident report form includes information on:

- Accident location (with a scheme and GPS coordinates)
- Description of accident location
- Road characteristics
- Lighting conditions
- Type of accident
- Damages
- Vehicles involved
- Reasons of accident.

An important part of the new data collection system was formulation of procedures regarding a flow of information on road accidents from police to roads administration and joint efforts to prevent accidents and eradicate accident black spots. The procedure for co-operation in data exchange on road infrastructure and verification of accident data covers:

- Putting information from accident report forms into the data base
- Verification of the data on casualties
- Verification of the data on accident location
- Preparation of overall data reports on traffic accidents.

The procedure for co-operation in liquidation of high risk areas includes:

- Exchange of analysis made by the Police and the Roads Administration
- Field survey of the road network
- Preparing the list of high risk areas
- Monitoring of the black spots liquidation.

The procedure of co-operation descriptions, as an annex to the agreement signed by the Police and the Roads Administration, will help in increasing road safety level in Poland.

1. Road safety in Poland

The development of the Polish road network does not follow an increase in vehicle fleet. In the country populated by 38.2 million inhabitants at the end of the year 2003 we had 11,2 million of cars and 2.2 million of lorries – what means about 100 percent increase since 1990. Difficult traffic conditions are one of the reasons making the road safety in Poland very poor.

During the year 2004 in 51 069 traffic accidents 5 712 people lost their lives and 64 661 were injured. There were also 424 938 (15,6% more than in 2003) traffic collisions reported to the Police and this number is each year higher by about 5 percent. The situation looks very bad, however, it is better than in the worse during last 10 years 1997, when in 66 586 traffic accidents 7 311 people have been killed and 83 162 injured.

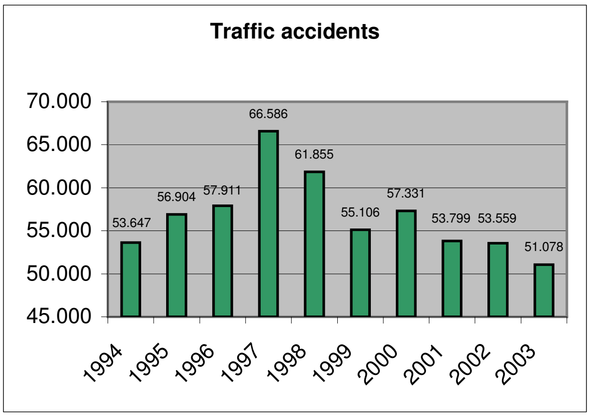
In 2004 over 81 percent of traffic accidents occurred as a result wrong driver's behavior – 4 301 people have been killed and 55 915 injured. The most important reason of those accidents was speeding (29.1 %).

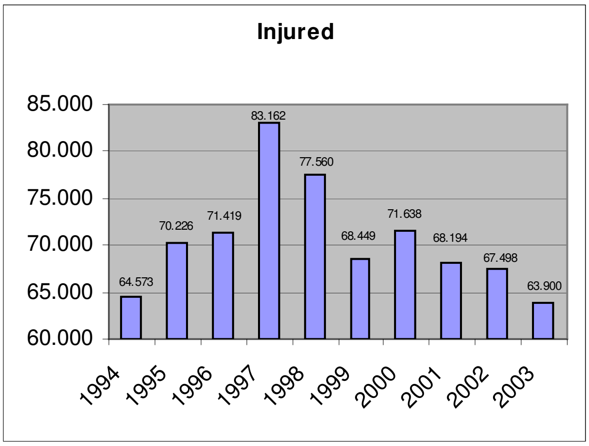
In 2004 out of 70 373 victims of traffic accidents 8.1 percent lost their lives. Most often the victims of accidents were:

- Car occupants (54.4 %)
- Pedestrians (24.8 %)
- Cyclists and mopedists (10.9 %)
- Lorry occupants (4.7 %)
- Motorcyclists (2.1 %).

People under the influence of alcohol were involved in 6 929 traffic accidents, where 837 victims have been killed and 8 450 injured. 67.3 percent of those accidents were caused by drivers and 29.9 percent by pedestrians.

Foreigners participated in 1 439 traffic accidents, where 281 people died and 2 210 have been injured. Over a half of those accidents (722) were caused by foreigners – 93.4 percent by the foreign drivers.





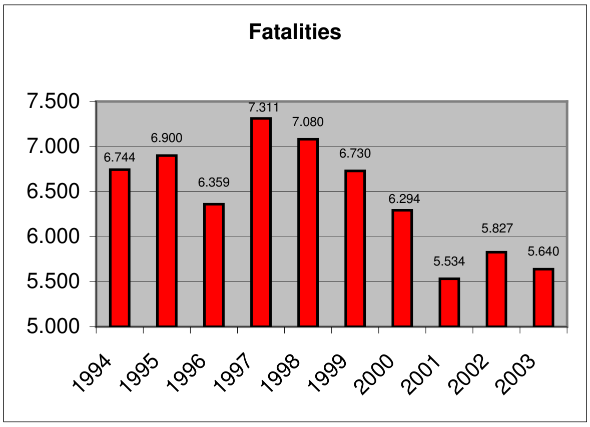


Figure 1: Road safety in Poland

"Road safety in Poland' – the report prepared in 1992 by the World Bank experts – is considered as a milestone in the history of preventive action in Poland. In 1993 the government appointed the National Road Safety Council, which one year later presented the first assumptions of the GAMBIT programme. The GAMBIT 2000 was endorsed by the council of ministers as the road safety programme for the years 2001-2010. The long term goal of this programme is to decrease the number of fatalities in traffic accidents to 4 000 in 2010. The new version of GAMBIT 2005 is more ambitious. The number of people killed in road accidents should go down from 6 294 in the year 2000 and 5 640 in 2003 to 3 500 in the year 2010 and 2 800 in 2013.

This goal looks quite difficult to be achieved. In my opinion the reason of some risky driver behavior in Poland is that for many people their life worth nothing, what could be connected with low economical status, unemployment, etc. This opinion should be proved however by comparative study which covers psychological aspects of driver's behavior in some Western and Eastern European countries.

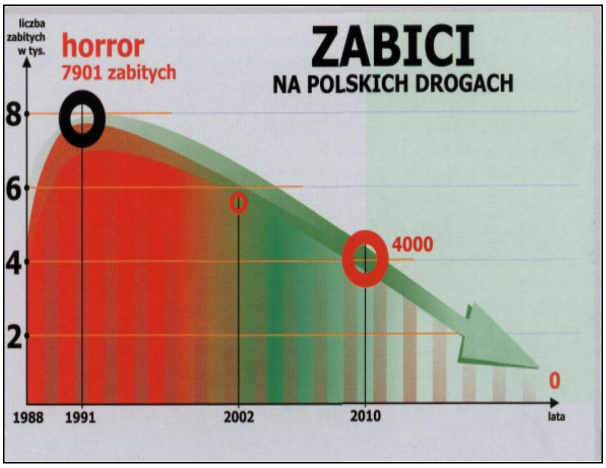


Figure 2: GAMBIT 2000 programme – from nearly 8000 fatalities to 4000 in 2010

The GAMBIT programme indicates 4 main problems in the first order:

- Excessive speed
- Alcohol
- Young drivers
- Unprotected participants of road traffic, i.e. pedestrians and cyclists.

The GAMBIT programme includes 4 system tasks:

- Improving the road safety management structure is designed to ameliorate regulations and create regional and local structures to guarantee the efficient implementations of the GAMBIT 2000 tasks.
- Expanding the information system plays a key role in keeping politicians informed about the condition of road safety in Poland and contributes to increasing the efficiency of road safety improvement methods.
- Audit will provide a means of systematic control over the process of planning, designing and building of the road infrastructure.
- Staff training is an indispensable condition for the realization of the three previous tasks.

2. New pattern of an accident report form

Collection of data on accident reasons and their location is an important method used for improving the road safety in Poland. These data should be precise enough, to help analyzing in detail the ways of decreasing number of traffic accidents and collisions. That is why the new pattern of an accident report form gives more information, in particular concerning location and road conditions. The front page of the accident report form can be used by the road administration, local governments, insurance companies and research institutes for delimitation of high risk areas and undertaking actions to make these places less dangerous for the road users. To avoid any misleading, a very precise 34 pages long instruction was elaborated, with definitions and description how to fill in all records.
Over a hundred changes in the pattern of the accident report form have been made after analyses of report forms used in France, Germany and Holland. All suggested changes have been discussed with the Polish Police Headquarters and the General Directorate of National Roads and Motorways. It was found that more information should be collected in particular on accident location, road and its equipment.

The new pattern of the accident report form has two pages and comprises 166 records and additionally detailed information on persons and vehicles involved. Because of personal data protection reasons all information on the accident participants are located on the second page. The front page of the accident report form includes 154 records with all information indispensable for road safety analyses. It starts with information on accident location (according to administrative country division: name of the county, town, etc.) and time. The accident location in detail can be described in several ways:

- By the road No. and the point of reference (in case of accidents outside build-up areas)
- By the address
- By distance from the nearest intersection
- By GPS co-ordinates

There is also a place for the scheme of an intersection with pictograms of different accident reasons and its precise location. The record No. 154 gives information on the speed allowed on the place of accident.

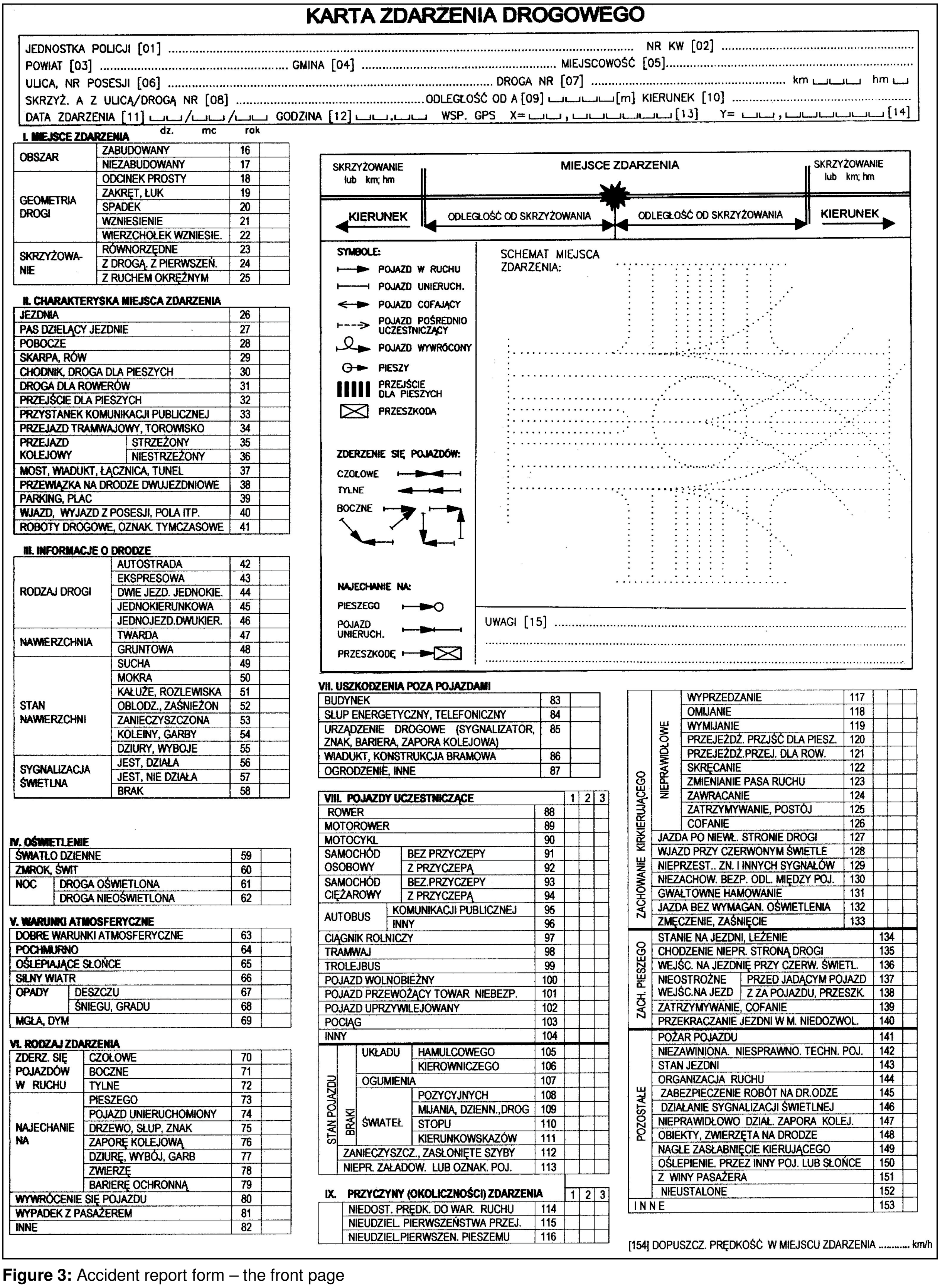
Other important data are grouped in 9 chapters:

- I – Description of accident surroundings (within or not build-up area, road alignment, type of intersection)
- II – Description of accident location (traffic lane, sidewalk, bicycle route, pedestrian crossing, bus stop, on the bridge, etc.)
- III – Road characteristics (road category, type of pavement and state of repair, traffic lights, etc.)

- IV – Lighting conditions (daylight, dusk or daybreak, illumination)
- V – Weather conditions (rain, snow, mist, strong wind, etc.)
- VI – Type of accident (front, side or back collision; strike against pedestrian, animal, tree, etc.)
- VII – Damages outside vehicle (building, fence, lamp post, sign post, traffic lights, etc.)
- VIII – Vehicles involved and their technical conditions
- IX – Reasons of accident (driver or pedestrian behavior, other reasons: like pavement poor state of repair, traffic engineering, etc.).

All information on traffic accidents are kept in the central data base which is used for:

- Elaboration of statistical data on accidents number by type for the whole road network
- Analyzing of observed trends and preparing reports on different aspects of road safety
- Elaboration of comparison analysis on road safety with other European countries
- Publishing annual reports on the level of traffic safety in the whole country and regions.



KARTA ZDARZENIA DROGOWEGO

JEDNOSTKA POLICJI [01] .... NR KW [02] ....
POWIAT [03] .... GMINA [04] .... MIEJSCOWOŚĆ [05] ....
ULICA, NR POSESJI [06] .... DROGA NR [07] .... km ___ hm _
SKRZYŻ. A Z ULICĄ/DROGĄ NR [08] ....ODLEGŁOŚĆ OD A [09] ___ [m] KIERUNEK [10] ....
DATA ZDARZENIA [11] __/__/__ (dz. mc rok) GODZINA [12] __.__ WSP. GPS X= __,______ [13] Y= __,______ [14]

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KIERUNEK — ODLEGŁOŚĆ OD SKRZYŻOWANIA — ODLEGŁOŚĆ OD SKRZYŻOWANIA — KIERUNEK

SYMBOLE:
POJAZD W RUCHU
POJAZD UNIERUCH.
POJAZD COFAJĄCY
POJAZD POŚREDNIO UCZESTNICZĄCY
POJAZD WYWRÓCONY
PIESZY
PRZEJŚCIE DLA PIESZYCH
PRZESZKODA

ZDERZENIE SIĘ POJAZDÓW:
CZOŁOWE
TYLNE
BOCZNE

NAJECHANIE NA:
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[154] DOPUSZCZ. PRĘDKOŚĆ W MIEJSCU ZDARZENIA .... km/h

Figure 3: Accident report form – the front page

- accidents number and their reasons to the governmental administration and other national and international institutions interested in road safety issues
- Elaboration of detailed analysis of data from the first page of the accident report forms by research institutes and the road administration.

The new central data base should give possibility for analyzing all aspects of the road safety in Poland. It will accept more than one information on accident location, reasons, roads and weather conditions – what will allow to present a wide description of traffic incidents and will help in giving the credible conclusions. The central data base will be equipped with:

- The list of all towns and villages with roads numbers and streets names for given country region
- A tool for analyzing road safety along most important road corridors, which include several roads or streets and intersections
- A tool for accidents searching by their location, which can be described by the road number, street name or characteristic place on the road section
- A tool for accidents listing according to specific record numbers, i.e. by years, type of accident, weather conditions, etc.
- A tool for accidents listing according to several record numbers, i.e. drinking and driving by an accident type, etc.
- A tool for data export to the data bases operated by the road administration and data import for incidents with verified location
- An automatic identification of cases when the given threshold of accidents and collisions numbers in certain place or within the time period was over passed
- Specific levels of accessibility for different data base users.

3. Procedures for cooperation between police and road administration

The analysis of recent practice in collection data on road safety in Poland indicated that there is not enough information on the influence of road and its equipment on the reasons of traffic accidents. It was found that for being sure about correctness of data on traffic accident location, the road state of repair and its equipment in the place of an incident, the strong cooperation between Police and the road administration is indispensable. Two procedures for such cooperation have been elaborated:

- For information exchange on road infrastructure and verification of accidents data
- For improvement of the road safety level and eradication of the accident black spots.

The procedures of cooperation are concentrated mainly on:

- Verification of data from the accident report forms
- Traffic incident analysis aimed at identification of high risk areas and most important threats in the road safety
- Prevention actions connected with road safety improvements
- Elimination of most important accident reasons within high risk areas.

The forms of agreement on cooperation between Police and the road administration on different levels (national, regional and local) have been prepared. The procedure of cooperation descriptions, as an annex to the agreement signed by the Police and the road administration will help in increasing road safety level in Poland.

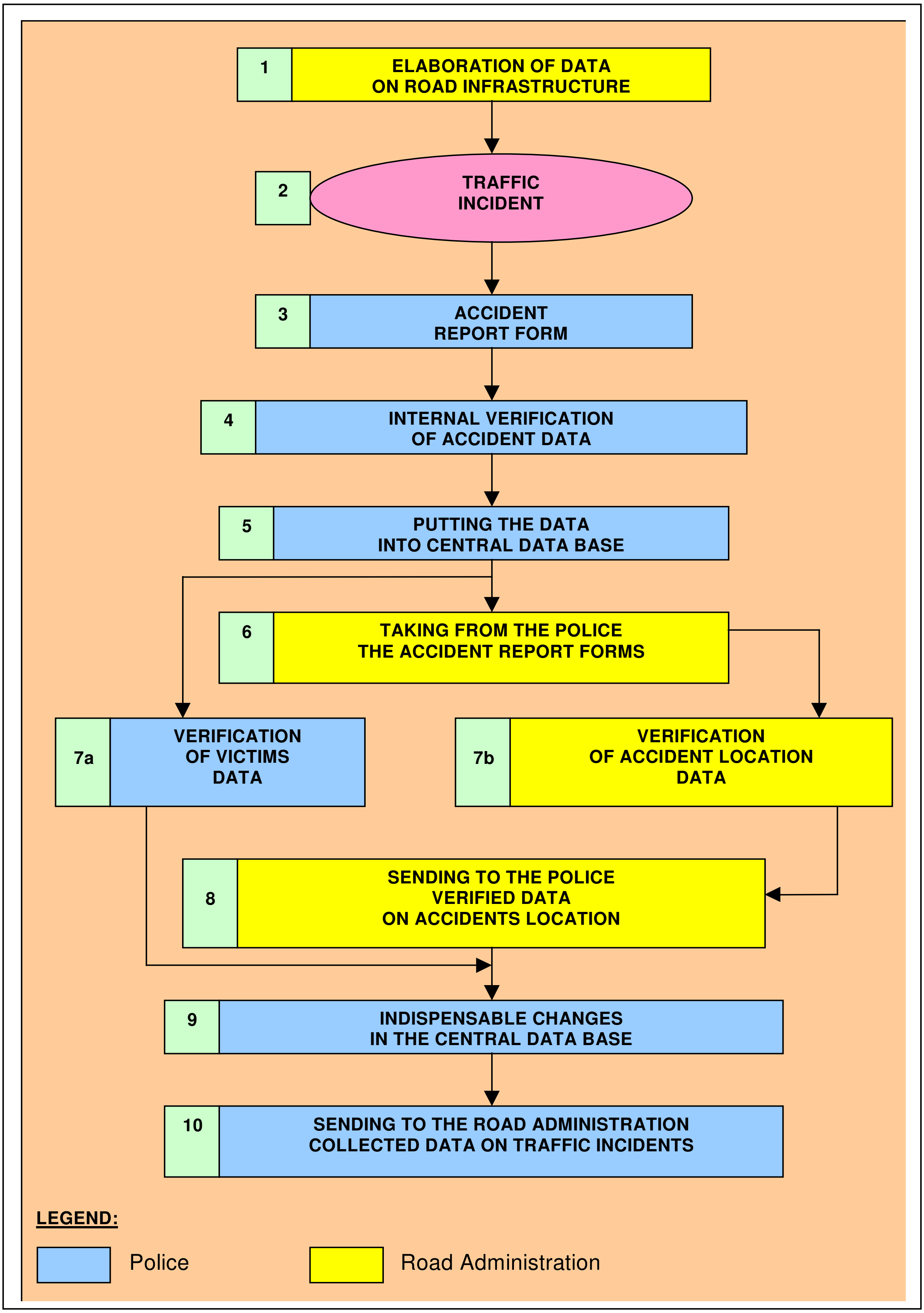


Figure 4: The procedure for cooperation between Police and the Road Administration in data on road infrastructure exchange and verification of accident data.

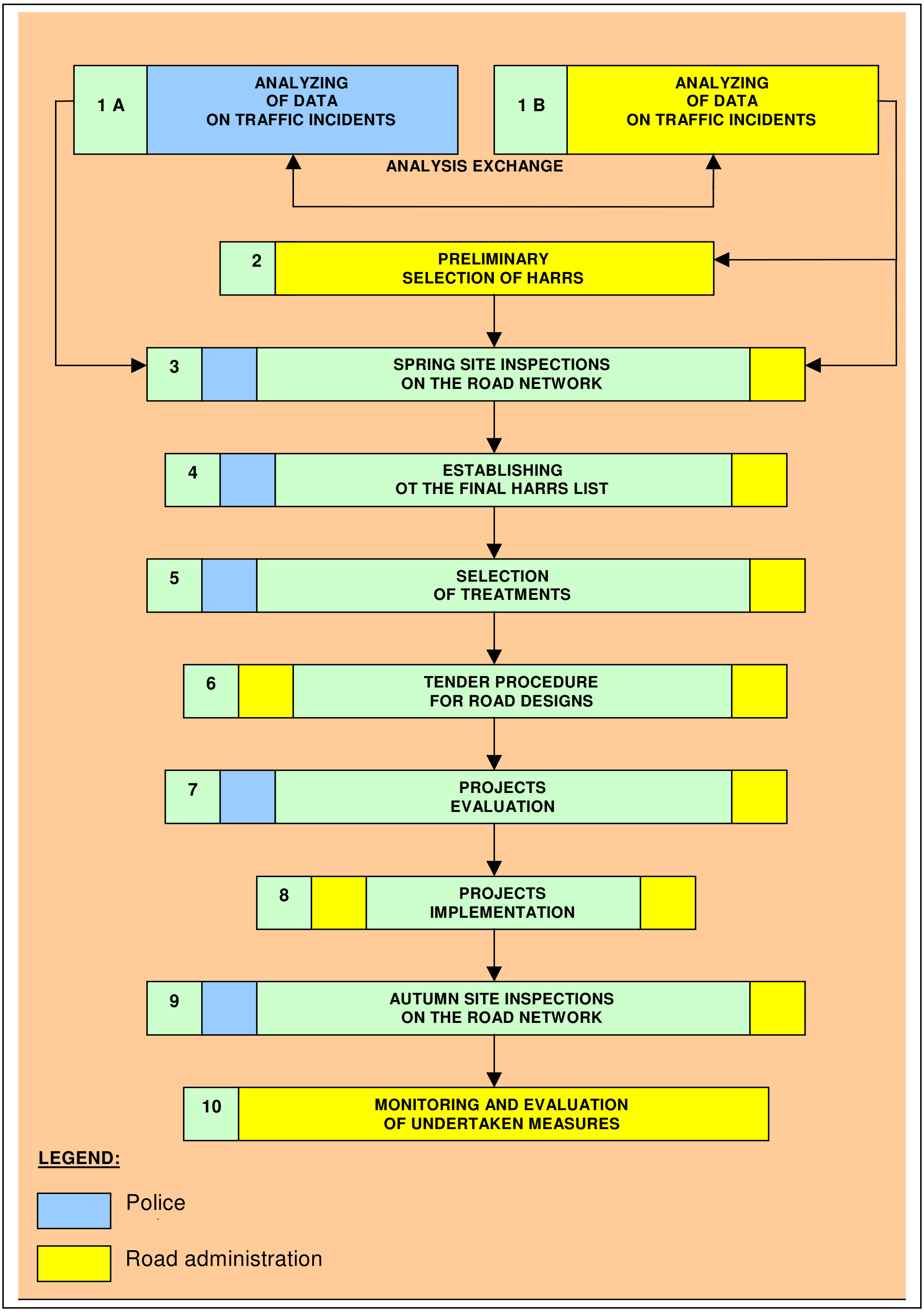
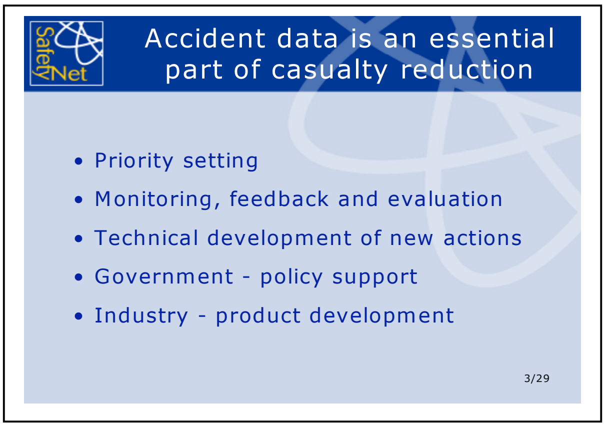


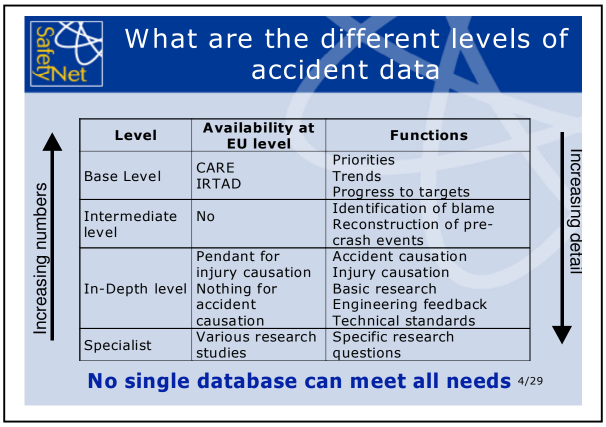
Figure 5: The procedure for cooperation between Police and the Road Administration in liquidation of High Accident Rate Road Sections(HARRS)

Vis, M.
SWOV,
Netherlands

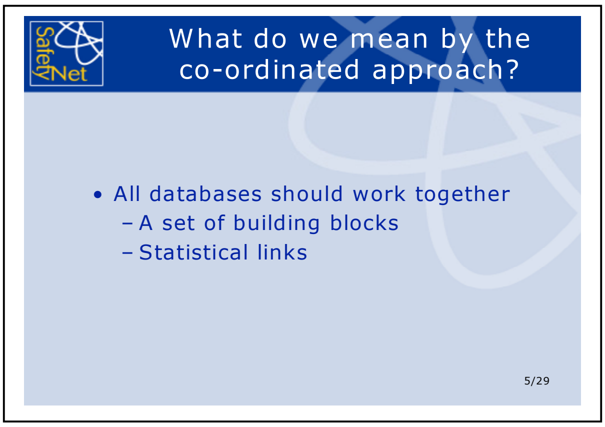
SAFETYNET

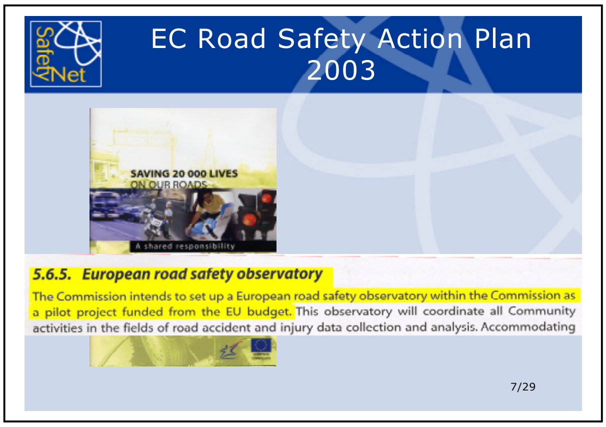
The current state of affairs of the project SafetyNet will be provided including an overview of the objectives and activities of the SafetyNet project and some of the results reached so far.
Among others, the results shown will include the analyses of data received from 28 European countries. This concerns CARE data, risk and exposure data, and data on safety performance indicators.





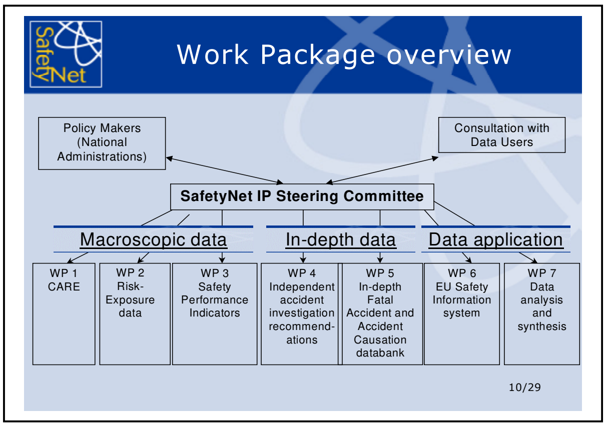
Level	Availability at EU level	Functions
Base Level	CARE IRTAD	Priorities Trends Progress to targets
Intermediate level	No	Identification of blame Reconstruction of pre-crash events
In-Depth level	Pendant for injury causation Nothing for accident causation	Accident causation Injury causation Basic research Engineering feedback Technical standards
Specialist	Various research studies	Specific research questions

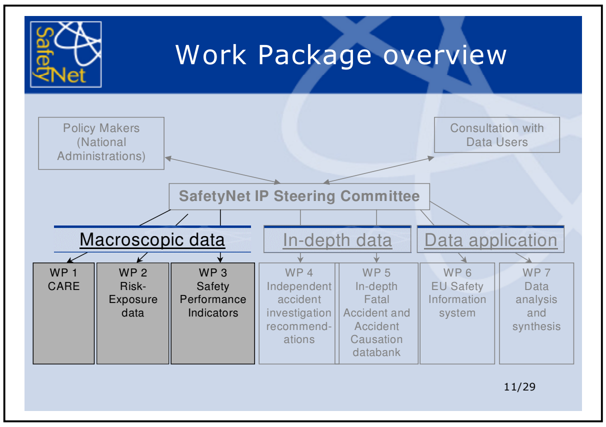



SafetyNet
EC Road Safety Action Plan 2003
SAVING 20 000 LIVES ON OUR ROADS
A shared responsibility
5.6.5. European road safety observatory
The Commission intends to set up a European road safety observatory within the Commission as a pilot project funded from the EU budget. This observatory will coordinate all Community activities in the fields of road accident and injury data collection and analysis. Accommodating
7/29


SafetyNet
What is SafetyNet?
• Integrated Project to build the data framework of the Observatory
• Primarily directed to EU and national level road safety policy-making
8/29


SafetyNet
Organisations involved
▪ 21 Partners
▪ 18 Countries
9/29


SafetyNet
Work Package overview
Policy Makers (National Administrations)
Consultation with Data Users
SafetyNet IP Steering Committee
Macroscopic data
In-depth data
Data application
WP 1 CARE
WP 2 Risk-Exposure data
WP 3 Safety Performance Indicators
WP 4 Independent accident investigation recommend-ations
WP 5 In-depth Fatal Accident and Accident Causation databank
WP 6 EU Safety Information system
WP 7 Data analysis and synthesis
10/29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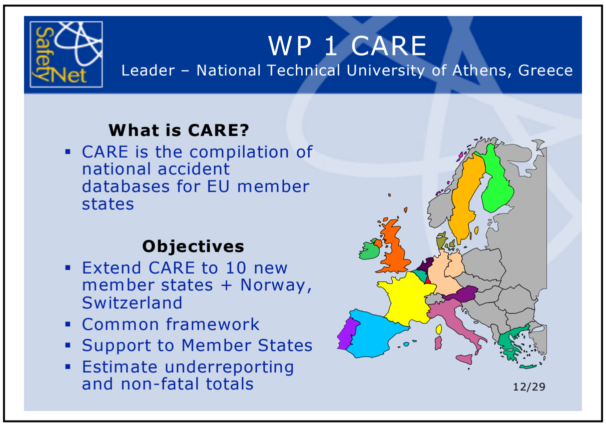
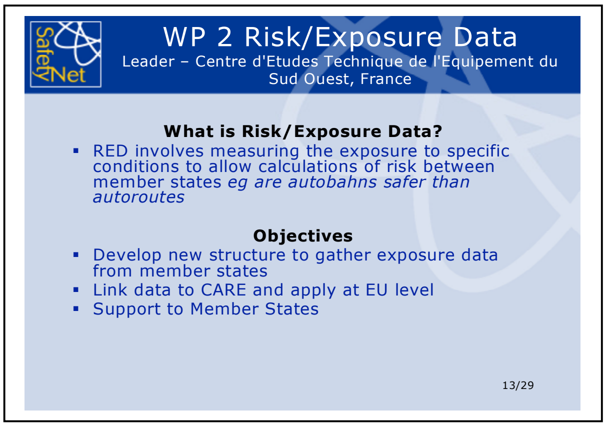
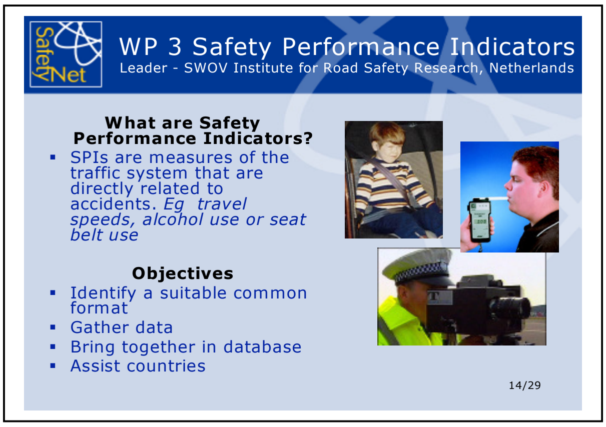
11/29


SafetyNet
WP 1 CARE
Leader – National Technical University of Athens, Greece
What is CARE?
▪ CARE is the compilation of national accident databases for EU member states
Objectives
▪ Extend CARE to 10 new member states + Norway, Switzerland
▪ Common framework
▪ Support to Member States
▪ Estimate underreporting and non-fatal totals
12/29


SafetyNet
WP 2 Risk/Exposure Data
Leader – Centre d'Etudes Technique de l'Equipement du Sud Ouest, France
What is Risk/Exposure Data?
▪ RED involves measuring the exposure to specific conditions to allow calculations of risk between member states eg are autobahns safer than autoroutes
Objectives
▪ Develop new structure to gather exposure data from member states
▪ Link data to CARE and apply at EU level
▪ Support to Member States
13/29

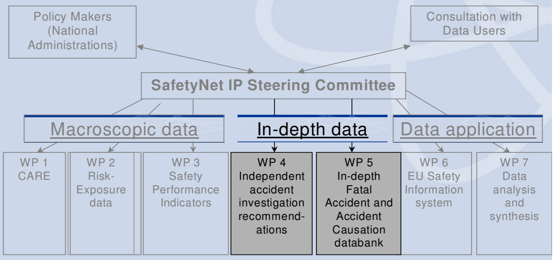

SafetyNet
WP 3 Safety Performance Indicators
Leader - SWOV Institute for Road Safety Research, Netherlands
What are Safety Performance Indicators?
▪ SPIs are measures of the traffic system that are directly related to accidents. Eg travel speeds, alcohol use or seat belt use
Objectives
▪ Identify a suitable common format
▪ Gather data
▪ Bring together in database
▪ Assist countries
14/29

Data gathering

- EU Working Group with National Experts from 28 countries
- Information Collection Coordinator

15/29

Work Package overview



16/29

WP 4 Independent Accident Investigation Recommendations

Leader - Institut National de Recherche sur les Transports et leur Sécurité, France

Objectives

- Methods to determine independence of accident data
- Specification of institutional and legal arrangements for EU-wide accident data gathering

Outcomes

- Recommendations and protocols for independent accident investigation

17/29

WP 5 In-depth Accident Data

Leader – Vehicle Safety Research Centre, UK

What is in-depth data?

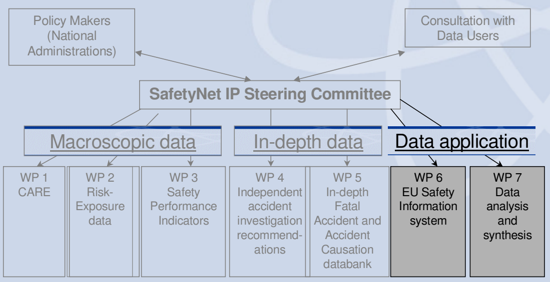
- Detailed analysis of each crash to identify the causal factors

Objectives

- Develop new fatal accident database with 1300 cases
- Develop new accident causation database with 1000 cases concentrating on infrastructure safety and eSafety data requirements

18/29

Work Package overview



WP 6 EU Road Safety Information System

Leader - SWOV Institute for Road Safety Research, Netherlands

Objectives

- Develop new information gateway to access SafetyNet results
- Include other road safety related information

Outcome

- Broad ranging accident data website to be handed over to EC for public access
- EC core activity

20/29

WP 7 Data Analysis and Synthesis

Leader - Institut Belge pour la Sécurité Routière, Belgium

Objectives

- Demonstrate added value of analytic outcomes based on co-ordinated data sources
- Conduct linked analyses of SafetyNet data
- Develop methods for time-series analysis and multilevel modelling

Outcome

- Recommendations for further analysis of EU level accident data

21/29

Results

- Basic factsheets
- Annual statistical reports
- State-of-the-Art Safety Performance Indicators
- Prototype Observatory web site

- Many results in the next two months

22/29

Results

- Basic factsheets
- Annual statistical report
- State-of-the-Art Safety Performance Indicators
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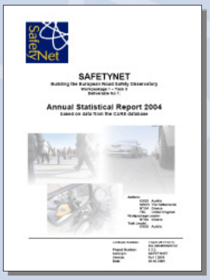


23/29

Results

- Basic factsheets
- Annual statistical reports
- State-of-the-Art Safety Performance Indicators
- Prototype Observatory web site

- Many results in the next two months

24/29

External Links

Policymakers

- EU and national level

- High Level Group on Road Safety

Special Groups

- National representative working groups on CARE and SPIs

- EC 6FP projects in infrastructure and eSafety

25/29

SafetyNet 2006 Conference

Prague, 10th and 11th May, 2006

Purpose

- To demonstate how data driven road and vehicle safety policies are formed, and to identify new challenges

Target audience

- Road and vehicle safety policy-makers and practitioners as well as politicians and NGO's

26/29

SafetyNet 2006 Conference

Prague, 10th and 11th May, 2006

Invited speakers

- Key group of decision makers at EU and broader international level

More information

- Flyers available or contact us at http://safetynet.swov.nl

27/29

Summary

- Large ambitious project
- Well underway (start: 1 May 2004)
- Broad ranging, co-ordinated set of accident data
- EC core activity
- Wide support to road safety policy, new resources for infrastructure and eSafety

28/29

Contact

http://safetynet.swov.nl

29/29

Winkelbauer, M.
KuSS,
Austria

RONCALLI (Information platform for traffic relevant information)

Initial situation: Traffic telematic applications do not reach by far the projected acceptance in their intended market, predominant caused by a lack of comprehensive and moreover reliable content. But even if static and dynamic content would exist in real-time, at the moment no system exists which could impart both types of content for the consumer, related to his current situation (position, point of time) in a self-explanatory way. To overcome this obvious existing gap within traffic telematic, RONCALLI was started.

The objective of RONCALLI is to create an information platform for traffic relevant information. This information, arising from different sources, is prepared and accessed for every single road user, especially based on his/her current situation. Special significance is ascribed to the topics road safety, customer-friendliness and reliability of information.
The implementation is structured in two subprojects - RONCALLI and RONCALL_I2 - corresponding to the program structure of BMVIT (Au-strian Ministry of Transport, Innovation & Technology), more precisely to ARTIST (Austrian Radionavigation Technology and Integrated Satnav services and products Testbed) and I2 (Intelligent Infrastructure).

The subproject **RONCALLI** establishes the basic technical conditions by creating a central data procession which perfectly prepares information of different sources. The valorised information, static as well as dynamic, is - optimised to fit the consumer's profile of movement - transferred by conventional ways of mobile communication (GPRS).

Then the end device (e.g. PDA) filters the relevant matters of each current situation (defined by GPS-Position [in future Galileo], point of time, speed, etc.). This information is within the scope of RONCALLI prototypical implemented and presented to the road user in an appropriate way. By the use of solely existing and accordingly common technologies high prospects for a successful commercial implementation arise.

Moreover, in Klosterneuburg (Lower Austria) a testbed for demonstration reasons was - supported by the city council - installed. Three public owned vehicles were equipped with the essential technology and are currently used for testing and to verify partial results of each single project step. This permanent relation to practice is of high importance for the developed services, especially concerning the user acceptance.
The following services are planned:

- ISA – Intelligent Speed Adaption
- Warnings of sections of poor surface characteristics (skid resistance, ruts)
- Children on the road – pay attention
- Risk of accident (accident spots)

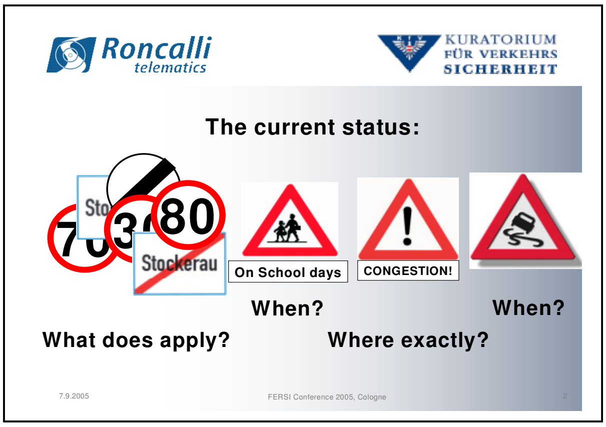
To offer in future attractive traffic telematic services for the end user a network of content suppliers, content providers and service providers is essential. That is why **RONCALL_I2** deals with the conception and the setup and operation of a market place for multimodal traffic telematic information.

This market acts as a place where different content providers offer their content to different service providers. Because of the fact, that all content is related to a common reference system the content providers can primarily offer their content without any manipulation to several service providers. The other way round, the service providers can primarily use the content of different content providers to make attractive services for the end user available. Beside providing and obtaining content the market place also takes care of all the billing between service and content providers.

By the establishment of the market place an innovation sphere developes which causes a constant mulipicator effect. From the content point of view it means additional and higher quality content, as well as more extensive and attractive services. From the institutional point of view one can expect an increasing number of content suppliers, content providers, service developers and service providers as well as, logically, an increasing number of satisfied end users. The following services are currently being developed on the basis of RONCALLI telematics:

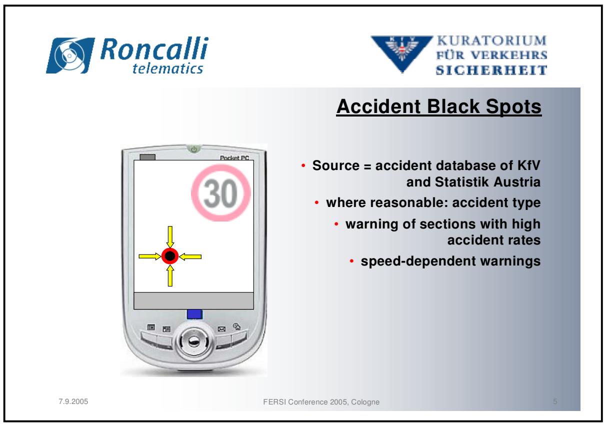
- ISA – Intelligent Speed Adaption
- XFCD – Extended Floating Car Data
- Right of Way Information
- Eco-Driving.

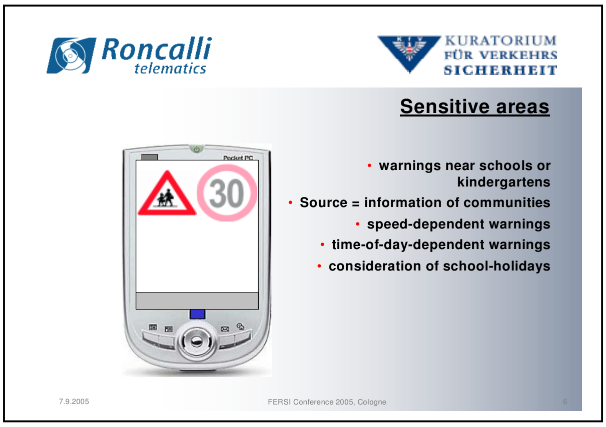

Roncalli telematics
KURATORIUM FÜR VERKEHRSSICHERHEIT
New approaches in Austria
THE RONCALLI PROJECT
Martin Winkelbauer
Kuratorium für Verkehrssicherheit - KfV
(Austrian Road Safety Board)
7.9.2005
FERSI Conference 2005, Cologne


Roncalli telematics
KURATORIUM FÜR VERKEHRSSICHERHEIT
The current status:
80
Stockerau
On School days
CONGESTION!
When?
When?
What does apply?
Where exactly?
7.9.2005
FERSI Conference 2005, Cologne

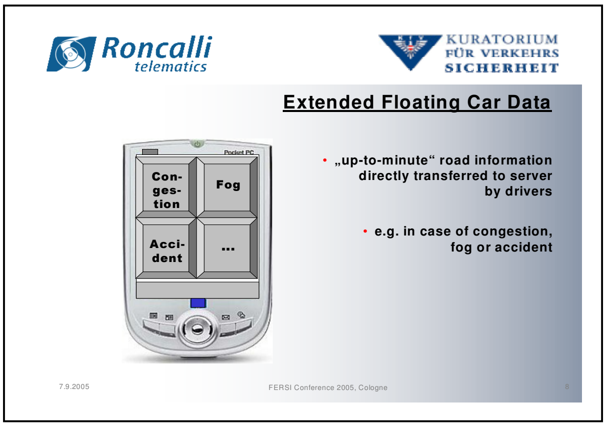

Roncalli telematics
KURATORIUM FÜR VERKEHRSSICHERHEIT
RONCALLI
Location-based and dynamic
road (safety) information in real time...
√ that drivers want
√ exactly where it is needed
√ only when relevant
√ in a non-distracting way
30
7.9.2005
FERSI Conference 2005, Cologne

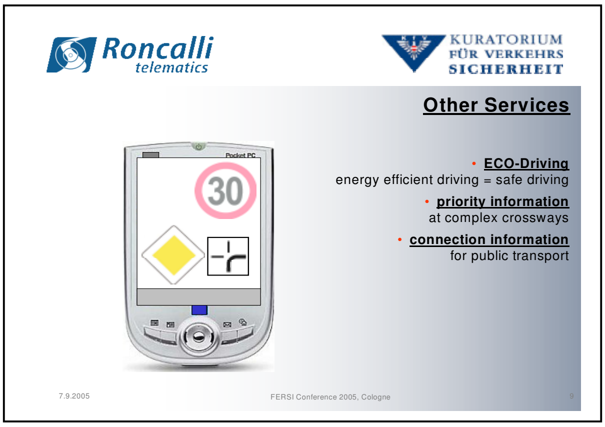

Roncalli telematics
KURATORIUM FÜR VERKEHRSSICHERHEIT
Intelligent Speed Adaptation
30
• driver assistance system
• large-scale experiment in S, NL, UK
• remarkably good feedback from test persons
• Prognosis: accident reduction up to 25 %
• RONCALLI: visual + acoustic warning
7.9.2005
FERSI Conference 2005, Cologne

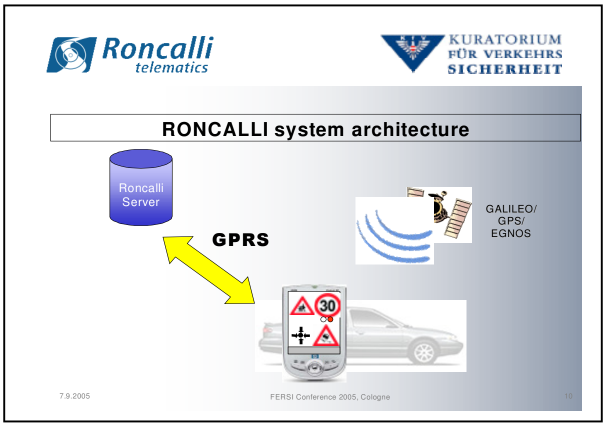

Roncalli telematics
KURATORIUM FÜR VERKEHRSSICHERHEIT
Accident Black Spots
30
• Source = accident database of KfV and Statistik Austria
• where reasonable: accident type
• warning of sections with high accident rates
• speed-dependent warnings
7.9.2005
FERSI Conference 2005, Cologne

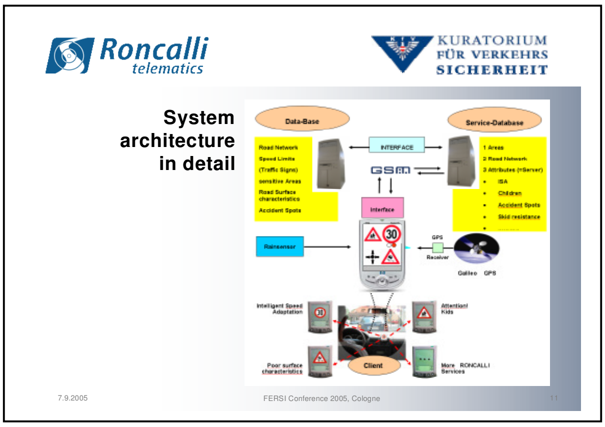

Roncalli telematics
KURATORIUM FÜR VERKEHRSSICHERHEIT
Sensitive areas
30
• warnings near schools or kindergartens
• Source = information of communities
• speed-dependent warnings
• time-of-day-dependent warnings
• consideration of school-holidays
7.9.2005
FERSI Conference 2005, Cologne

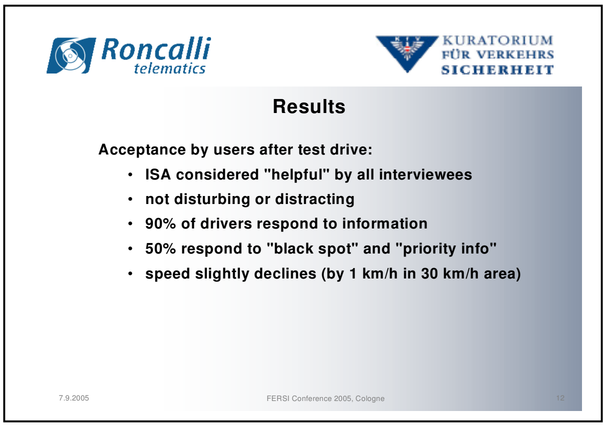

Roncalli telematics
KURATORIUM FÜR VERKEHRSSICHERHEIT
Problems with skid resistance and ruts
30
• Source = survey of Arsenal Research (RoadStar)
• warning only in wet road conditions!
• warning only when speed critical
7.9.2005
FERSI Conference 2005, Cologne

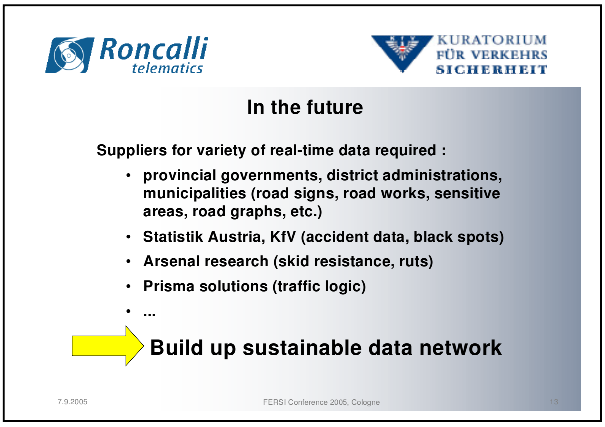

Roncalli telematics
KURATORIUM FÜR VERKEHRSSICHERHEIT
Extended Floating Car Data
Con-ges-tion
Fog
Acci-dent
...
• „up-to-minute“ road information directly transferred to server by drivers
• e.g. in case of congestion, fog or accident
7.9.2005
FERSI Conference 2005, Cologne

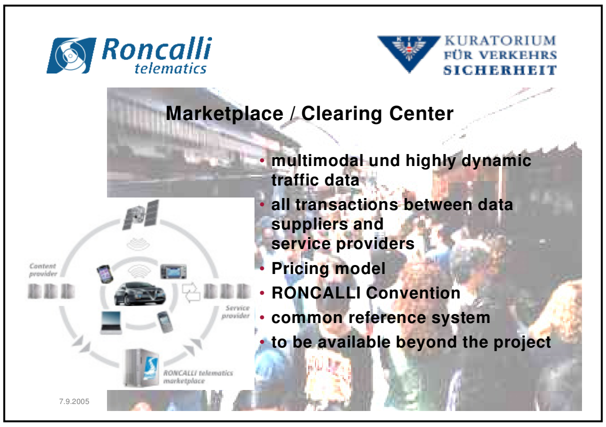

Roncalli telematics
KURATORIUM FÜR VERKEHRS SICHERHEIT
Other Services
ECO-Driving
energy efficient driving = safe driving
priority information
at complex crossways
connection information
for public transport
30
7.9.2005
FERSI Conference 2005, Cologne

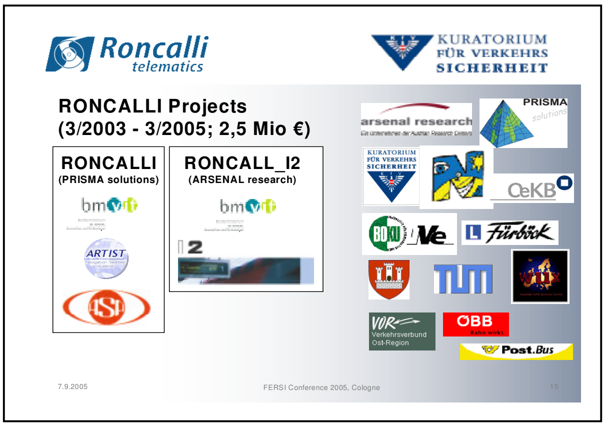

Roncalli telematics
KURATORIUM FÜR VERKEHRS SICHERHEIT
RONCALLI system architecture
Roncalli Server
GPRS
GALILEO/ GPS/ EGNOS
7.9.2005
FERSI Conference 2005, Cologne


Roncalli telematics
KURATORIUM FÜR VERKEHRS SICHERHEIT
System architecture in detail
Data-Base
Service-Database
INTERFACE
GSM
Interface
7.9.2005
FERSI Conference 2005, Cologne


Roncalli telematics
KURATORIUM FÜR VERKEHRS SICHERHEIT
Results
Acceptance by users after test drive:
ISA considered "helpful" by all interviewees
not disturbing or distracting
90% of drivers respond to information
50% respond to "black spot" and "priority info"
speed slightly declines (by 1 km/h in 30 km/h area)
7.9.2005
FERSI Conference 2005, Cologne


Roncalli telematics
KURATORIUM FÜR VERKEHRS SICHERHEIT
In the future
Suppliers for variety of real-time data required :
provincial governments, district administrations, municipalities (road signs, road works, sensitive areas, road graphs, etc.)
Statistik Austria, KfV (accident data, black spots)
Arsenal research (skid resistance, ruts)
Prisma solutions (traffic logic)
...
Build up sustainable data network
7.9.2005
FERSI Conference 2005, Cologne


Roncalli telematics
KURATORIUM FÜR VERKEHRS SICHERHEIT
Marketplace / Clearing Center
multimodal und highly dynamic traffic data
all transactions between data suppliers and service providers
Pricing model
RONCALLI Convention
common reference system
to be available beyond the project
7.9.2005


Roncalli telematics
KURATORIUM FÜR VERKEHRS SICHERHEIT
RONCALLI Projects
(3/2003 - 3/2005; 2,5 Mio €)
RONCALLI
(PRISMA solutions)
RONCALL_I2
(ARSENAL research)
bmvit
ARTIST
arsenal research
PRISMA solutions
ÖKB
ÖBB
Post.Bus
7.9.2005
FERSI Conference 2005, Cologne


Roncalli telematics
KURATORIUM FÜR VERKEHRS SICHERHEIT
further information:
www.roncalli-telematics.com
7.9.2005
FERSI Conference 2005, Cologne

Workshop 4

Road safety attitudes

Leitung

J.P. Cauzard (INRETS) und Denis Huguenin (bfu)

Vorträge

Claudia Evers

“Presentation from the project SARTRE 3”

Ewert, Uwe (bfu)

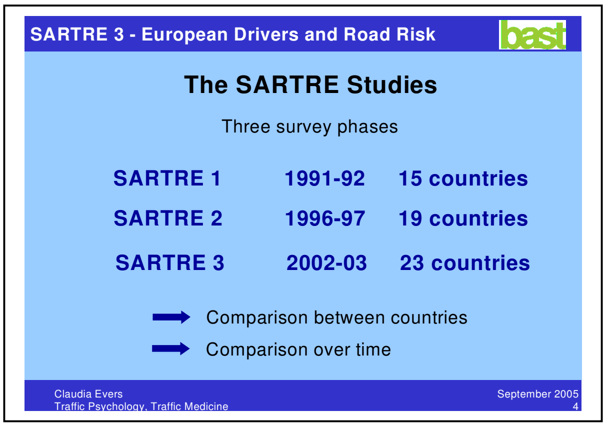
“Risk factors for self reported and observed seat belt use in Switzerland“

Evers, Claudia
Federal Highway Research Institute,
Germany

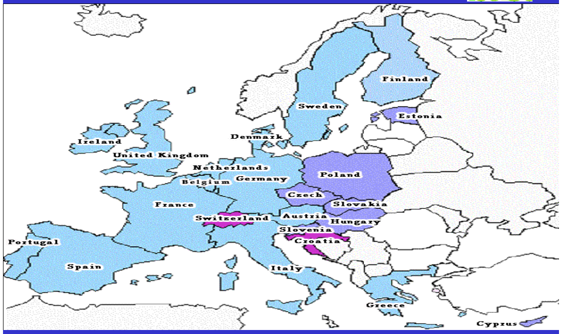
Presentation from the project SARTRE 3

The EU project SARTRE 3 (“Social Attitudes to Road Traffic Risk in Europe – 3rd phase”) is the third wave of a representative questionnaire survey about opinions and behaviours of European car drivers. The first survey was conducted in the beginning of the 1990’s in 15 countries and the second in 1996-97 in 19 countries. The SARTRE 3 survey was carried out in 2002-03 in 23 countries. In each country, a representative sample of about 1,000 car drivers was interviewed regarding a variety of topics relevant for European road safety, such as drinking and driving, speeding, seat belt wearing and enforcement. Simultaneously, data about the current situation of road traffic and traffic safety was collected in each country to interpret the survey data within the countries’ road safety context (e.g. fatalities, legislation, infrastructure, vehicle fleet).

The study results show that traffic safety has improved since the last SARTRE survey in the majority of countries in terms of fatality reductions, more safety-minded opinions and (self-reported) driver behaviours. Some general trends: Most drivers see drinking and driving as being unacceptable. However, the perception and experience of being checked for alcohol is low throughout Europe. Attitudes towards speeding have improved since earlier surveys. Many drivers recognise that speeding is dangerous – but mainly for other drivers. Although nearly all vehicles have front seat belts and most cars have rear seat belts fitted, seat belt wearing rates are rather low in some countries and wearing rates are not regularly monitored in all countries. There is strong support for safety related enforcement activity. However, for sustainable effects, enforcement activity needs to be “visible” and accompanied by education and publicity campaigns.
Conclusively there is no common, simple pattern to the results. Instead there still exist major differences among European car drivers’ attitudes and behaviours and the countries’ status of road safety. Insofar, the SARTRE data help to understand which areas of traffic safety need more attention in which countries, so that each country can examine it’s own performance against the European “benchmark” and introduce policies and measures to suit its own aims.



SARTRE 3 - European Drivers and Road Risk



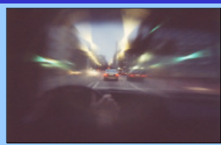
Institutes involved

SARTRE 3 - European Drivers and Road Risk

Method

- Standardised questionnaire translated in the languages of all participating countries
- Face-to-face interviews with appr. 1,000 car drivers per country => Total: 24,000 drivers interviewed
- Questions concerning issues of traffic safety, e.g.:
  - Drinking and driving
  - Speeding
  - Seat belt wearing
  - Enforcement
  - European harmonisation of traffic rules

Selected results



Drinking and driving

Speeding

Seat belt wearing

Drinking and driving

- Most drivers now see drinking and driving as being unacceptable - more than in the earlier SARTRE surveys
- The perception and experience of being ‘checked’ for alcohol is very low throughout Europe
- Need more publicity and enforcement

Speeding

- Attitudes towards speeding have improved since earlier surveys
- Many drivers recognise that speeding is dangerous - but mainly for other drivers
- Need to raise awareness about the risk of speeding and increase “ownership” of the problem
- Need to sell speed enforcement as being safety-related and not revenue raising

Seat belt wearing

- Nearly all cars have front seat belts fitted, a vast majority also have rear seat belts
- Seat belt wearing is obligatory in all countries
- Nonetheless: In some countries seat belt wearing rates are rather low
- A good part of the countries does not monitor wearing rates on a regular basis

Conclusions and recommendations (1)

There is no common, simple pattern of results.
There still exist major differences between countries regarding car drivers’ attitudes and behaviours and the status of road safety.

The SARTRE data can help to understand:
– which areas of road safety need more attention
– in which countries

Conclusions and recommendations (2)

The "average" European car driver is very different:

➔ Safety practitioners need to target:
Countries, behaviours, individuals

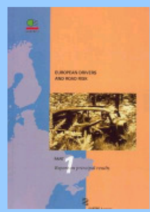
➔ Countries need to set realistic targets in terms of:
Accident reduction, behaviour changes

➔ Each country must examine it's own performance against the European benchmark and introduce suitable polices and measures.

Claudia Evers
Traffic Psychology, Traffic Medicine
September 2005
13

More information on SARTRE 3...

Full report (English)



Summary of results (all languages)

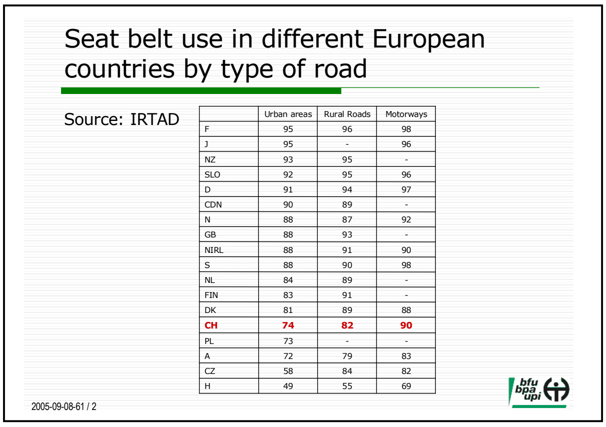
http://sartre.inrets.fr

Claudia Evers
Traffic Psychology, Traffic Medicine
September 2005
14

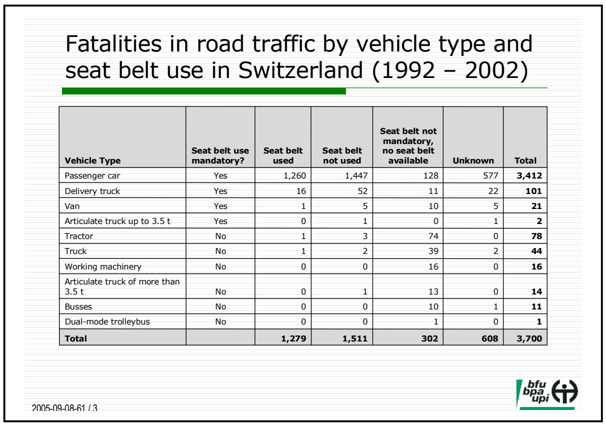
Ewert, Uwe
Bfu,
Swisse

Risk factors for self reported and observed seat belt use in Switzer-land

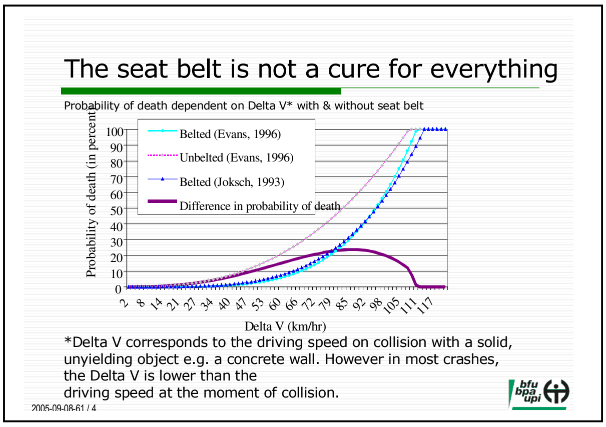
Seat belt use in Switzerland is only about 80%. A research project was conducted to find new ways to improve seat-belt wearing rates. A questionnaire was distributed in shopping centres in all parts of Switzerland (quota sample). The questionnaire existed in two colours and was handed out to the drivers depending on whether they had used the seat belt or not. Of the 10’000 distributed questionnaires 3’400 were returned. 1’200 cases were deleted from the present analyses because of differences between the observed and the reported seat belt use. Of the remaining 2’200 questionnaires 1’500 were seat belt users and 700 were non-users. A logistic regression was carried out that allowed to identify several factors that predict seat belt non-use. The most important factors were: Time when the seat belt is being fastened; Forgot to use the seat belt either during the last week, month, and year; Being too lazy to use the seat belt; Wearing clothes that get creases; Negative attitudes towards seat belt ignition interlock; Having been punished for not wearing the seat belt; Hometown with less than 10’000 inhabitants; and Because parents never wore a seat belt. Age and gender did not have a significant effect although they were significant in the univariate analyses. 93% of the subjects could be predicted correctly. Many of the significant items can be regarded as excuses for not wearing the seat belt. Especially the items regarding the forgetting of using the seat belt are somewhat contradicted by the opposition to the seat belt ignition interlock which would be a strong reminder.



	Urban areas	Rural Roads	Motorways
F	95	96	98
J	95	-	96
NZ	93	95	-
SLO	92	95	96
D	91	94	97
CDN	90	89	-
N	88	87	92
GB	88	93	-
NIRL	88	91	90
S	88	90	98
NL	84	89	-
FIN	83	91	-
DK	81	89	88
CH	**74**	**82**	**90**
PL	73	-	-
A	72	79	83
CZ	58	84	82
H	49	55	69



Vehicle Type	Seat belt use mandatory?	Seat belt used	Seat belt not used	Seat belt not mandatory, no seat belt available	Unknown	Total
Passenger car	Yes	1,260	1,447	128	577	**3,412**
Delivery truck	Yes	16	52	11	22	**101**
Van	Yes	1	5	10	5	**21**
Articulate truck up to 3.5 t	Yes	0	1	0	1	**2**
Tractor	No	1	3	74	0	**78**
Truck	No	1	2	39	2	**44**
Working machinery	No	0	0	16	0	**16**
Articulate truck of more than 3.5 t	No	0	1	13	0	**14**
Busses	No	0	0	10	1	**11**
Dual-mode trolleybus	No	0	0	1	0	**1**
Total		**1,279**	**1,511**	**302**	**608**	**3,700**



The seat belt is not a cure for everything

Percentage of fatally injured motor vehicle passengers by direction of the impact (Green, German, Nowak, Dalmotas & Stewart, 1994)

Localisation of the impact	Percentage of all passengers killed	Percentage of passengers killed that wore the seat belt
Head-on	46.2	37.5
Side		
• **Next to a passenger**	**14.8**	**38.8**
• Not next to a passenger	15.1	11.1
Rear	14.2	3.5
Top	2.1	4.1
Other	5.1	4.5
Unknown	2.5	0.5
Sum	100	100

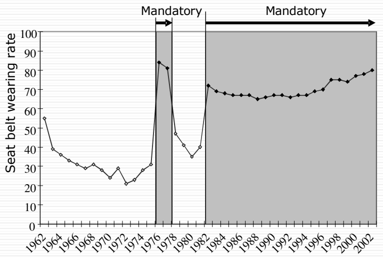
2005-09-08-61 / 5

Seat belt history in Switzerland

- Seat belt wearing is mandatory since 1981 on front seats
- Since 1994 is mandatory on rear seats, too
- Fine for not wearing the seat belt is CHF 60 (about € 40)

2005-09-08-61 / 6

Seat belt wearing and seat belt law from 1962 to 2002



2005-09-08-61 / 7

Aim

The present study wants to analyse the reason for not wearing seat belts and to give cues regarding things to do to improve seat belt wearing rates in Switzerland and thus reduce the number of road fatalities.

2005-09-08-61 / 8

Method

- Survey regarding attitudes, opinions and behaviours of frequent and infrequent seat belt users.
- Comparison of frequent and infrequent seat belt users regarding their attitudes, opinions and behaviours via multiple logistic regression.

2005-09-08-61 / 9

Problem

Will the people tell the truth in the survey – especially regarding their seat belt use behaviour?

2005-09-08-61 / 10

Solution

2 types of questionnaires were distributed – green or orange – depending on whether the persons were observed wearing a seat belt or not shortly before entering a public parking space (method by Hunter, Stewart, Stutts & Rodgman, 1993).

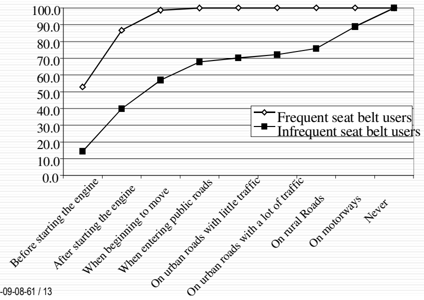
2005-09-08-61 / 11

Results for observed and reported behaviour

	Observation: seat belt used (green questionnaire)	Observation: seat belt not used (orange questionnaire)	Sum
Survey: Always wearing belt in urban areas	**1,526**	779	2,305
Survey: not always wearing belt in urban areas	372	**687**	1,059
Sum	1,898	1,466	3,364

2005-09-08-61 / 12

Time when fastening seat belt



Results of multiple logistical regression model to predict wearing of seat belt controlling for all other significant variables

Time when fastening safety belt

Variable	Answer category	Frequent users in %	Infrequent users in %	Odds Ratio
Time of fastening safety belt	Before I start the car (reference category)	52.8	14.5	1.0
Time of fastening safety belt	After I've started the car but before moving off	33.8	25.5	1.7
Time of fastening safety belt	When the vehicle moves off	12.1	17.0	1.7
Time of fastening safety belt	When vehicle reaches public roads or even later	1.4	43.0	18.8

Results of multiple logistical regression model to predict wearing of seat belt controlling for all other significant variables

Socio-demographics

Variable	Answer category	Frequent users in %	Infrequent users in %	Odds Ratio
Number of inhabitants of place of residence	Less than 10,000	54.9	47.9	3.3
Number of inhabitants of place of residence	10,000 to 100,000	25.6	36.3	2.0
Number of inhabitants of place of residence	Over 100,000 (reference category)	19.5	15.8	1.0

Results of multiple logistical regression model to predict wearing of seat belt controlling for all other significant variables

Forgetfulness

Variable	Answer category	Frequent users in %	Infrequent users in %	Odds Ratio
Safety belt forgotten in past week	Yes	3.1	73.1	5.2
Safety belt forgotten in past month	Yes	8.4	81.1	3.4
Safety belt forgotten in past year	Yes	26.2	89.2	3.4

Results of multiple logistical regression model to predict wearing of seat belt controlling for all other significant variables

Police enforcement

Variable	Answer category	Frequent users in %	Infrequent users in %	Odds Ratio
Wearing a safety belt is not a matter for the police	Yes	13.5	45.0	2.2
Fine for not wearing a safety belt in the last three years	Yes	29.3	46.1	2.1

Results of multiple logistical regression model to predict wearing of seat belt controlling for all other significant variables

Previous personal experience / habit

Variable	Answer category	Frequent users in %	Infrequent users in %	Odds Ratio
Parents never wore a safety belt	Yes	22.0	34.5	2.2
For me wearing a safety belt is a matter of course. I've never known anything else.	No	16.0	69.3	3.8

Results of multiple logistical regression model to predict wearing of seat belt controlling for all other significant variables

Excuses for not wearing safety belt

Variable	Answer category	Frequent users in %	Infrequent users in %	Odds Ratio
I'm a safe driver and so I don't need a seat belt	Yes	4.6	17.2	3.9
Safety belt sometimes not used if clothes get easily creased	Yes	2.2	33.4	4.8
Sometimes too lazy to fasten safety belt	Yes	4.3	64.0	5.1

Results of multiple logistical regression model to predict wearing of seat belt controlling for all other significant variables

Emotions associated with safety belt use

Variable	Answer category	Frequent users in %	Infrequent users in %	Odds Ratio
Don't feel right without a safety belt	No	18.8	63.4	1.8

Results of multiple logistical regression model to predict wearing of seat belt controlling for all other significant variables

Attitude towards safety belt ignition interlock

Variable	Answer category	Frequent users in %	Infrequent users in %	Odds Ratio
Car should not be able to be started if not all passengers are belted	I find this a bad idea	64.4	82.0	3.6

2005-09-08-61 / 21

Further results of the logistic regression

Explained variance (Nagelkerke R-square)	81 %
Percentage of frequent seat belt users predicted correctly	97 %
Percentage of infrequent seat belt users predicted correctly	86 %

2005-09-08-61 / 22

Measures to improve seat belt wearing rates in Switzerland

- Clearly visible, significantly intensified police control measures
- Police monitoring concentrated on high-risk periods, circumstances and persons
- Fines for each car occupant not wearing a safety belt
- Introduction of a mandatory technical system indicating belts are not being worn
- Promotion of child seats and use of seat belts for children
- Belt-ignition-interlock as a penalty for repeat offenders
- Campaign in the French-speaking region to promote awareness of laws on safety-belt wearing
- Compulsory wearing of safety belts on tractors and in trucks
- Fewer exceptions in traffic regulations to compulsory wearing of safety belts
- Psychological intervention to change attitudes on wearing of safety belts

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Workshop 7

Safety strategy and planning – Part I

Leitung

Peter Hollo (KTI) und Antonio Lemonde de Macedo (LNEC)

Vorträge

Cardoso, João Lourenço, de Macedo, Antonio Lemonde, (LNEC)

“A strategy for road infrastructure safety research within the scope of the Portuguese road safety plan”

Morsink, Peter (SWOV)

“Summary presentation SUNflower+6“

Siegrist, Stefan (bfu)

“Development of an evidence based national road safety strategy”

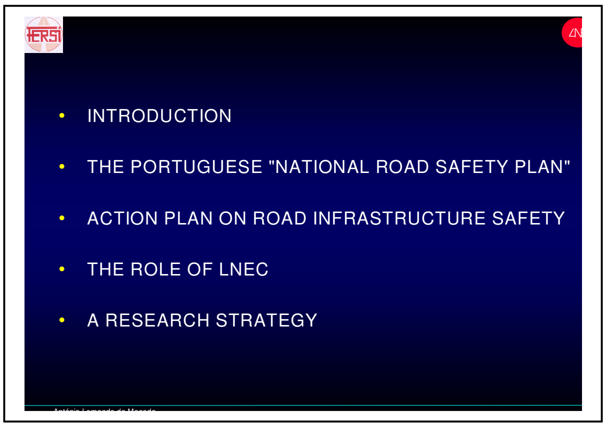
Cardoso, João Lourenço, de Macedo, Antonio Lemonde
LNEC,
Portugal

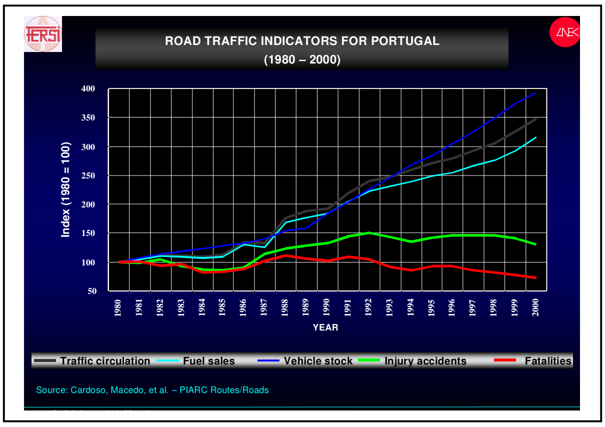
A strategy for road infrastructure safety research within the scope of the Portuguese road safety plan

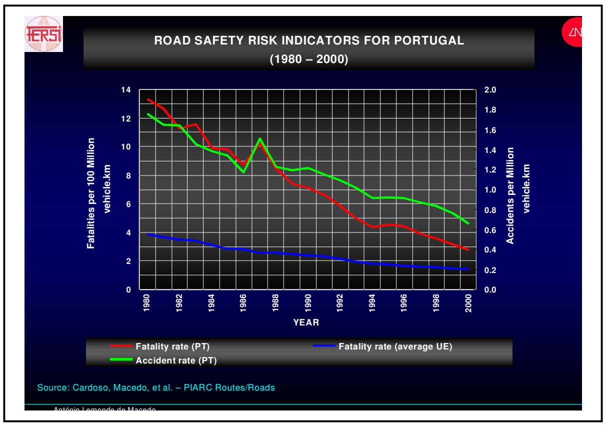
The Portuguese National Road Safety Plan (PNPR – “Plano Nacional de Prevenção Rodoviária”) was launched in 2003, having as its main target a 50% reduction, until 2010, of the number of fatalities and serious injuries from road accidents.The National Laboratory for Civil Engineering (LNEC), through the Planning, Traffic and Safety Division (NPTS) of its Transportation Department (DT), provided an important collaboration for the setting up of this Plan, its researchers being involved in its technical commission for coordination, and in several of its preparation working groups.

A “safe road environment”, which includes the infrastructures, was one of the main topics that received a significant input from LNEC, as regards not only the characterization and analysis of the situation in Portugal, but also the definition of safety measures to be undertaken. Within this context, the need for research studies to support several of those actions was duly recognized and included in the detailed action program that was adopted. At the same time, LNEC was participating, namely with partners from FERSI Institutes, in the preparation of proposals for joint European projects in this area, which were thereafter approved by the EC (e. g. SAFETY-NET, RIPCORD-ISEREST, IN-SAFETY and SUNflower+6), and are now under way.

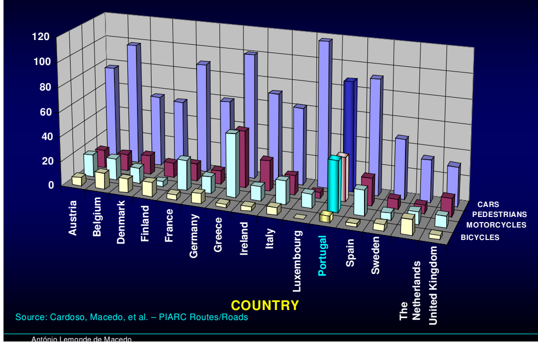
This presentation highlights the main contributions that are expected from research on road infrastructure safety, for the accomplishment of the objectives that were set in the Portuguese Road Safety Plan. Furthermore, mention is made to the overall research strategy which encompasses those contributions, and for which the participation of LNEC in joint European projects is also relevant.







FATALITY RATE (FATALITIES PER MILLION INHABITANTS) BY TRANSPORT MODE IN THE EU (15)



Source: Cardoso, Macedo, et al. – PIARC Routes/Roads

António Lemonde de Macedo

THE NATIONAL ROAD SAFETY PLAN (PNPR) MAIN FACTORS AFFECTING ROAD SAFETY IN PORTUGAL

- Inadequate road user behaviour (drivers and pedestrians)
- Deficiencies in the activity of the entities having responsibilities on the safety of the road system
- Several deficiencies at the different phases of the road infrastructure life cycle
  - ✓ Inconsistencies at the design stage
  - ✓ Poor quality in construction
  - ✓ Inadequate safety treatment of the roadside
  - ✓ Insufficiencies in road maintenance
  - ✓ Low safety at work zones

António Lemonde de Macedo

THE NATIONAL ROAD SAFETY PLAN

- Prepared in 2002 –
  - *Ministry of Internal Administration*
  - *National Road Safety Council*
  - *Technical Commission*
  - *Work Groups*
- Launched in March, 2003 –
  - *After approval by the Council of Ministers*
- Targets (for 2010):
  - ➢ 50% reduction of the total number of persons dead or seriously injured in road accidents (with reference to the mean values for 1998-2000)
  - ➢ 60% reduction of accidents involving pedestrians and two wheeled vehicles, and accidents in urban areas
- Structure
  - ➢ A strategic level (3 "**Structuring Areas**")
  - ➢ An operational level (9 priority thematic **Priority Objectives**)

António Lemonde de Macedo

RELATIONS BETWEEN PRIORITY OPERATIONAL OBJECTIVES AND STRUCTURING AREAS WITHIN THE ROAD SAFETY PLAN

Main Structuring Areas	Priority Operational Objectives								
	1. Safer drivers' speeds	2. Enhanced safety for pedestrians	3. Enhanced safety for two wheelers	4. Fight against driving under alcohol and drugs	5. Fight against fatigue driving	6. Greater and better use of safety devices	7. Less accidents involving heavy vehicles	8. A safer road infrastructure	9. Better aid to injured persons in road accidents
I Continuous Education of the Road User	High	High	High	High	High	High	Medium	Low	Medium
II A Safe Road Environment	Medium	High	Medium	Low	Medium	Low	Medium	High	Medium
III Legal Framework and Enforcement	High	Medium	Medium	High	High	Medium	High	Medium	Medium

Degree of Incidence: High / Medium / Low

Source: Cardoso, Macedo, et al. – PIARC Routes/Roads

António Lemonde de Macedo

THE NATIONAL ROAD SAFETY PLAN

Structuring Area II – A Safe Road Environment

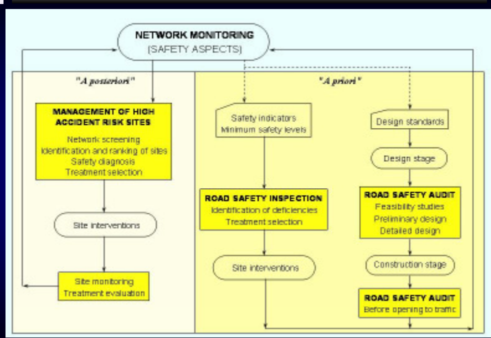
Basic assumptions:

- The demands posed by the environment should not exceed the capabilities of the road users, nor violate their expectations
- The road environment must not only induce correct driver's behaviour, but also be able to "forgive" drivers' errors

Main action lines:

- Long term continuous measures (education, training, regulations, best practice, etc.)
- Measures for the safety management of the road networks (urban and rural):
  - ✓ "a priori" interventions
  - ✓ "a posteriori" interventions

SAFETY MANAGEMENT OVER THE LIFE CYCLE OF THE ROAD INFRASTRUCTURES



Adapted from: Cardoso J. L., Vieira S. C. (2003)

THE NATIONAL ROAD SAFETY PLAN

Priority Area/Objective 8 – A Safer Road Infrastructure

Main Planned Actions:

- Setting up of adequate hierarchies for the road networks (urban and rural) – revision of technical standards to comply with this purpose
- Regular application of road safety audits to the design of new interurban roads or to the redesign of existing roads
- Development of procedures and a manual, for the explicit consideration of safety in road maintenance inspections
- Safety interventions in urban road networks (pedestrians protection, treatment of high risk sites, etc.)
- Safety interventions in interurban roads (treatment of high risk sites, measures for enhanced protection of vulnerable road users, etc.)
- Safety area-wide interventions (classification of curve consistency, uniform application of signs and markings, geometry of intersections, etc.)

António Lemonde de Macedo

LNEC

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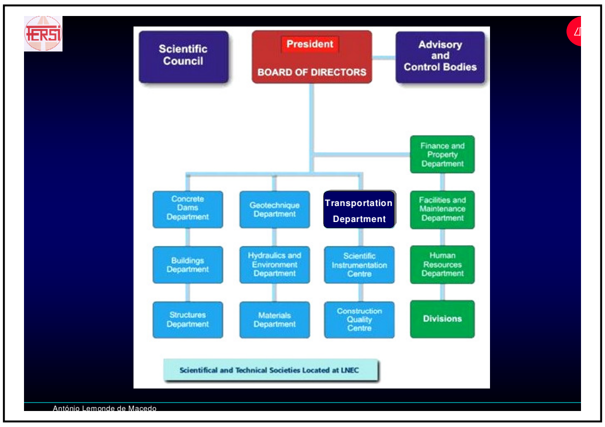
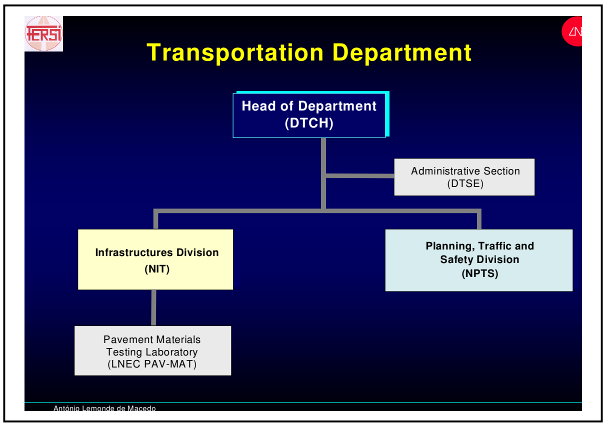
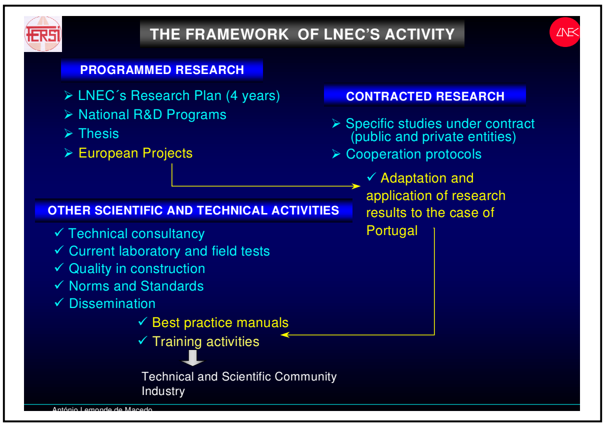

Scientific Council
President
BOARD OF DIRECTORS
Advisory and Control Bodies
Finance and Property Department
Concrete Dams Department
Geotechnique Department
Transportation Department
Facilities and Maintenance Department
Buildings Department
Hydraulics and Environment Department
Scientific Instrumentation Centre
Human Resources Department
Structures Department
Materials Department
Construction Quality Centre
Divisions
Scientifical and Technical Societies Located at LNEC
António Lemonde de Macedo

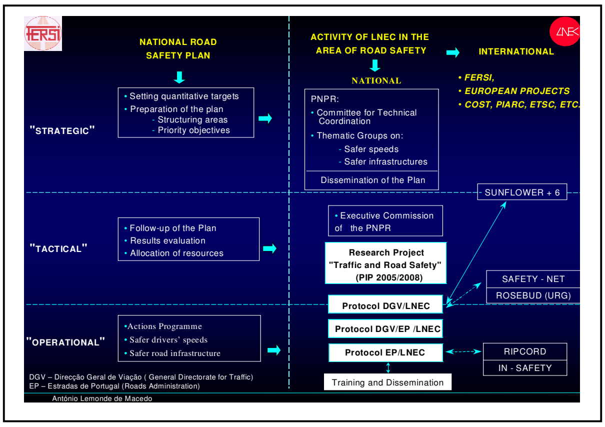

Transportation Department
Head of Department (DTCH)
Administrative Section (DTSE)
Infrastructures Division (NIT)
Planning, Traffic and Safety Division (NPTS)
Pavement Materials Testing Laboratory (LNEC PAV-MAT)
António Lemonde de Macedo


THE FRAMEWORK OF LNEC'S ACTIVITY
PROGRAMMED RESEARCH
➢ LNEC´s Research Plan (4 years)
➢ National R&D Programs
➢ Thesis
➢ European Projects
CONTRACTED RESEARCH
➢ Specific studies under contract (public and private entities)
➢ Cooperation protocols
✓ Adaptation and application of research results to the case of Portugal
OTHER SCIENTIFIC AND TECHNICAL ACTIVITIES
✓ Technical consultancy
✓ Current laboratory and field tests
✓ Quality in construction
✓ Norms and Standards
✓ Dissemination
✓ Best practice manuals
✓ Training activities
Technical and Scientific Community
Industry


ACTIVITY OF LNEC IN THE AREA OF ROAD SAFETY
• LNEC PROGRAMMED RESEARCH PLAN (2005-2008)
PROJECT: TRAFFIC AND ROAD SAFETY
✓ 4 European Projects + 1 Study on "Road Safety in Urban Areas"
• PROTOCOL DGV/LNEC
(DGV: General Directorate for Traffic)
✓ Drivers' speeds on Portuguese roads
✓ Sponsor the Portuguese participation in the SUNFLOWER + 6 Project
• PROTOCOL EP/DGV/LNEC
(EP: The National Roads Administration)
✓ Detection of high risk zones in the National Roads Network and manual for at site safety diagnosis
• PROTOCOL EP/LNEC
✓ Pilot studies on road safety audits
✓ Safety interventions in Main Itinerary IP4
✓ Sponsor the Portuguese participation in the RIPCORD Project (under proposal)


ACTIVITY OF LNEC IN THE AREA OF ROAD SAFETY
ON GOING EUROPEAN PROJECTS
➢ SUNFLOWER + 6 – "Comparative study of the development of road safety in nine European countries following the methodology used in the Sunflower report" (DGTREN)
➢ SAFETY-NET – "The European Road Safety Observatory" (Integrated Project – 6th FP)
✓ Participation in:
WP2 – Risk Exposure Data
WP3 – Safety Performance Indicators (Speed, Roads)
➢ IN-SAFETY – "Infrastructure and Safety" (STREP – 6th FP)
✓ Participation in:
WP3 – New models, tools and guidelines for road auditing


ACTIVITY OF LNEC IN THE AREA OF ROAD SAFETY
ON GOING EUROPEAN PROJECTS
➢ RIPCORD – ISEREST – "Road Infrastructure Safety Protection – Core Research and Development for Road Safety in Europe" and "Increasing Safety and Reliability of Secondary Roads for a Sustainable Surface Transport" (STREP – 6th FP)
✓ Participation in:
WP2 – Road Safety Impact Assessment
WP3 – Best practice on Road Design and Road Environment
WP4 – Best practice on Road Safety Audits
WP5 – Best practice on Safety Inspection
WP6 – Best practice on Black Spot Management and Safety Analysis of Road Networks

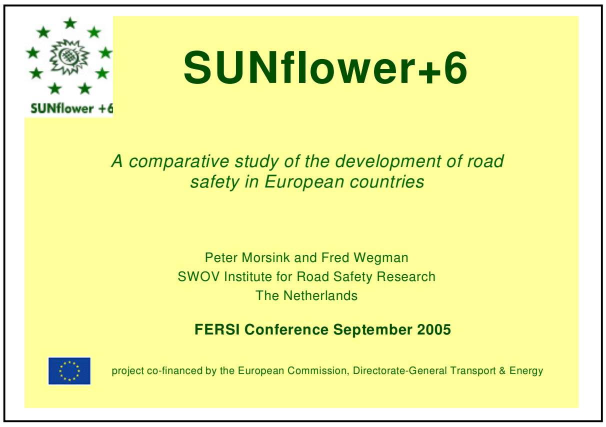

NATIONAL ROAD SAFETY PLAN
ACTIVITY OF LNEC IN THE AREA OF ROAD SAFETY
NATIONAL
INTERNATIONAL
• FERSI,
• EUROPEAN PROJECTS
• COST, PIARC, ETSC, ETC.
"STRATEGIC"
• Setting quantitative targets
• Preparation of the plan
- Structuring areas
- Priority objectives
PNPR:
• Committee for Technical Coordination
• Thematic Groups on:
- Safer speeds
- Safer infrastructures
Dissemination of the Plan
SUNFLOWER + 6
"TACTICAL"
• Follow-up of the Plan
• Results evaluation
• Allocation of resources
• Executive Commission of the PNPR
Research Project "Traffic and Road Safety" (PIP 2005/2008)
SAFETY - NET
ROSEBUD (URG)
"OPERATIONAL"
•Actions Programme
• Safer drivers' speeds
• Safer road infrastructure
Protocol DGV/LNEC
Protocol DGV/EP /LNEC
Protocol EP/LNEC
RIPCORD
IN - SAFETY
Training and Dissemination
DGV – Direcção Geral de Viação (General Directorate for Traffic)
EP – Estradas de Portugal (Roads Administration)
António Lemonde de Macedo

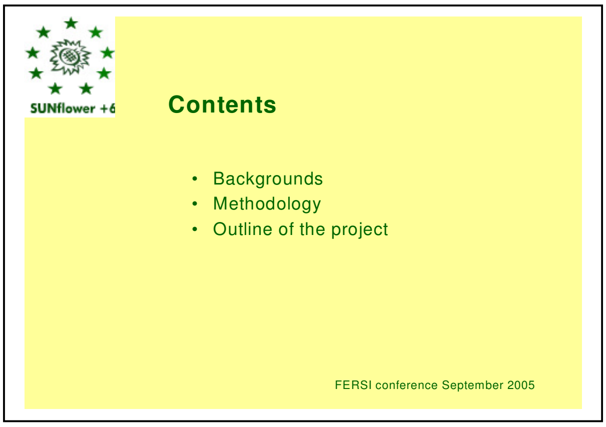

LNEC

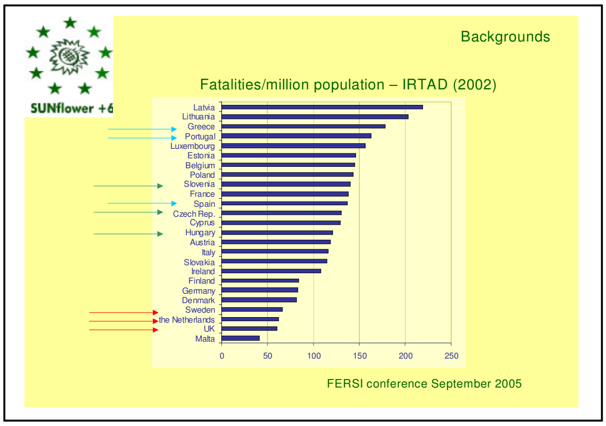
Morsink, Peter
SWOV,
Netherlands

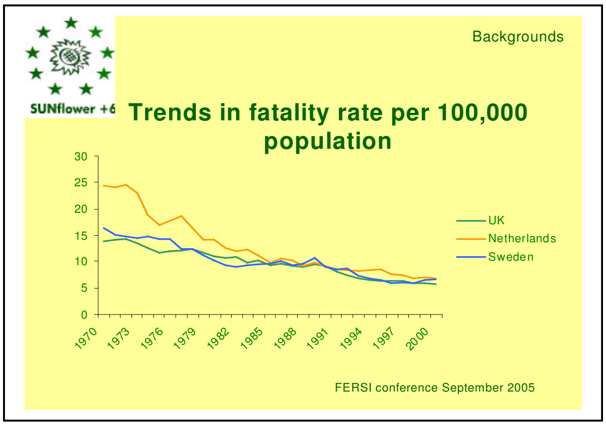
Summary presentation SUNflower+6

How did traffic safety of European countries develop in the last decades? How do countries compare? Can differences be explained and mutual lessons learnt? The SUNflower project, finished in 2002, made some first steps for an international comparison methodology. It dealt with these questions, and provided insight into the relatively good safety performance of Sweden, the United Kingdom, and the Netherlands. It also identified differences between them, but they could not all be explained. In the SUNflower+6 project, the scope has widened by introducing Southern European countries (Spain, Catalonia, Greece, and Portugal) and Central European countries (Czech Republic, Slovenia, and Hungary) into the study. Comparative studies are being performed by describing safety developments and elaborating case studies on key safety issues (such as drink-driving, vulnerable road users, speed management). This is in line with the methodology of the SUNflower project. Final results will be delivered at the end of 2005. The presentation will give an overview of project activities.





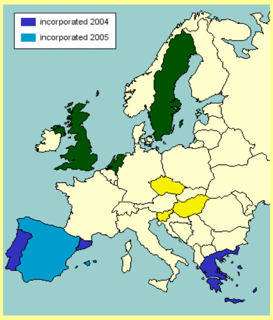




Backgrounds

Partners

- SUN
  - SWOV, Netherlands
  - TRL, United Kingdom
  - VTI, Sweden
- Central
  - CDV, Czech Republic
  - KTI, Hungary
  - Omega, Slovenia
- South
  - DSD, Spain/Catalonia
  - LNEC, Portugal
  - Trademco, Greece



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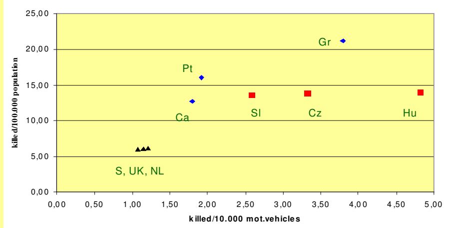
Backgrounds

Personal safety – traffic safety (2002)



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Backgrounds

Objectives

- Insight in road safety risks and road safety policies, programmes and measures in the 9 individual countries.
- Identify key factors that explain past developments
- Learn about further improvements that may be expected of current and future road safety practices in each of the 9 countries.
- To benchmark road safety developments and road safety policies in order to get guidance for remedial actions in the 9 countries in the future
- To identify potential contributions that might be used in European Road Safety Action Plans
- To support road safety policies in other countries.

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Methodology

Basic questions

- How to compare countries?
- How to compare policies?
- How to understand road accident trends?

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Methodology

How to compare countries and policies?

- Use high quality data (e.g. IRTAD)
- Define relevant benchmarks (characteristics at different hierarchical levels in road safety)
- Understand differences between benchmarks values

- Use a target hierarchy (derived from Road Safety Strategy 2010 from New Zealand)
- Target hierarchy is credible, transparent, consistent
- Target hierarchy to be used on a disaggregated level, make stakeholders accountable

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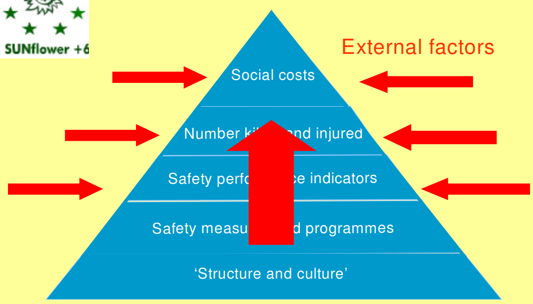
Methodology



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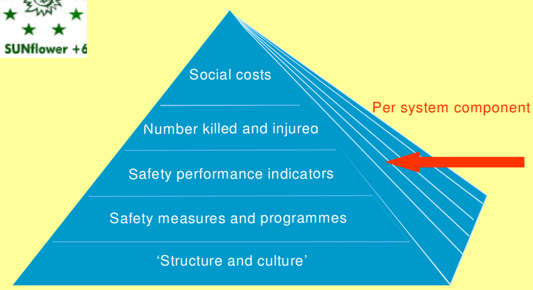
Methodology



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Methodology

How to understand road accident trends? (1)

Describing trends + explaining trends + assess impacts of road safety interventions

- Motorisation + traffic growth
- Adapting road infrastructure to traffic growth (road and traffic measures)
- Improving vehicles
- Road safety measures (legislation + enforcement, education)

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Methodology

How to understand road accident trends? (2)

Take into account external factors
- Long term/structural developments (age pyramid, licensing, collective learning)
- Changes in societies (awareness, acceptance)
- Public health improvements
- Short term fluctuations (weather)
- Accident reporting
- etc.

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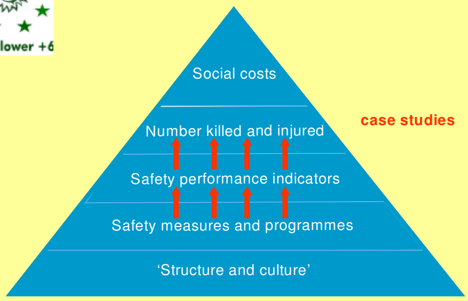
Methodology



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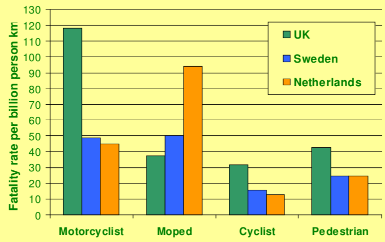
Methodology

Comparative study: example



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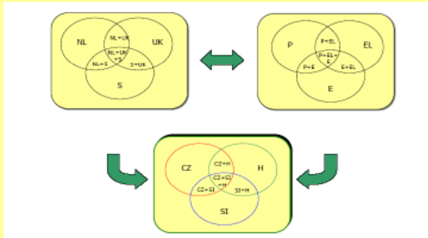
Methodology

From SUNflower to SUNflower+6



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Methodology

From SUNflower to SUNflower+6

- Comparison of **S**weden, the **U**nited Kingdom and the **N**etherlands, that are among the countries in the world with the best safety records
- Macroscopic very similar, but many differences on more detailed level
- Comparing three countries is better than two –what added value by comparing 9 countries?
- Explanation of history trend based on case studies
- What added value by performing more case studies?

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Outline

Project tasks

- Extended study on the road safety comparison of the SUN countries
- A similar comparison between the South countries/regions
- A similar comparison between the Central countries
- Development of a 'footprint methodology' for the safety performance of the 9 countries
- Final reporting

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Outline

Comparative study: selection of case studies

	SUN	Central	South
Drinking & Driving	X	X	X
Seat belts	X	X	X
Low cost engineering	X	X	
Pedestrian	X	X	X
Cyclist	X	X	
Moped	X		X
Motorcycle	X		X
Young drivers	X	X	X
Heavy goods vehicles	X		
Speed management	X	X	X
Enforcement	X		
Implementation strategies	X		

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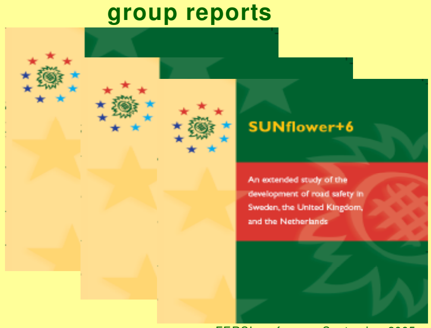
Soon available products: group reports

Outline



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Outline

Using past trends to inform future policies

- Past trends: how far can they be explained?
- What can we learn from recent trends?
- Do current targets and strategies reflect performance and likely future potential?

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Outline

Effects in SUNflower countries:1980-2000

	Saving in fatalities between 1980-2000 attributed to each source		
	Sweden	Britain	Netherlands
Vehicle safety, seat belts, drinking and driving	48%	54%	46%
Local road engineering	4%	10%	5%
Other vulnerable road users-related measures	38%	29%	31%
Other car occupant measures	10%	7%	18%
Total	**100%**	**100%**	**100%**

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Outline

Types of conclusions

- Potential learning points
- Contribution to safety targets
- Feasibility of the methodology
- On country level and EU level

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More information:

http://sunflower.swov.nl

Contact persons:
- Overall project: Fred Wegman (SWOV), Peter Morsink (SWOV)
- SUN extended study: David Lynam (TRL)
- Central comparative study: Jaroslav Heinrich (CDV)
- South comparative study: Simon Hayes (DSD)

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On behalf of the team: thank you for your attention!

FERSI conference September 2005

Siegrist, Stefan
bfu,
Swisse

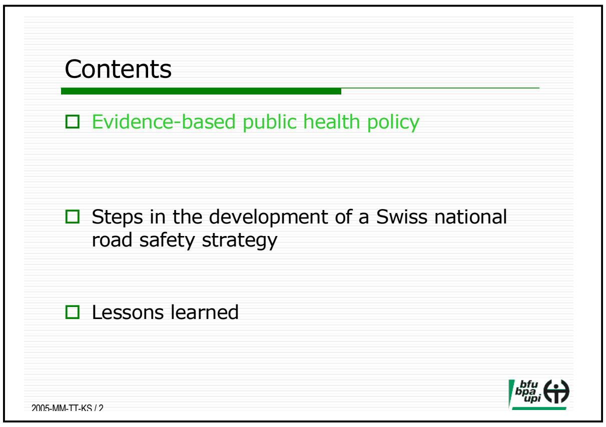
Development of an evidence based national road safety strategy

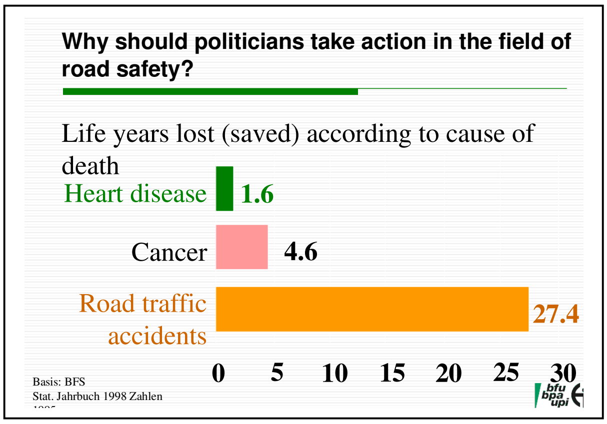
The role of safety research in transport policy is discussed referring to the Swiss experience between 2001 and 2004.

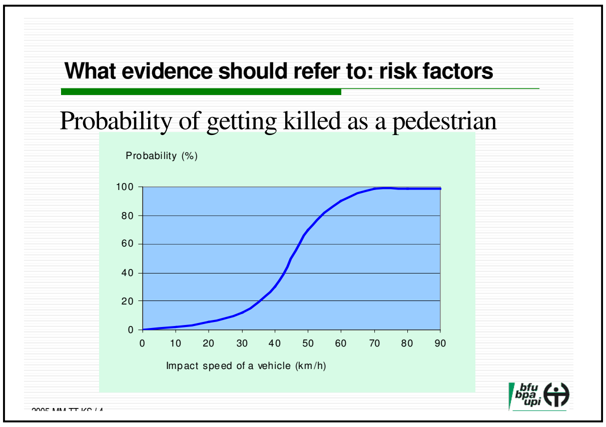
The aim of the Swiss Safety Policy is to half the number of fatally injured by 2010 and to reduce death toll below 1/3 of the level of the year 2000 within 20 years.

The development of a national safety strategy is based on a bfu-study which assesses the effectiveness as well as the cost benefit ratio of possible measures. First the potential for improvement in education, engineering, and enforcement was assessed and possible measures developed. Next step was to calculate the safety benefit of these measures. The calculation was based on five parameters: influencable accidents, impact range, effectiveness, dissemination and compliance. Additionally a benefit-cost analysis (BC) was used. This method places monetary values on all significant outcomes, including death, pain and suffering, and property loss, so that benefits are directly compared with costs in monetary terms.

The presentation focuses not only on the methodology used in the study. It also sheds a light on how the results were apprehended by the public and decision makers. Some conclusions regarding the interaction between science and politics are drawn.







What evidence should decision makers refer to?

- What happens? (epidemiology PYLLS, QALYS per capita)
- What are the reasons? (risk factors: attributable risk)
- What works? (efficacy, in a given situation)
- What are the alternatives? (cost-benefit ratio)

We need research results referring to individual risk factors and measures/groups of measures.

2005-MM-TT-KS / 5

Milestones in evidence-based traffic safety work

- Borkenstein: The Grand Rapids Study (1964)
  Dose-Effect Relationship (BAC-Crashrisk)
- Evaluation:
  Effectiveness of safety belts, random breath testing, police checks in combination with feedback, ….

2005-MM-TT-KS / 6

Evidence-based traffic safety?

- Few case-control studies
- Few meta-analyses
- Low interest in output-evaluation? (e.g. driver training)

2005-MM-TT-KS / 7

Contents

- Evidence-based public health policy
- Steps in the development of a Swiss national road safety strategy
- Lessons learned

2005-MM-TT-KS / 8

Targets set

	Today (2000)	2005	2010	2020
Fatalities	600	500	400	300 (- 50%)
Seriously injured victims	6,200	5,000	4,000	3,000

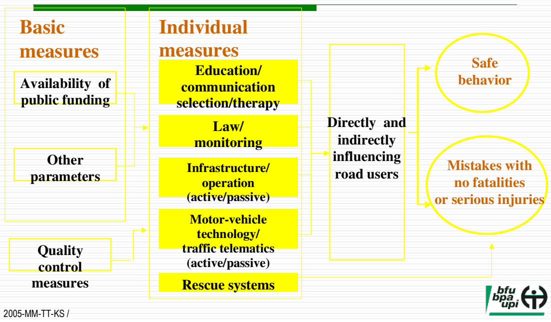
Goal of the bfu study

The basic principles must be worked out in order to develop national road-safety policies. To achieve this:

- The actual state of affairs must be analyzed, evaluated and any need for action defined
- Specific measures for improvement must be worked out (evidence-based)

= Scientific basis for a national traffic safety program

Strategy



2005-MM-TT-KS /

Analysis of the effect of safety measures

Example

Seat belt/ignition interlock

(This measure makes it impossible to start the car engine if any passenger is not wearing a seat belt)

2005-MM-TT-KS /

Maximum no. of preventable fatalities thanks to seat belt/ignition interlock system

Potential number of (445 seriously 136 fatalities
that could be (Accidents where victims were not wearing
belts)

Area of application in **100%** (a) (No victims wearing seat belts)

Efficacy in **45%** (b) (Result of various studies)

Degree of implementation in **100%** by 2020 (c max)

Degree of compliance in **95%** (d max) (5% = exemptions and sabotage)

Formula: **Maximum** no. of seriously injured
No. of inj./fatal. × a/100 × b/100 × c max/100 × d max/100

Maximum no. of prevente

136 × 100/100 × 45/100 × 100/100 × 95/100 = 58

2005-MM-TT-KS /

Results

Measures with high priority (major benefits)

- Automation of car control
- In-car implementation of traffic signs
- Driver alertness monitoring system
- Automated localization of scene of accident and automated emergency call
- Compulsory seat belt/ignition interlock system
- Elimination of accident blackspots
- 0.5 bac and random breath testing
- Compulsory installation of daytime running lights
- Speed limits of 50/30 in built-up areas

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Economic evaluation of road safety measures

Evaluation steps

- Determination of the costs
- Determination of the benefits
  (in financial terms)
- Weighting of the benefits
  (by allocating measures to risk categories)
- Balance sheet of costs and benefits

2005-MM-TT-KS /

1. Determination of the costs

Example: Speed limits 50/30 in built-up areas
30 kph in residential areas and 50 kph on main roads)

- Research and development EUR 0.005m
- Technical equipment EUR 7.1m
- Maintenance, repairs EUR 4.1m
- Evaluation EUR 0.02m
- Average annual costs (10 years) EUR 11m

2005-MM-TT-KS /

2. Determination of the benefits

2 steps

- Avoidable fatalities and injuries
- Monetisation of avoidable victims

2005-MM-TT-KS /

2. Determination of the benefits

Example: Speed limits 50/30 in built-up areas

- Avoidable fatalities 38
- Avoidable serious injuries 234
- Avoidable slight injuries 4,500

2005-MM-TT-KS /

2. Determination of the benefits

Social cost of road accidents

Fatalities	Serious injuries	Slight injuries
EUR 1.3m	EUR 165,000.–	EUR 6,000.–

(Cost of damage to property: EUR 18,000 per injured person)

2005-MM-TT-KS /

2. Determination of the benefits

Example: Speed limits 50/30 in built-up areas

- Fatalities avoided EUR 49m
- Serious injuries avoided EUR 39m
- Slight injuries avoided EUR 27m
- Property damage avoided EUR 89m
- Total benefits (max.) EUR 203m
- Average benefits (10 years) EUR 102m

2005-MM-TT-KS /

3. Weighting of the benefits

Weighting by the voluntary nature of the action leading to the risk

Risk class	Example	Factor (x social cost)
1	Seat belt/ignition interlock system	1 x
2	Bicycle helmet wearing campaign	1.5 x
2-3	0.2 bac for novice drivers	2 x
3	Blackspot treatment	3 x
4	Measures to increase safety on school routes	5 x

4. Balance sheet

Example: Speed limits of 50/30 in built-up areas

		Unweighted	Weighted
• Total average cost	EUR	11m	11m
• Total average benefits	EUR	102m	203m
• Cost-outcome ratio (benefit-cost ratio)		9.0	18.0
• Benefit-cost difference	EUR	91m	192m

Results

No. of measures	Benefit-cost ratio
56 (73 %)	> 1
16 (21 %)	< 1
5 (6 %)	only benefits

Effects of the proposed measures

	Decrease compared with the status in 2000	
Fatalities prevented in **2005**:	**– 80–90**	= 500
Fatalities prevented in **2010**:	**– 310**	= 280
Fatalities prevented in **2020**:	**– 370**	= 210

Reactions to the bfu report

- Many articles in the mass media
- Confusion regarding its aims: vision (0) or target (-50%)
- All political parties and many interest groups commented on the measures mentioned in the report
- Confusion regarding the measures: suggestions or policies?

Reactions to the bfu study

Reactions to the bfu study

Reactions to the bfu report

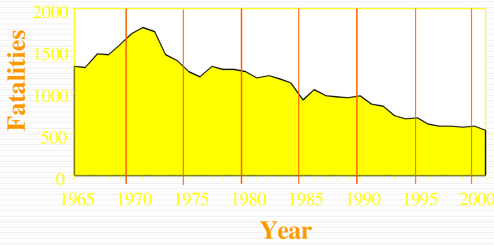
- Federal traffic department invites several groups to discuss the results
- By the end of 2004: presentation of an action program by the traffic department
- 2005(?): the government (Federal Council) decides on an action plan

Contents

- Evidence-based public health policy
- Steps in the development of a Swiss national road safety strategy
- Lessons learned

2005-MM-TT-KS /

Declining number of fatalities, automatism?



2005-MM-TT-KS /

Research and politics

If there is a downward trend in the death toll and if an international comparison (per capita) shows quite good results, then

- Most politicians do not see a need for action
- There is little support for a comprehensive, national traffic safety policy
- It is crucial to show that measures will work (evidence of efficacy)

2005-MM-TT-KS /

Conclusion

Experience in Switzerland shows that:

- You need a target in order to start a planning process
- You need a policy on basic and quality-assuring measures as well as the goals of interventions (e.g. forgiving roads)
- At safety-measure level, it is essential to be very clear and evidence-based

2005-MM-TT-KS /

Maximum no. of preventable fatalities thanks to seat belt/ignition interlock system

Potential number of that could be belts)	(**445** seriously **136** (Accidents where victims were not	
Area of application in	**100%**	(a) (No victims wearing seat belts)
Efficacy in	**45%**	(b) (Result of various studies)
Degree of implementation in	**100%**	by 2020 (c
Degree of compliance in sabotag	**95%**	(d (5% = exemptions and sabotage

Formula: **Maximum** no. of seriously injured No. of inj./fatal. × a/100 × b/100 × c/100 × d/100

Maximum no. of fatalities prevented: 136 × 100/100 × 45/100 × 100/100 × 95/100 = 58

2005-MM-TT-KS /

Workshop 10

Safety strategy and planning – Part II

Leitung

Patric Derweduwen (IBSR) und Bojan Zlender (SPV)

Vorträge

Assum, Terje (TOI)

"Barriers and potentials for the implementation of road accident countermeasures"

Broughton, Jeremy (TRL)

"Formulating a challenging but achievable casualty reduction target"

Stipdonk, Henk, Wesemann, Paul (SWOV)

"Road safety forecasting: a new approach"

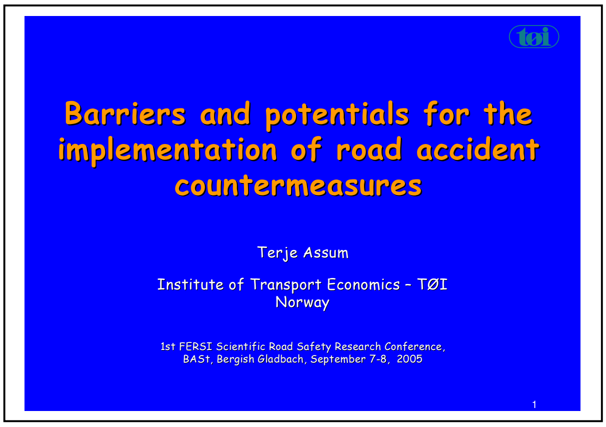
Assum, Terje
TOI,
Norway

Barriers and potentials for the implementation of road accident countermeasures

Many countries have road safety plans and policies. Some even have targets for maximum number of fatalities in road traffic. There is a wealth of knowledge about effective road accident countermeasures, but still it seems most difficult to implement countermeasures to such an extent that the targets are achieved. What are the main barriers to the implementation of road accident countermeasures? And what is the potential for overcoming the barriers and for the implementation of effective countermeasures?

The presentation will be based on a study of Swedish road safety policy and other relevant research carried out at the TØI. The main potential for further implementation of road safety measures is the commitment of the politicians, which has brought about an integration of road safety into the political objectives and targets as well as economic resources for road safety work. The commitment exists primarily within the committee of transport within the Parliament, but the impression is that the whole Parliament supports the road safety work.

One of two important barriers is the limited road-safety commitment of the police on all levels. The other barrier is the limited priority for road safety in the county and municipal politics, which is also reflected in the regional offices of the SRA.



Why not?

- Conflicting interests?
- Vested interests in ineffective measures?
- Lack of resources?
- Other possible barriers?
- What can be done?
- How to study?

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"Potentials and barriers for road safety work in Sweden"

C H Sørensen & T Assum

- Swedish Road Administration – SRA
- Responsible for Road Safety
- Barriers and potential for implementation?

6

Qualitative analysis

- Objectives and management
- Organizational interaction
- Resources
- In general
- Two cases:
  - Median barriers
  - Speed cameras
- Data: Documents and interviews

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Six questions:

	Objectives and management	Organizatonal interaction	Economic resources
Ex-ternal	1. RS integrated in political objectives?	3. Interaction contributes to RS?	5. Resources for RS in society?
In-ternal	2. RS integrated in SRA's goals and management?	4. RS integrated in relevant units within SRA?	6. Resources for RS within SRA?

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1: RS integrated into political objectives?

- Main objective: Economically efficient and sustainable transport
- Safety is one of 6 subobjectives
- Vision Zero and quantified target: max 270 fatalities in 2007
- Nobody believes the 2007 target will be achieved

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2: RS integrated into SRA's goals and management?

- RS included in SRA vision and business idea
- RS included in management system for regional offices and partly for head quarters
- RS is one of many objectives
- Several units have no RS in management system

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3a: Interaction with political institutions?

- Common understanding and open communication with political institutions
- Genuine political interest and support for RS
- Too much harmony between SRA and politicians?
- Insufficent emphasis on resources and political responsibility for RS

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3b: Interaction with police?

- Improved co-operation between SRA and police
- Poor co-op between committees in Parliament and between ministries
- RS is not a priority for the police
- Young police officers don't want to work in road traffic enforcement
- Local police have other priorities
- Traffic police have other duties

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4: RS integrated in relevant units within SRA?

- RS more integrated than before
- Recent reorganization requires the integration of RS in all SRA
- Attitude in parts of SRA: "Roads are for travel and for travelling fast"
- RS is not a priority in regional offices nor in local comunities and counties

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5 & 6: Enough resources for road sector and RS ?

- Resources for RS increased in spite of reduction for SRA
- RS - a priority in national roads plan 2004-2015
- SRA spends less free resources for road safety

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Case 1: Median barriers

- Improve highway safety without the costs of four lanes?
- Two + one lane with a physical barrier
- Political support for new solution
- Opposition from road engineers and media
- No support from police
- 6 trial road sections planned, but difficult to realize
- First section – a great success
- Media pressure for more median barriers

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Case 2: Speed cameras

- Speeding – most important risk factor
- Speed cameras – effective in reducing speed
- Late introduction in Sweden
- Political initiative
- Poor co-operation between ministries
- Initial opposition from police turned into support
- Inexpensive for SRA – expensive for police
- Improved cooperation - SRA and police

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Potential

- Committed politicians
- RS well integrated into transport objectives
- Improving co-operation with police
- Improved understanding for road safety within SRA

External barriers

- Limited commitment from police
- No belief in 2007 target
- Attitude: Sweden is No 1 Road Safety Country – why do more?
- Poor co-operation between Ministries
- Poor co-operation between parliamentary committees
- Mobility rather than safety – the priority of local politicians

Internal barriers

- Harmony in interaction with politicians – no pressure from SRA on politicians for more money
- RS one among many subobjectives within SRA
- RS is not a priority in regional offices
- Traditional engineers in SRA
- No belief in 2007 target

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Way forward?

- New political initiative – new objectives and more resources for the police
- In-depth study of police road traffic work and priorities
- More pressure on regional offices from SRA head office
- In-depth study of local politicians, local police and SRA regional offices
- More research on implementation

20

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Formulating a challenging but achievable casualty reduction target

1. Introduction

The purpose of setting a casualty reduction target is generally accepted to be to provide a common goal for those involved with improving road safety. They can easily understand a quantitative target, and later will be able to check whether there has been progress towards the target. In order to gain the support of the many people whose co-operation will be needed if the target is to be attained, they need to feel that the goal is achievable. On the other hand, the target should also be challenging in order to avoid complacency and focus efforts on the most effective measures. If the target is not challenging then a major opportunity for saving lives will have been lost.

It is important to use a sound methodology to prepare the target for reducing road accidents and casualties. If the methodology is not sound then the target will lack credibility and the efforts for improving safety and saving lives will be jeopardised. Moreover if, as time passes, key people involved in improving road safety come to realise that a poor methodology has produced a target that is too demanding and which cannot be achieved, they will lose motivation and it will be difficult to make progress.

In 1997, the UK Government announced its intention of building upon the experience of the original British casualty reduction target by setting a further target for the year 2010. This paper summarises the methodology that was developed by the group that was established to provide the numerical context for the national casualty reduction targets. Full technical details are available in Broughton et al (2000).

2. Casualty trends

A forecast is not the same as a target, but there are good reasons to build a target on casualty forecasts that are soundly based upon knowledge of what has occurred in the recent past. The casualty changes over these years show what has been achieved by national and local efforts to improve road safety, applying the level of resources that the country's political system has judged to be appropriate. Consequently, a forecast representing the continuation of recent trends shows what may be expected if these efforts were to continue at broadly the same rate in the coming years. This is the starting point for assessing what may realistically be achieved in future with additional efforts.

The key feature of a scientific approach to forecasting based on past data is to identify consistent relationships among these data that can be projected into the future. Thus, the first step in forecasting casualties is to identify consistent relationships among the available accident data. In view of the inherent unpredictability of accidents and the consequent variability of the accident data, it may seem surprising that such relationships do in fact exist. Naturally, the results do not take account of future developments that cannot be foreseen, but the methodology does provide a powerful means of organising available knowledge and thinking systematically about the future development of road transport.

These relationships involve the casualty rate (the number of casualties of a specific severity per billion vehicle-km of motor traffic). British casualty rates have fallen consistently over the years, in spite of the many changes that have occurred to the road transport system during that period. This is illustrated by Slides 4-6 which show various national casualty rates (logarithmically transformed, to allow rates to be compared directly they have been multiplied by a suitable constant to fit within the scale). Research as part of the Sunflower project has found that rates in Sweden and the Netherlands have changed with similar consistency, so the methodology outlined below could certainly be followed in countries other than Great Britain.

3. Forecasting methodology

The rate of casualties per billion vehicle-km of traffic is a powerful measure of the risks of road travel. Thus, the general approach consists of assessing how these risks developed in the past, then examining how they might develop in future. Many policies are directed at specific groups, so the approach had to be disaggregate to allow the expected effects of a policy to be linked with its beneficiaries as directly as possible. On the other hand, the forecast for a group of casualties is likely to be more reliable than the forecast for a subgroup, so only a limited degree of disaggregation was appropriate.

It was decided to prepare casualty forecasts for five groups of road user:

- car occupants (with an urban/rural road split)
- pedestrians
- pedal cyclists
- motorcyclists (includes users of mopeds, scooters and other two-wheeled motor vehicles)
- others (a relatively small and heterogenous group including people travelling by bus, coach, van or lorry).

Annual casualty rates were calculated for 1983-98 for each group. The rates for car occupants and motorcyclists were calculated using the relevant traffic volume. This was not possible for the other groups, so the overall traffic volume had to be used instead. The consistency with which the rates fell over this period offered a simple way of forecasting casualty numbers in a future year:

1. estimate the casualty rates in a future year by extrapolating these consistent falls to that year,
2. multiply the forecast casualty rates by the volume of traffic forecast for that year to predict the number of casualties.

This approach of 'trend-extrapolation' was not sufficient for this application, however, since it took no explicit account of road safety policies. The basic forecasting approach had to be developed to allow assessments of the likely effectiveness of future policies to be incorporated.

It is difficult or impossible to assess reliably the effect of many road safety activities at the national level, for various reasons. Some only affect a relatively small group of casualties, for example, while others such as road safety education are intrinsically difficult to assess. Three areas of policy were identified which had contributed significantly to the casualty reductions of the previous decade and which could be assessed reliably:

- improved standards of secondary safety in cars,
- measures to reduce the level of drink/driving,
- road safety engineering.

These were referred to as the 'DESS' measures (Drink/driving, Engineering, Secondary Safety). The combination of all other road safety activities was referred to as the core programme. The effectiveness of this programme and of the 'DESS' measures in reducing casualties between 1985 and 1995 were compared. These results suggested that the combination of the DESS measures had been roughly as effective as the core programme in containing the growth of slight casualties. Among KSI, however, the core programme had proved more effective than the DESS measures.

The procedure for forecasting the consequences of a new road safety strategy by 2010 had three stages:

1. estimate casualty rates in 2010 to show what would be expected if there were no further DESS measures and only the core road safety activities were undertaken (at the 1998 level of effect) during the period to 2010; this was done by extrapolating trends from the 1983-98 period (slides 10 and 11 illustrate these adjusted casualty rates),
2. prepare a Baseline casualty forecast using these estimated rates together with predictions of the volume of road travel in 2010,
3. apply the assumed effects of the measures in the new road safety strategy (including any further DESS measures) to the baseline forecast.

There is uncertainty about the future volume of road travel. This is represented in Stage 2 by the concept of a 'transport scenario', which consists of a prediction of the level of activity for each of the five groups of road user in 2010.

There was limited official guidance to help to define representative scenarios. The approach adopted, therefore, was to derive assumptions independently for each user group, informed by knowledge of past trends and, in the case of motor vehicles, by the Government's 1997 National Road Traffic Forecast. The car occupant assumptions ranged between 0% and 35% traffic growth relative to 1996. The pedestrian assumptions ranged from "decline continues at recent rate" to "decline reversed, as much walking as in 1983". For pedal cyclists they ranged from "decline continues at recent rate" to "major growth, three times as much cycling as in 1996". Motorcycling assumptions ranged from 25% reduction to 50% increase. The range was much less for the final group, others, with increases from 30%-35%. Slide 8 illustrates the values assessed.

The final list of 36 scenarios only included those that were internally consistent (e.g. lower car traffic assumptions in combination with increased pedestrian and pedal cycling activity). They were felt to be sufficient to demonstrate the extent to which road casualty outcomes were sensitive to the activity levels for different user groups.

Since the casualty trends already represented the effects of continuing with existing road safety measures, these Baseline forecasts showed the number of casualties that would be expected if no new road safety measures were to be introduced over the forecasting period. In this context, 'new' measures were either innovatory or a substantial expansion of existing measures.

In Stage 3, these forecasts were adjusted to take account of the likely effects of road safety measures that were expected to be implemented by 2010. This involved listing likely new measures in consultation with appropriate experts, and using whatever information was available to assess their potential for reducing casualties. The assessment were done separately for each road user group, since measures designed to protect one group may well provide little or no benefit to others. Slide 9 shows the measures and their expected potential for casualty reduction.

The overall method for forecasting casualty rates is illustrated by Slide 7, which displays the casualty rate using an arbitrary scale. The effectiveness of DESS measures could be measured with some confidence, but casualty rates fell faster between 1983 and 1998 than could be explained purely by these measures. The main solid line shows (in an idealised form) how the rate actually fell, while the upper broken line shows how the rate would have fallen without these measures. The lower broken line predicts how the rate might fall between 1999 and 2010 if there were no new measures (including no more of the DESS measures), leading to the Baseline forecast for 2010. The lower solid line shows how the likely effects of expected new measures lead from this to the Final forecast for 2010.

4. Target setting

The forecasting process produced a wide range of results that represented alternative views about the future development of road travel and of road safety measures, as summarised in slide 12. This range provided the numerical context for setting the casualty reduction target, not the target itself. When setting the target, attention naturally focused on forecasts for the more plausible alternatives. Several 'political' judgements were required, such as:

a) Might it prove difficult to maintain the past rate of progress because some key existing measures may start to lose effectiveness in the coming years? – this would suggest that the target should be less ambitious than indicated by these forecasts,

b) May the assumptions about the rate of introduction of new measures be over-optimistic? – this would also suggest a less ambitious target,

c) Conversely, may there be grounds for greater confidence about the effectiveness of new measures, perhaps involving innovatory systems or technologies? - this would suggest a target that was more ambitious than indicated by these forecasts.

The outcome was that the Government announced a new national casualty reduction target in March 2000 (DETR, 2000):

"By 2010 we want to achieve, compared with the average for 1994-98:

- a 40% reduction in the number of people killed or seriously injured in road accidents;
- a 50% reduction in the number of children killed or seriously injured; and
- a 10% reduction in the slight casualty rate, expressed as the number of people slightly injured per 100 million vehicle kilometres."

5. Monitoring progress

Progress in reducing casualties has been monitored annually from 2001 in order to judge whether further measures may be needed to reach (or indeed surpass) the target, and the forecasting methodology has provided a valuable framework for this. As each year passes, the casualty forecasts for that year have been checked against the actual outcome. In the early years, this has mainly been useful for checking the validity of the forecasting equations derived originally. Now, as new road safety measures start to be implemented, this comparison can be extended to check whether collectively they are proving sufficiently effective for the target to be reached.

Overall progress is summarised in slide 15. The target reduction of the slight casualty rate was achieved in 2002, and there are concerns that the reason was a lower rate of reporting slight accidents to and by the police. Good progress has been made towards the other two targets, and it seems likely that they will be surpassed. More details are provided by Broughton and Buckle (2005).

No explicit target was set for reducing the number of people killed, partly because the fatality trend had fallen in parallel with the serious casualty trend (see slide 4). The number of people killed tended to rise from 1998, although it fell by 8% in 2004, and this report examines the likely reasons.

6. References

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Stipdonk, Henk, Wesemann, Paul
SWOV,
Netherlands

Road safety forecasting: a new approach

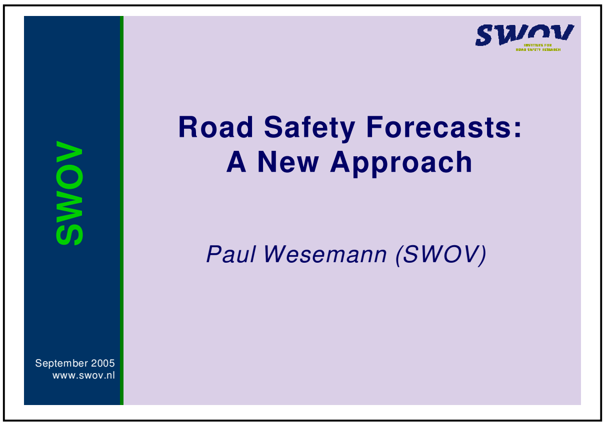
The Dutch Institute for Road Safety Research SWOV has decided to put more emphasis in its current research program on analyzing, explaining and forecasting road safety. One of the core projects aims at developing models that perform better in explaining and forecasting the development of accident risks than those that were used by SWOV in the past. The basic axiom remains the same: the number of accidents is the product of accident risk (number of accidents per unit of exposure) and the amount of exposure.

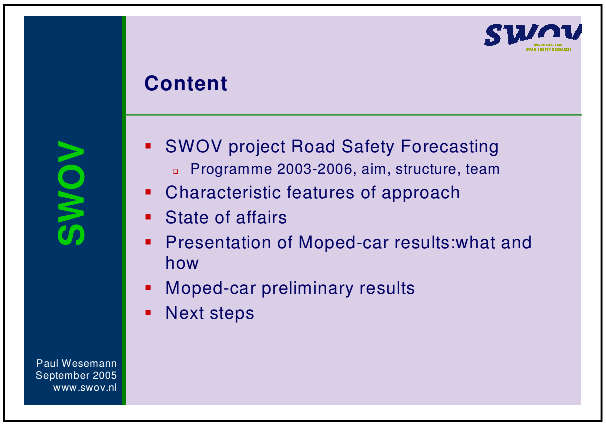
The models describe the annual risk as a function of accidents and exposure and its confidence intervals; multiplication of the predicted accident risk and forecasts for future exposure will provide the accident prediction and its confidence interval. The forecasts for exposure data (mainly vehicle-kilometers) will not be modeled by SWOV but will be obtained from external sources.

The approach that we have chosen, however, is different in various respects:

- the total of accidents has been disaggregated into the risk-groups of the traffic modes that are involved in each conflict; six of these groups have been priorized (car onesided; car-car; moped-car; pedestrian-car; car-truck; bicycle-car). The reason for this disaggregation is twofold: the exposure can be more realistic if the different traffic modes are distinguished, and the risk within each risk group (with respect to the corresponding exposure) can be studied separately.
- within the risk-groups, further disaggregation into subgroups is considered, when it is clear that the risks in these subgroups differ significantly.
- the time series are analyzed with state space models (details of this method will be presented in a separate workshop by Commandeur and Bijleveld).
- the models will incorporate also variables that explain major changes in risk; after an exploratory analysis of accident and exposure data, these explanatory variables are rigorously selected on the basis of literature and expert-knowledge. Examples of these variables are: driving speeds, alcohol use, road design, safety measures.

Currently this approach is being applied on three of the selected risk groups. One of the challenges is to solve the problem of missing data (in particular exposure data).





SWOV project Road Safety Forecasting

- Research programme 2003-2006
- Planning office function: balance and forecast of road safety, taking into account surrounding areas
- Ambition: improve explanation and prognosis
- First steps: explanatory model, surroundings explorations
- Multi-disciplinary projectteam Model-development

Paul Wesemann
September 2005
www.swov.nl

Characteristic features of approach

- Subdivision in risk groups (travel mode of collision partners)
- Predicted or dependent variable: risk (accidents / exposure)
- Explanatory or independent variables: only if effect on risk has been proved
- Steps towards explanatory model: descriptive analysis, literature scan,(linear regression analysis), state-space analysis
- To be added in forecasting model: policy variables, future external influences, mobility forecast

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State of affairs: “work in progress”

- Moped-car risk group: preliminary results
- Draft report Goldenbeld, De Blois, Bijleveld
- Broad variety of subject and methods
- Final approach: to be decided after completion of next riskgroups
- Challenges: data, methods, multi-disciplinarity, ambition

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Presentation of moped-car results:what and how

- All steps taken, but not yet concluded
- Examples of each step
- Aim:
  - Demonstrate working method (no technical details)
  - Get feedback

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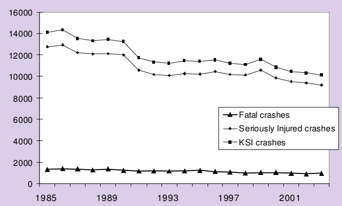
All KSI crashes (1985 – 2003)



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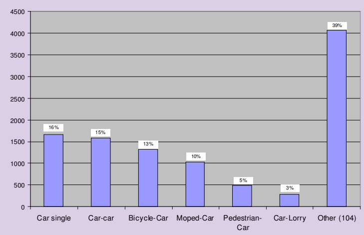
KSI crashes per type of conflict (mean 2000-2003)



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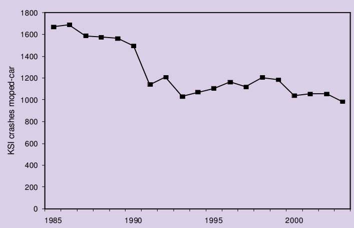
Moped-car KSI crashes



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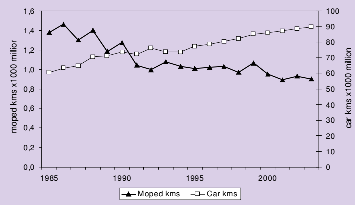
Moped and car vehicle kms



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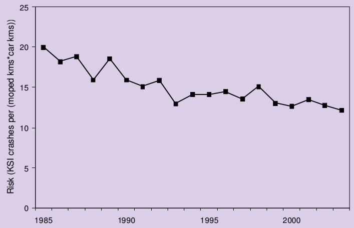
Moped-car KSI crash risk (based on observed data)



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Subdivisions

- KSI Victims, exposure and risk: trends, breaks, periods
- Victims: Urban/rural, speed limit, intersection/road section, side/head-on collision, season, day of week, time of day, gender, age,alcohol, daylight/ darkness, weather
- Exposure and risk for relevant subdivisions: (intersection/road section), (urban/rural for intersections), (crash type for intersections), gender, age, season, time of day

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Subdivisions: some conclusions

- Trend 1985-2003: mobility and risk are different per age and season
- Trendbreak 1991: change in mobility and risk are different per age and season
- Trendbreak 1993/ period 93-99: change in risk is different per age and gender
- Trendbreak 2000: change in mobility and risk is different per age, urban area, time of day and season

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Literature scan

- Effective road safety interventions:
  - 30 km zones, roundabouts, 60 km zones, moped on the roadway (MOR), enforcement
  - Varying periods
- Background variables:
  - Free Public Transport Pass, economic recession, moped characteristics (scooter model, light model, tune-up equipment), weather (precipitation, high temp.)

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Literature scan: some conclusions

- Trend 1985-2003: no additional evidence (other than a combination of subsequent factors)
- Trendbreak 1991: Free Public Transport Pass
- Trendbreak 1993: no additional evidence
- Trendbreak 2000: MOR, eventually in combination with enforcement, 30 km zones, roundabouts

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Modelling with explanatory variables: some results

- Crashes
- Exposure: moped and car kms
- Risk without explanatory variables
- Risk with 2 explanatory variables: interventions in 1991 and 2000
  - 2 exposure measures: mopedxcarkms; mopedkms only
- Risk with 2 interventions, subdivided per age group

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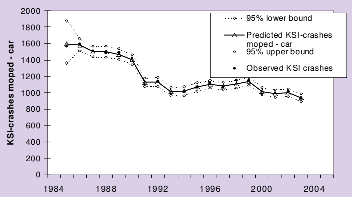
Modelled moped-car KSI crashes



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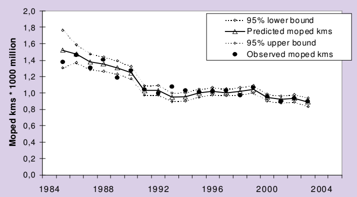
Modelled moped kms



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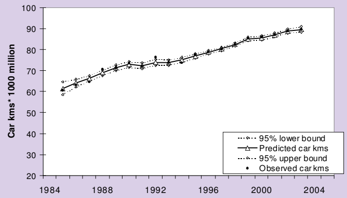
Modelled car kms



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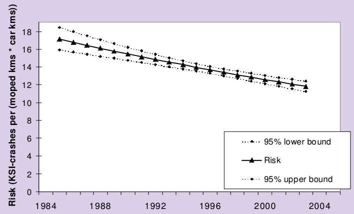
Modelled moped-car KSI crash risk (without explanatory variables)



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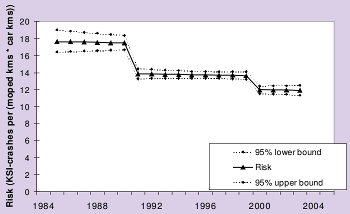
Modelled moped-car KSI crash risk (with 2 explanatory variables)



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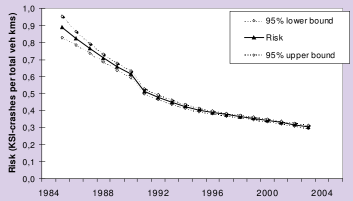
Modelled total KSI crash risk (with 2 explanatory variables)



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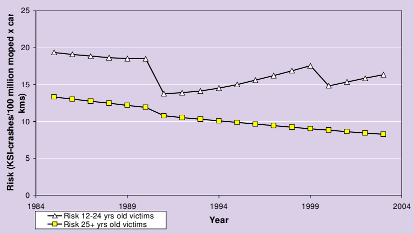
Modelled moped-car KSI crash risk per age group (with 2 expl. variables)



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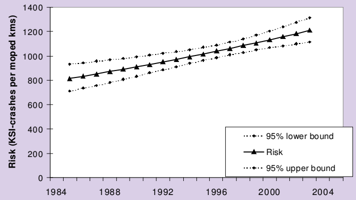
Modelled moped-car KSI crash risk (with 2 explanatory variables)



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Next steps

- Completion moped-car
- Other types of conflict (car-car, single car, pedestrian-car, bicycle-car, car-truck)
- Model adaptations for forecasting (policy variables, external influences)
- Input data collection (explanatory variables, policy scenario´s, mobility forecast)

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Suggestions for discussion

- Promising approach? (given the available data)
  - Effective; efficient; possibilities for improvement
- Similar on-going research elsewhere
- Continuous explanatory variables (gradually improved infrastructure)
- Etc etc

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General Topic „Behaviour and education“

Workshop 2

Driver behaviour

Workshop 5

Safety education

Workshop 8

Driver education and training

Workshop 11

Alcohol and drugs

Workshop 2

Driver behaviour

Leitung

Juha Luoma (VTT) und Fridulv Sagberg (TOI)

Vorträge

Bekiaris, E., Nikolaou, S. (HIT)

“AWAKE project results: Final assessment of the developed driver fatigue monitoring system using both physiological & behavioural data. Knowledge gained and roadmap.”

Sagberg, Fridulv (TOI)

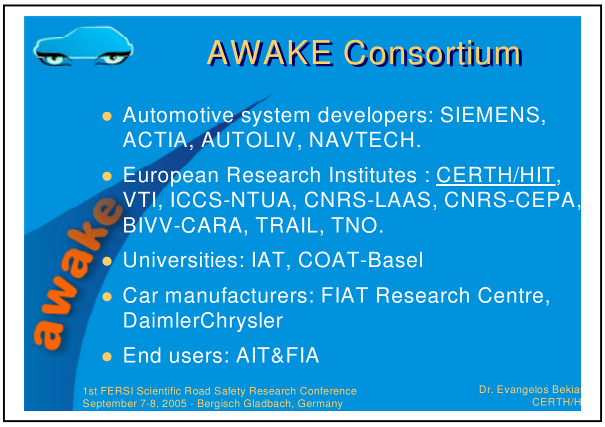
“Falling asleep while driving: Incidence, contributing factors, consequences and driver precautions.”

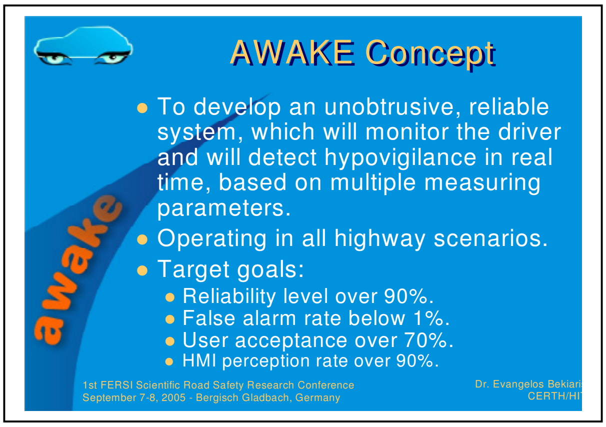
Bekiaris, E., Nikolaou, S.
CERTH/HIT,
Greece

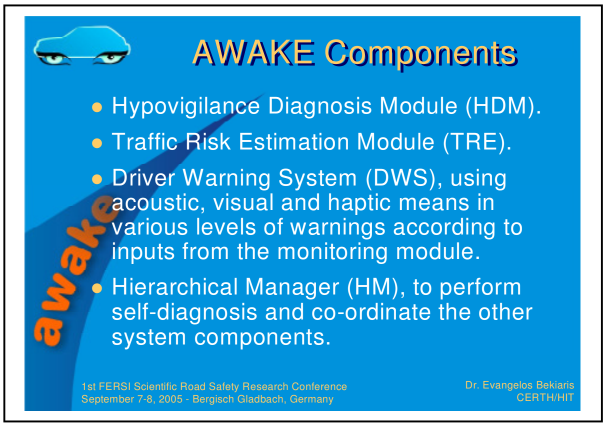
AWAKE project results: Final assessment of the developed driver fatigue monitoring system using both physiological & behavioural data. Knowledge gained and roadmap.

AWAKE (IST-2000-28062) is a 5th Framework research project aimed to increase traffic safety by reducing driver hypovigilance related accidents, through the development of an unobtrusive, reliable system, which monitors the driver and the environment and detects hypovigilance in real time. AWAKE subsystems and overall system were tested in 14 different validation Pilots, aiming to identify system reliability and impact to road safety. In addition, AWAKE developed three different prototypes (city-car, luxury-car and truck) which were evaluated in a live demonstration event, held in September 2004 at the closing of the project. This paper aims to present the results from the evaluation of the developed driver fatigue monitoring system in both simulation and real-road environment, using all three test vehicles. Results are related to various parameters such as: performance, reliability, usefulness, user acceptance on the various HMI elements and are finally compared between the different environments (simulation, real-road) and the different test vehicles.

In addition conclusions are drawn in terms of: knowledge gained, lessons learned, strengths and weaknesses within the 3 years of its research life, and how this knowledge may be used in further research in order to break the barriers and develop an independent low cost system that may be applied in all driving scenarios and for all driver groups. This roadmap is applied within the SubProject 4 of SENSATION (IST-507231) Integrated Project, aiming to develop multisensorial applications that may be applied not only for drivers but for various critical operators' (air-traffic controllers, crane operators, air-fighters) that are susceptible to accidents in case of fatigue.






AWAKE Components
Hypovigilance Diagnosis Module (HDM).
Traffic Risk Estimation Module (TRE).
Driver Warning System (DWS), using acoustic, visual and haptic means in various levels of warnings according to inputs from the monitoring module.
Hierarchical Manager (HM), to perform self-diagnosis and co-ordinate the other system components.
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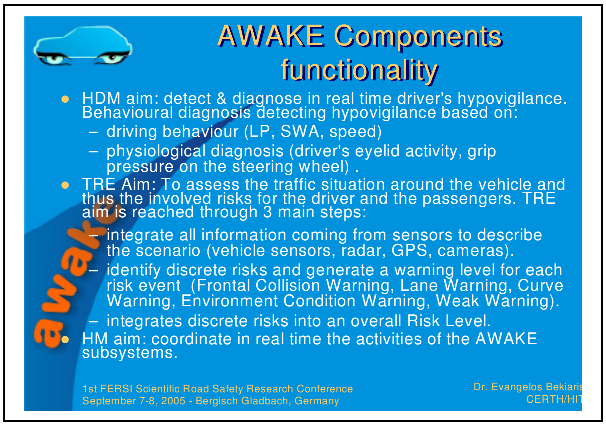
CERTH/HIT


AWAKE Components functionality
HDM aim: detect & diagnose in real time driver's hypovigilance. Behavioural diagnosis detecting hypovigilance based on:
– driving behaviour (LP, SWA, speed)
– physiological diagnosis (driver's eyelid activity, grip pressure on the steering wheel) .
TRE Aim: To assess the traffic situation around the vehicle and thus the involved risks for the driver and the passengers. TRE aim is reached through 3 main steps:
– integrate all information coming from sensors to describe the scenario (vehicle sensors, radar, GPS, cameras).
– identify discrete risks and generate a warning level for each risk event (Frontal Collision Warning, Lane Warning, Curve Warning, Environment Condition Warning, Weak Warning).
– integrates discrete risks into an overall Risk Level.
HM aim: coordinate in real time the activities of the AWAKE subsystems.
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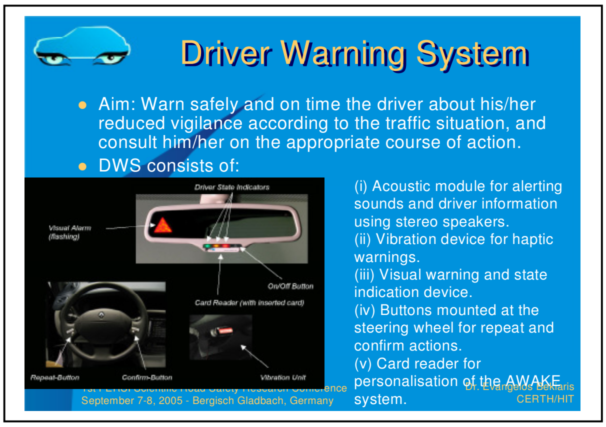
Driver Warning System
Aim: Warn safely and on time the driver about his/her reduced vigilance according to the traffic situation, and consult him/her on the appropriate course of action.
DWS consists of:
Driver State Indicators
Visual Alarm (flashing)
On/Off Button
Card Reader (with inserted card)
Repeat-Button
Confirm-Button
Vibration Unit
(i) Acoustic module for alerting sounds and driver information using stereo speakers.
(ii) Vibration device for haptic warnings.
(iii) Visual warning and state indication device.
(iv) Buttons mounted at the steering wheel for repeat and confirm actions.
(v) Card reader for personalisation of the AWAKE system.
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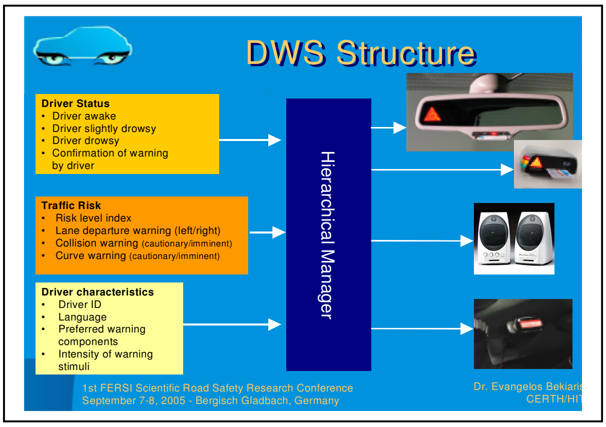
DWS Structure
Driver Status
Driver awake
Driver slightly drowsy
Driver drowsy
Confirmation of warning by driver
Traffic Risk
Risk level index
Lane departure warning (left/right)
Collision warning (cautionary/imminent)
Curve warning (cautionary/imminent)
Driver characteristics
Driver ID
Language
Preferred warning components
Intensity of warning stimuli
Hierarchical Manager
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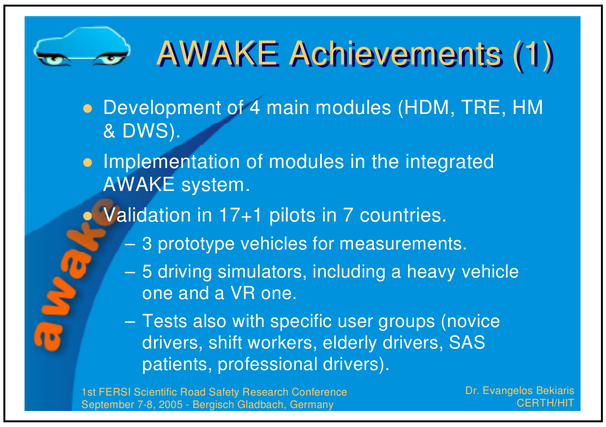
AWAKE Achievements (1)
Development of 4 main modules (HDM, TRE, HM & DWS).
Implementation of modules in the integrated AWAKE system.
Validation in 17+1 pilots in 7 countries.
– 3 prototype vehicles for measurements.
– 5 driving simulators, including a heavy vehicle one and a VR one.
– Tests also with specific user groups (novice drivers, shift workers, elderly drivers, SAS patients, professional drivers).
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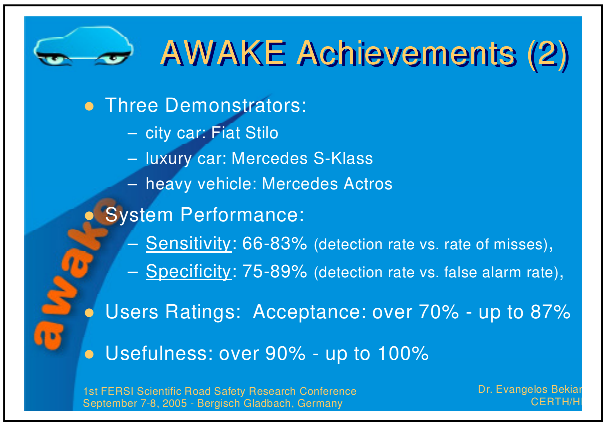
AWAKE Achievements (2)
Three Demonstrators:
– city car: Fiat Stilo
– luxury car: Mercedes S-Klass
– heavy vehicle: Mercedes Actros
System Performance:
– Sensitivity: 66-83% (detection rate vs. rate of misses),
– Specificity: 75-89% (detection rate vs. false alarm rate),
Users Ratings: Acceptance: over 70% - up to 87%
Usefulness: over 90% - up to 100%
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AWAKE City-Car Demonstrator
AWAKE mirror device
Frontal Radar
Enhanced GPS
Lane Tracker
Eyelid Camera
Infrared Illumination
SLEEPY
Steering grip force sensor
DWS buttons
Eyelid Sensor
Steering wheel angle sensor
Eyegaze Detection
Seatbelt Vibration Device
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AWAKE Luxury-Car Demonstrator
Frontal radar
Steering grip force sensor
Visual warnings and card reader
Lane tracking camera
SLEEPY
Eyelid sensor
Infrared illumination
DWS buttons
Eyegaze detection
Steering wheel angle sensor
Seatbelt vibration device
Additional stereo speaker
Enhanced GPS
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AWAKE Heavy-Vehicle Demonstrator

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AWAKE Results

- **Positive Results**
  - ✓ Real time detection
  - ✓ High performance - potential
  - ✓ High acceptance among drivers
  - ✓ Technical performance high
- **Negative Results**
  - ✓ Big differences between individuals
  - ✓ No true reference
  - ✓ Too many experimental settings with different sensors caused problems during developing phase

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AWAKE system sensitivity

- Lack of true reference for the sensitivity evaluation.
- However, a drowsiness detection system should at least diagnose the driver incapability to drive when or just before an incident or an accident (feasible only in driving simulator environment).

Sensitivity Pilot	KSS	OSS	Incidents/ Accidents
15 - VTI Driving simulator	66	62	82
16 – CRF Fiat Stilo	23		
3/8 – ACTIA/CARA Actros Truck	34	-	
17 – DC S-class	60	60	

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AWAKE system specificity

- Lack of the 'golden standard' or 'true reference':
  - the objective reference used (EEG) is not reliable enough (involuntary sleep cannot be triggered).
  - the subjective rating (KSS) is susceptible to own driver's opinion, though closely related to driver's acceptance.

Specificity Pilot	KSS	OSS	Incidents/ Accidents
15 - VTI Driving simulator	89	75	65
16 – CRF Fiat Stilo	71		
3/8 – ACTIA/CARA Actros Truck	76	-	
17 – DC S-class	80	80	

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AWAKE HMI Usefulness

- The most highly rated warning elements were the seat belt vibration and the rumble strips emulation sound. The light indicator seems to have the lowest ranking due to the driver's difficulty to notice it while he/she is hypovigilant.

AWAKE Warning Device Useful = Yes	*Pilot 15*	*Pilot 16*	*Pilot 3/8*	*Pilot 17*
Seatbelt vibration	95%	87%	100%	100%
Warning tone 1-beep	30%	-	-	50%
Warning tone 3-beep	18%	75%	70%	50%
Speech output	59%	75%	60%	50%
Light indic. (amber)	18%	-	-	50%
Light indic. (red)	17%	25%	55%	50%
Flashing triangle	53%	100%	60%	0%
Rumble strip sound	88%	50%	91%	-

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Traffic safety implications

- A high percentage of drivers consider AWAKE system as useful.
- Less than 50% of drivers stated that they would have AWAKE system always activated in their vehicle.
- However, there might be an emerging risk that the AWAKE system could encourage drivers to extend their driving and use it as an 'alertness keeping' system.

Implications Yes	*Pilot 15*	*Pilot 16*	*Pilot 3/8*	*Pilot 17*
Useful for drivers	*100%*	*100%*	*100%*	*89%*
Always activated	*25%*	*47%*	*67%*	*44%*
Extend driving	*35%*	*-*	*38%*	*11%*

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Knowledge Gained (1)

- AWAKE has made a major breakthrough but with the current sensor technologies can not be used outside the well-structured highway scenario nor can be applicable for all drivers.
- AWAKE know-how is an invaluable starting point for further research, as it identified the lack of a "golden standard" and enough reference data, offered promising sensors for further development and reliable and robust algorithms.

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Knowledge Gained (2)

- Existing sensors are at their limits (need for higher frequency rates, sensors physically closer to the user, more physiological signals to be recorded).
- Dependency upon mechanical sensors (i.e. lane recognition, frontal radar) needs to be ultimately removed, for rest ADAS independent application.
- No golden standard and reference data for microsleep phenomenon, limiting the success chances of the developed algorithms and hindering their objective assessment.
- Need for additional physiological data to distinguish the cause of the problem (sleepiness, inattention, stress, etc.).

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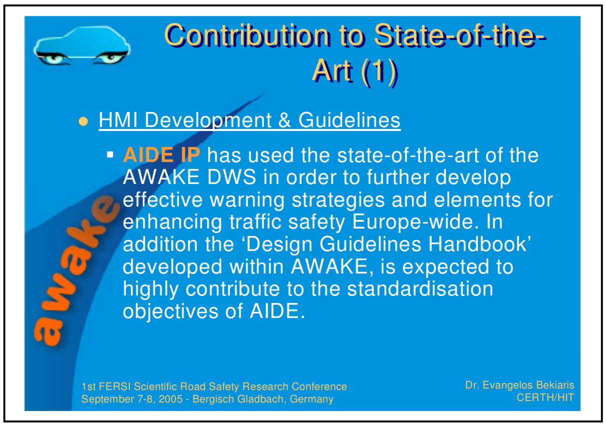
Contribution to State-of-the-Art (1)
HMI Development & Guidelines
AIDE IP has used the state-of-the-art of the AWAKE DWS in order to further develop effective warning strategies and elements for enhancing traffic safety Europe-wide. In addition the 'Design Guidelines Handbook' developed within AWAKE, is expected to highly contribute to the standardisation objectives of AIDE.
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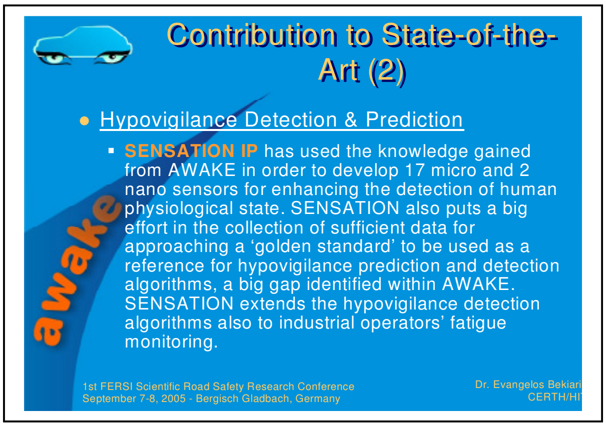
Contribution to State-of-the-Art (2)
Hypovigilance Detection & Prediction
SENSATION IP has used the knowledge gained from AWAKE in order to develop 17 micro and 2 nano sensors for enhancing the detection of human physiological state. SENSATION also puts a big effort in the collection of sufficient data for approaching a 'golden standard' to be used as a reference for hypovigilance prediction and detection algorithms, a big gap identified within AWAKE. SENSATION extends the hypovigilance detection algorithms also to industrial operators' fatigue monitoring.
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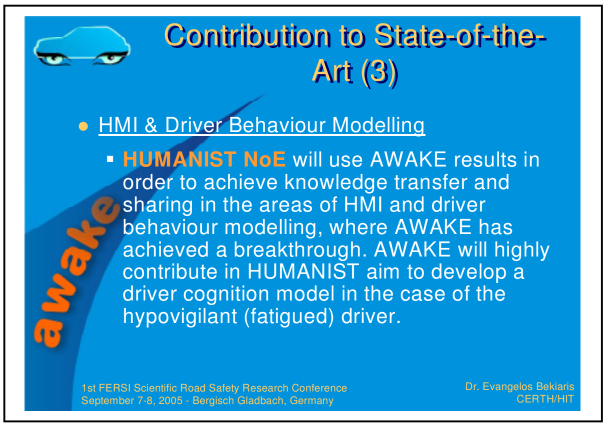
Contribution to State-of-the-Art (3)
HMI & Driver Behaviour Modelling
HUMANIST NoE will use AWAKE results in order to achieve knowledge transfer and sharing in the areas of HMI and driver behaviour modelling, where AWAKE has achieved a breakthrough. AWAKE will highly contribute in HUMANIST aim to develop a driver cognition model in the case of the hypovigilant (fatigued) driver.
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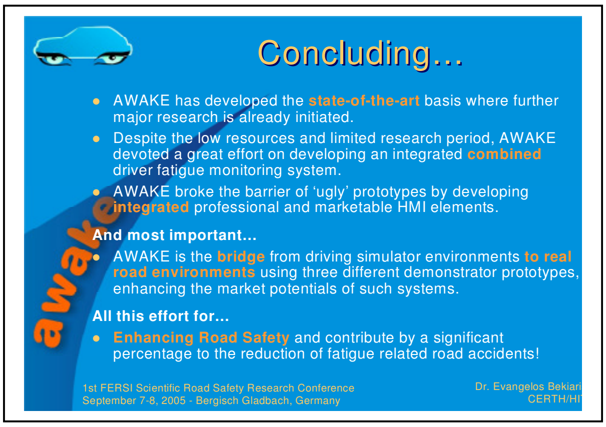
Concluding…
AWAKE has developed the state-of-the-art basis where further major research is already initiated.
Despite the low resources and limited research period, AWAKE devoted a great effort on developing an integrated combined driver fatigue monitoring system.
AWAKE broke the barrier of 'ugly' prototypes by developing integrated professional and marketable HMI elements.
And most important…
AWAKE is the bridge from driving simulator environments to real road environments using three different demonstrator prototypes, enhancing the market potentials of such systems.
All this effort for…
Enhancing Road Safety and contribute by a significant percentage to the reduction of fatigue related road accidents!
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Sagberg, Fridulv
TOI,
Norway

Falling asleep while driving: Incidence, contributing factors, consequences and driver precautions.

The following presentation gives a short overview of some issues related to the crash risk associated with fatigue and sleepiness among drivers. This is a topic that is presently receiving considerable interest among traffic safety researchers and professionals, as well as from the media. Driver fatigue and sleepiness are generally acknowledged to be among the most important causes of traffic injuries and fatalities, in line with factors like speeding and alcohol or drug use.

I will start by presenting some data on the scope of the problem, both sleep-related crashes and near-miss incidents. Then I will mention briefly the main determinants of driver sleepiness. Further, some data regarding the circumstances under which drivers fall asleep will be presented. Although we are all at risk of falling asleep while driving, some groups are more at risk than others, and I will show results for some particular high-risk driver groups. Finally, some research related to countermeasures will be mentioned. An overview of the contents of the presentation is shown in Figure 1.

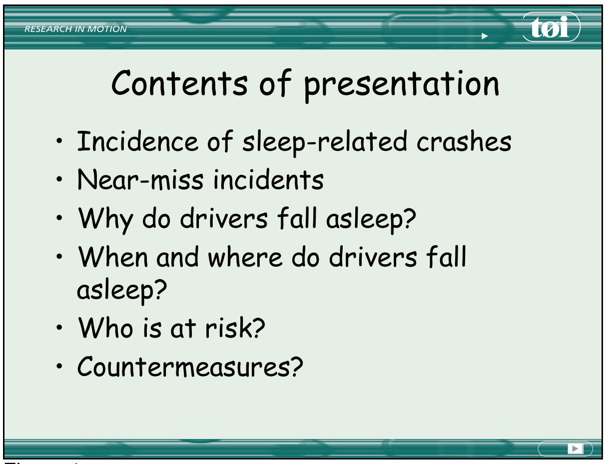

Figure 1

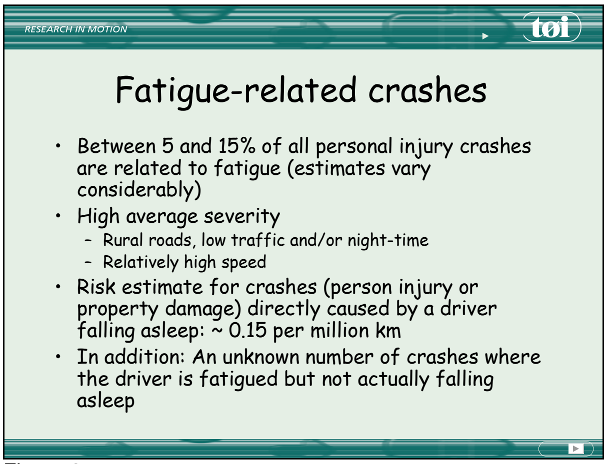

Figure 2

The estimates of the incidence of fatigue-related crashes (Figure 2) vary considerably between different studies, but most estimates tend to fall in the interval between 5 and 15 percent of all personal injury crashes (for an overview of studies, see Sagberg, Jackson, Krüger, Muzet, and Williams, 2004).

The estimates vary both depending on the method of reporting and on the type of crash. A general finding is that the percentage of sleep-related crashes is higher for crashes with high as opposed to low severity. This is probably related to the fact that the risk of falling asleep is especially high under driving conditions generally associated with relatively high speed, such as rural roads, night driving, or low traffic volume.

Based on anonymous self-reports from a large number of drivers who have fallen asleep while driving, we have estimated the risk of a directly sleep-related crash to be about 0.15 per million km, when all kinds of crashes are included (Sagberg and Bjørnskau, 2004). In addition there are an unknown number of crashes caused by fatigued drivers whose driving performance is impaired although they have not fallen asleep.

Every incident of a driver falling asleep can be considered a near-miss event. Whether it results in a crash or the driver wakes up before anything serious happens, is partly a question of chance events, like the presence of a vehicle in the opposite lane or a wide road shoulder.

Several studies have shown that at least 10 per cent of a random sample of drivers report to have dozed off some time while driving during the last 12 months. This problem is probably under-reported, because microsleep episodes may sometimes occur without being noticed by the driver.

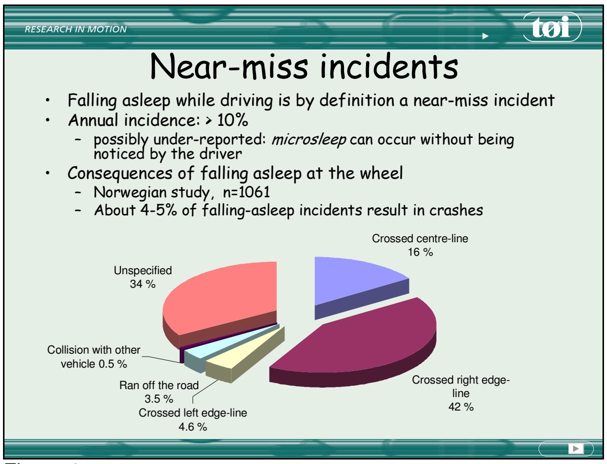

Figure 3

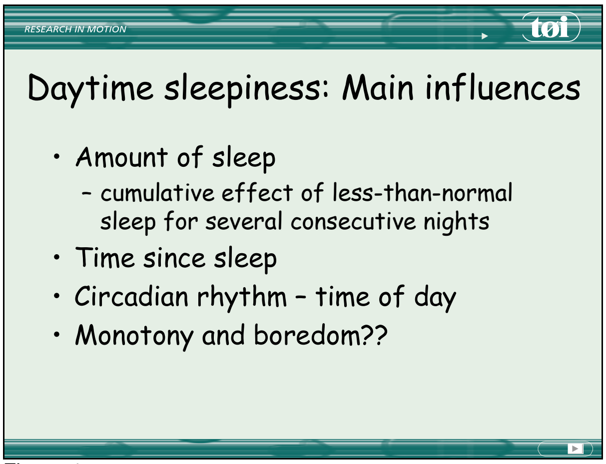

Figure 4

Our studies (Sagberg, 1999; Sagberg and Bjørnskau, 2004) show that about 4% of the falling-asleep incidents result in a crash (Figure 3).

The remaining 96% obviously include a high number of narrow escapes. It is notable that the most frequent consequence is crossing of the right-side edgeline, whereas crossing of the centreline is much rarer. This is likely to be explained by the fact that a vehicle on a straight road section with a sleeping driver will tend to drift off to the right due to the cross-section of the road.

This result is consistent with the finding that running off the road is the most frequent sleep-related crash type, and far more frequent than crashing with another vehicle.
The main factor determining the risk of falling asleep is the amount of previous sleep (Figure 4), and it is important to point out that sleep loss may accumulate over several nights, so one night of normal sleep is not always sufficient to be well rested for a long drive.

Further, sleepiness is obviously a function of time since the last sleeping period. A long time behind the wheel results both in impaired driving performance and increased risk of falling asleep.

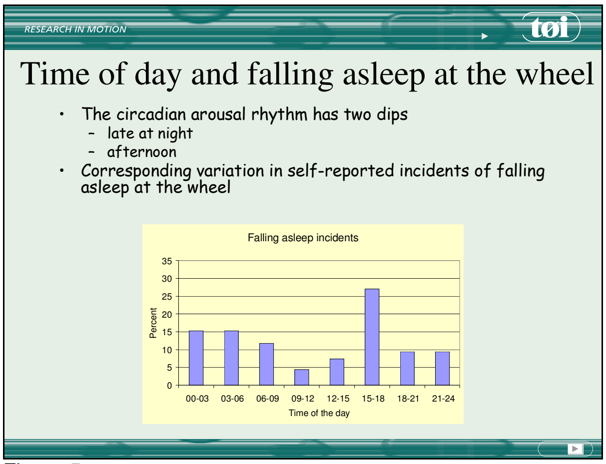

Figure 5

A very important influence is the circadian biological arousal rhythm, to which I shall return in a moment.

An interesting question is also to what extent sleepiness can result from a monotonous and understimulating environment, even in rested drivers.

The circadian rhythm has two low-arousal periods – or ”dips”, one late at night or early in the morning, and a smaller one in the afternoon. It is interesting that there is a corresponding variation by hours in the frequency of self-reported falling asleep while driving (Figure 5). The single 3-hour interval with the highest share of falling-asleep incidents is actually between 3 and 6 o’clock in the afternoon. (An additional factor explaining a higher share during the afternoon compared to the night is obviously the difference in traffic volume.)

The circadian rhythm is also reflected in the frequency distribution of sleep-related crashes over the 24-hour period (Figure 6). The intervals with the highest number of crashes are between 3 and 6 in the afternoon and between 6 and 9 in the

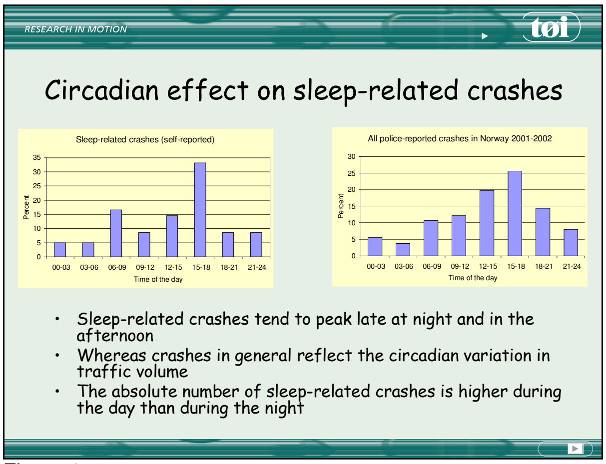

Figure 6

morning. Contrary to this, the frequency distribution for all crashes shows only a monophasic variation, mainly reflecting the variation in traffic volume across the 24-hour period.

Crashes on motorways (Figure 7) show a somewhat different picture, with a relatively higher share of crashes during the night (Horne and Reyner, 1995), compared to Figure 6 showing all crashes. This suggests that sleep-related crashes make up a higher share of crashes on motorways than on other roads, and it also explains the relatively high average severity of sleep-related crashes.

Figure 8 shows that the majority of falling-asleep incidents among drivers happen under relatively good driving conditions (Sagberg and Bjørnskau, 2004). Although we do not have corresponding data for the percentage of the traffic occurring under the same conditions, we can safely conclude that falling-asleep incidents are over-represented under the conditions listed here.

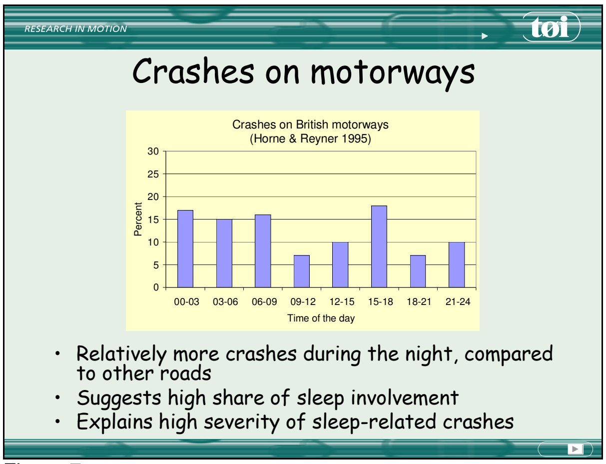

Figure 7

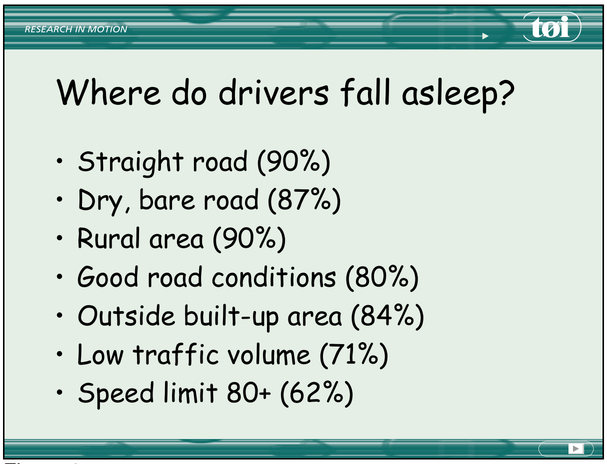

Figure 8

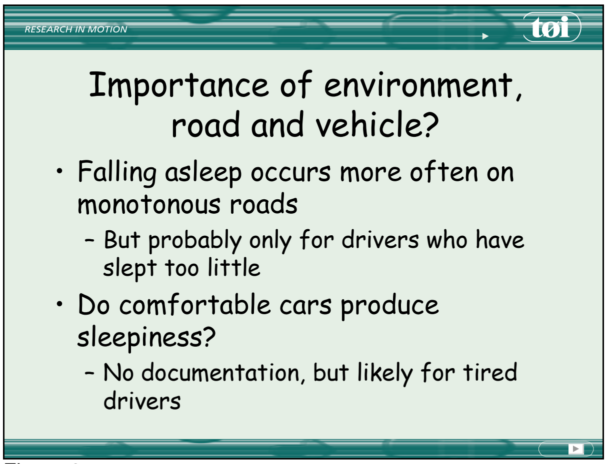

Figure 9

This over-representation naturally leads to the question of whether a monotonous environment actually causes sleepiness (Figure 9).

Sleep researchers tend to be of the opinion that monotony is not a causal factor for sleepiness in a fully rested person. But on the other hand, once a person has acquired a sleep debt, a monotonous environment may increase the probability of falling asleep. In other words, monotony does not cause sleep but it may permit sleep.

This holds both for the road environment and for the design of cars.

But since a high percentage of the population is likely to suffer from a chronic sleep debt, a stimulating driving environment may be one way to prevent sleepy drivers from falling asleep.

We can identify at least three specific groups of drivers that are especially likely to fall asleep while driving (Figure 10). First, it is not surprising that sleepiness is reported to be a notable problem among long-distance truck drivers, due to their long periods at the wheel, and often under the

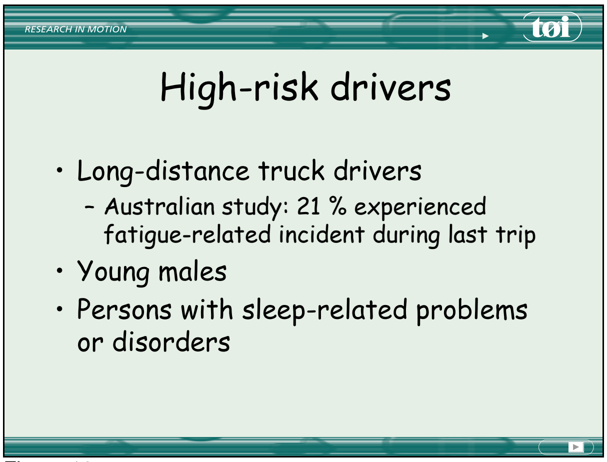

Figure 10

mentioned conditions that ”permit” sleep in tired drivers. An Australian study (Williamson, Feyer, Friswell and Sadural, 2001) found that about one in five drivers reported some fatigue-related incident during their last trip. And about 50% report to have actually dozed off some time during their driving career.

The two other groups are young male drivers and persons with sleep-related disorders or problems. Figure 11 shows that young males have a very high incidence of falling asleep while driving, compared both to older male drivers and female drivers. As many as 15 % of the drivers in the youngest group report to have fallen asleep during the last year. Possible explanations may be that young males tend to drive more during the night, get less sleep, and tend to overestimate their abilities and think they are able to stay awake just by effort.

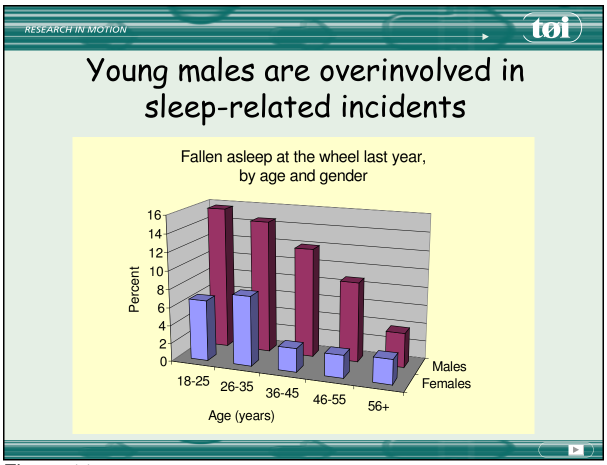

Figure 11

Figure 12

Drivers with sleep disorders are over-represented in sleep-related crashes. The most common disorder is the sleep apnoea syndrome, which has its highest prevalence among middle-aged men (Figure 12). Due to inhibited respiration during the night, the quality of sleep gets poor, and this results in increased daytime sleepiness. A less frequent but also more serious condition is narcolepsy, which implies that the person suddenly may fall asleep during normal activity. Fortunately, there is effective treatment available for both these conditions, provided they are properly diagnosed.

Finally, there are the more ”normal” sleep problems, that most of us may experience from time to time, such as difficulty to fall asleep, and waking up too early, which may also result in excessive daytime sleepiness.

Several studies, including ours, have shown the over-involvement of drivers with sleep problems in crashes. We found that 40 % of drivers that were responsible for a sleep-related crash reported some sleep problem.

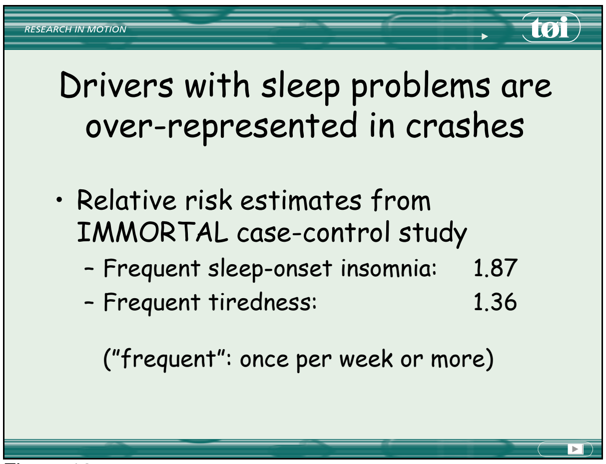

Figure 13

In the EU project IMMORTAL we found that both sleep-onset insomnia and frequent tiredness were associated with a significantly increased relative risk. The relative risk estimates shown in Figure 13 are odds ratios adjusted for age and annual driving distance (Sagberg, 2006).

Although there may bee some instances of drivers falling asleep without noticing any signs of sleepiness first, it has been shown that most drivers experience various ”early warning” symptoms before falling asleep (Figure 14). There may be bodily symptoms like yawning or heavy eyelids, mental symptoms like daydreaming, or behavioural signs like increased variation in speed or lateral position.

One problem is that many drivers tend to underestimate the importance of the early signs of sleepiness, and they think they can stay awake just by effort. Many of the common things drivers do to avoid falling asleep, such as opening the window or playing music, are not very effective in the long run. It is clear that the only effective countermeasure against sleepiness is sleep.

In Figure 15 (from Nordbakke, 2004) we can see that only 10 % of drivers report that they stop and take a nap when they get sleepy. Stopping to have a break and get out of the car is reported by 50%, and this may possibly have a temporary effect. The most frequent countermeasure is to open the window, which is probably less effective.

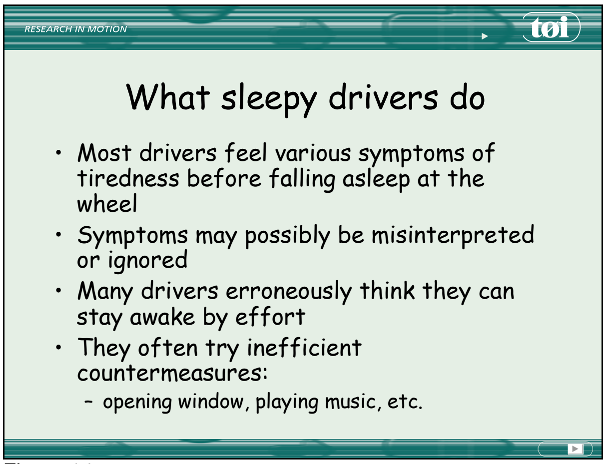

Figure 14

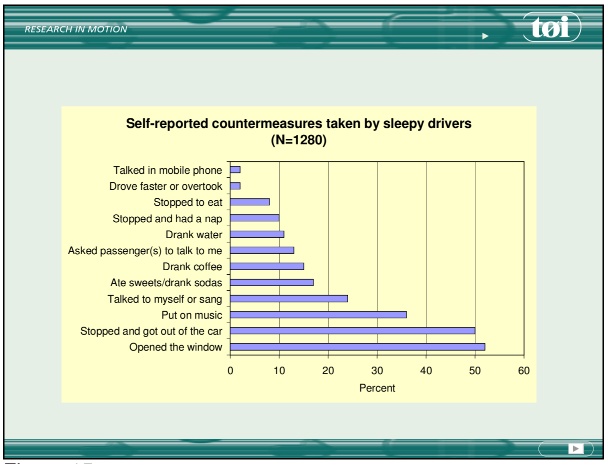

Figure 15

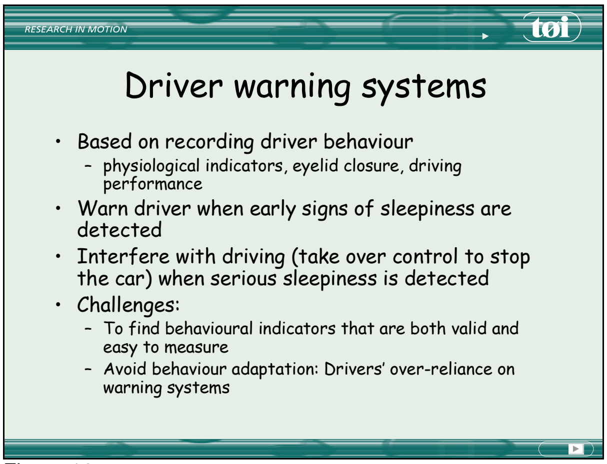

Figure 16

The topic of driver warning systems shall be mentioned only briefly here (Figure 16). The principle for such systems is to record the early signs of sleepiness and to warn the driver, e.g. by a sound, when those signs occur.

One important challenge is to find indicators that are both valid and easy to monitor, and another challenge is to prevent drivers from relying too much on the technical systems, and continue driving in a sleepy state, trusting that the system will interfere if necessary.

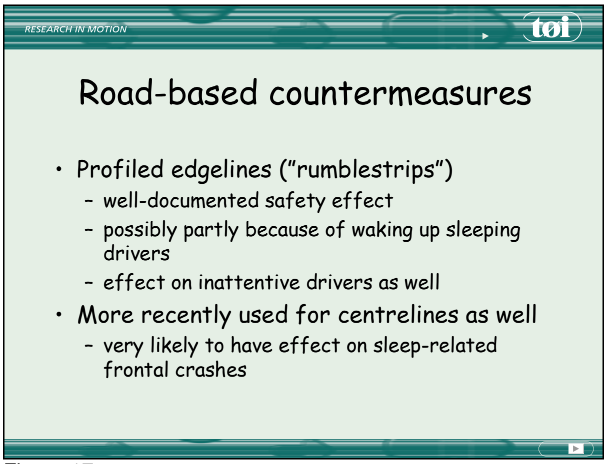

Figure 17

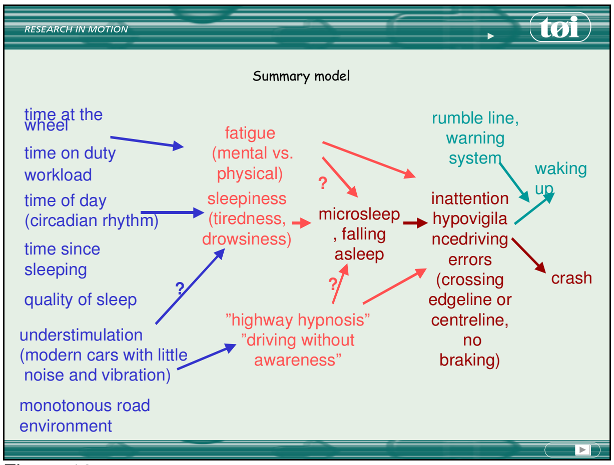

Figure 19

An example of a roadbased warning system (Figure 17) is the use of profiled edgelines, which have now been in use for a couple of decades, with very good results concerning crash prevention. More recently, profiled lines are used also for centrelines, which is likely to have some effect on sleep-related frontal crashes. On the background of the fact that crossing the edgeline is the most frequent consequence of falling asleep, more sleep-related crashes are probably prevented by profiled edgelines than by centrelines.

Countermeasures at the organisational level (Figure 18) have been tried out in the form of fatigue management programmes in companies, and also by considering fatigue in organising work and trip schedules.
Work-based programmes are probably more efficient than campaigns directed to the general public, because there are more possibilities for using incentives in an occupational setting. There is also a possibility that fatigue management in work-related driving may have some spin-off to private driving as well.

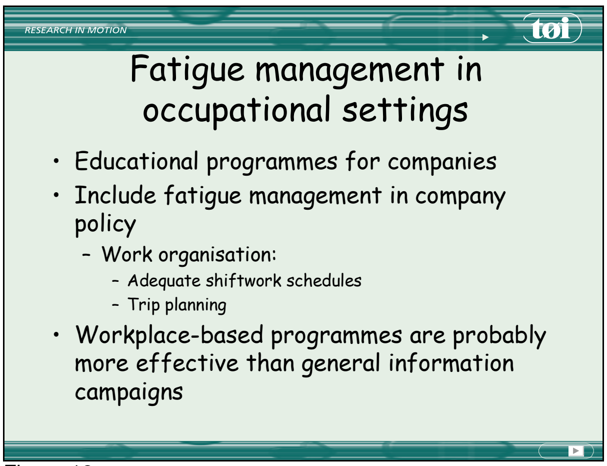

Figure 18

Finally, Figure 19 shows a conceptual model summarising the main influences on driver fatigue and sleepiness, and the possible consequences. Most components of the model have been mentioned already, and they will not be comment further here.

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Workshop 5

Safety education

Leitung

Gitte Carstensen (DTF) und Jaroslav Heinrich (CDV)

Vorträge

Heinrichova, Jitka, Heinrich Jaroslav (CDV)

“Czech approach to Safe way to school”

Weber, Karin (KuSS)

“Inventory and compiling of a European good practice guide on road safety education (ROSE25)”

Zabukovec, Vlasta (SPV)

“Educational Model for Road Safety Education”

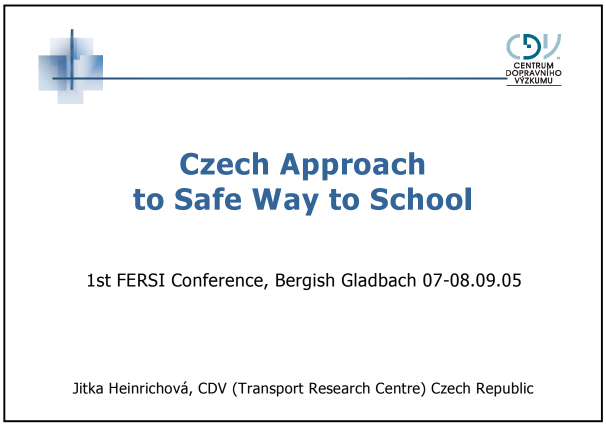
Heinrichova, Jitka, Heinrich Jaroslav
CDV,
Czech Republic

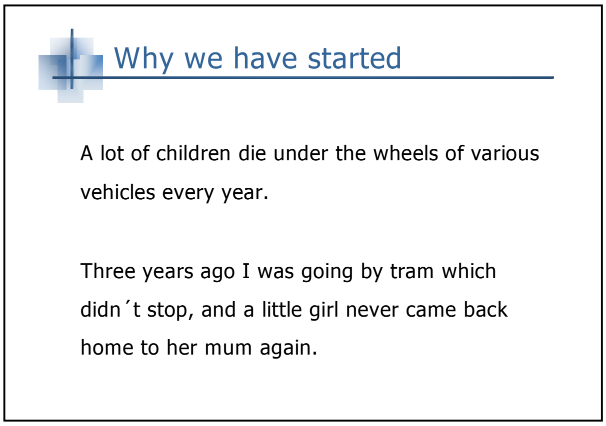
Czech approach to safe way to school

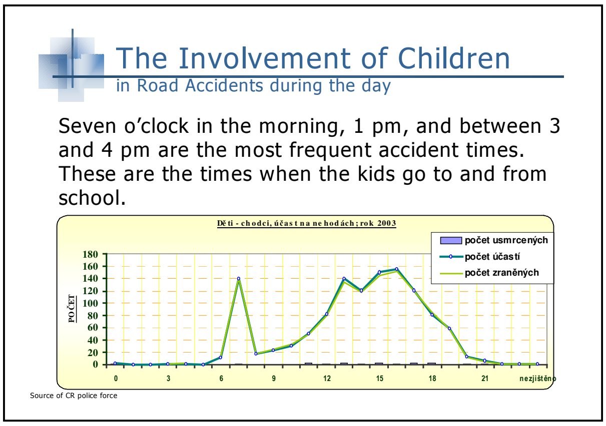
There have been nearly no changes in the road safety education in schools even after 14 years of the new development of the Czech Republic. In daily praxis the situation were worse than in 70th or 80th. The old materials coming from 70th are still in use on the most of schools if the teachers even would like to use anything. Less and less attention were dedicated to the RSE in schools, hand in hand with the decreasing amount of money coming from the central government. Taking this into account some local initiatives started to use different projects from abroad, but mostly dedicated only to local level and without any scientific framework or background. Some of them were very good, but some others made things even worse than before.

Taking this into account CDV started in 2004 several activities to reconstruct the RSE of children in a new way. The complete new RSE curricula has to be finished in 2007, but what to do immediately?

Based on the British experiences and after discussion with some additional experts we have started with Safe Way to School project. The Czech approach to this activity is very broad including safer and more sustainable mobility as well as advice to teachers and different partners how to include RSE in every nearly any activity of children. Results from around 20 pilot schools in different cities are very promising and will led to design of the Safer Way to School guidelines in 2005.



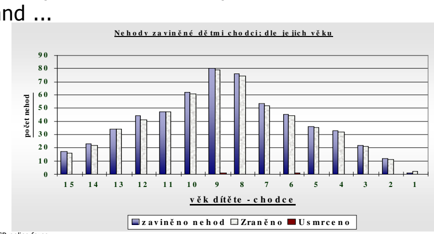




Accidents

Caused by Child Pedestrians; by their Age

The most affected age group of children is between 8 and 10. Current traffic education mostly starts in the 4th year of school. Too late and ...



Source of CR police force

Survey

As my survey revealed, there are usually only 2 lessons of RSE per year.

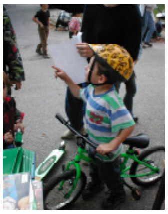
Typically, children only memorize the rules.

In some cases they go to a children traffic playground once a year.

Survey

Of course there is some road traffic education in kindergartens and in the primary stage of secondary school but ...

Is it really the right education to save children´s lives ???



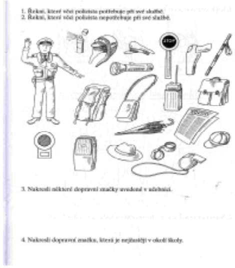
Schoolbook

current road safety education - for first – third class

In the schoolbooks children learn who is standing behind the girl in green jumper and in front of the boy in red jacket, and what the names of the vehicles and traffic signs in the picture are.

Schoolbook

for first – third class - current road safety education



In the workbook they complete what kind of clothes and aids the Police need for their work.

May information like those save children´s lives?

Start *Safe Way to School* in CR

Due to the dissatisfactory situation, we were looking for a new and interesting project.

We found the British project Safe Way to School as the most interesting one and we adopt this project in the new Czech curriculum.

The final draft for pilots is based on the British project, review of foreign experience and my own experience from 20 years of teaching children.

Workshops for teachers

Safe Way to School project suits the most to the ideas of the teacher of teachers J.A.Comenius

"We learn to work by working".

I always ask teachers: "How do you teach children so that their knowledge can be permanent ??"

How to teach children?

1 - we can ***read*** scholarly articles to the children
2 - we can let the children ***study*** an issue in the library or internet
3 - we can ***watch*** an interesting movie about the life in Sahara
4 - we can ***bring*** sand, animals, plants.. to the classroom
5 - we can ***live*** with the children for some days in Sahara - there the children could play and observe

How to teach children?

The same approach we may use in road safety education very easily.

We have the same possibilities in road safety education. Most experience children may obtain from their daily life in road traffic, but we have to take into account that each brain is unique.

Each child has different approach

Each brain is unique and has its own ways how to adopt information, and how to use what it has learned.

Each child has different dominant intelligence.

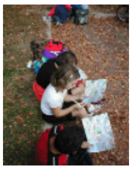
Each child has different interests.

Each child has different hobbies.

Each child learns differently.

Each child has different approach

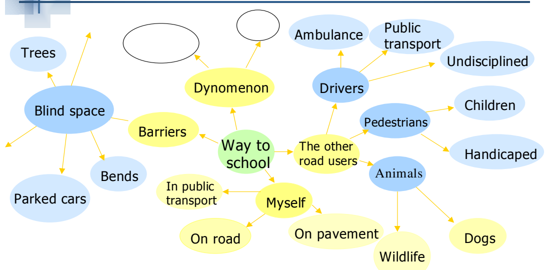
There is no method suitable and ideal for all children.



We must offer different activities

The children study the same topic (road safety), however, they choose activities that are familiar with.

Let children start with brainstorming



We assign the children a topic and they choose what is connected to it. Thus they have the chance to work with a familiar issue.

Intelligence and Activities

Every child can choose any activity it likes e.g.

- Logic-Mathematical Intelligence
- Space intelligence
- Musical intelligence
- Verbal intelligence
- Kinaesthetic intelligence
- Interpersonal intelligence
- Natural intelligence
- Intrapersonal intelligence

- MAPPING of ways to school
- STATISTICS
- EXPERIMENTS
- DYNOMENONS
- CHILDREN EDUCATE
- TRAVEL PLAN
- PUBLICATION

1. MAPPING of ways to school

Children make a map with risky and safe places

Children propose treatment and solutions

Activities for Space Intelligence:

Road mapping
Map modelling
Draft solution of risk localities

This activity helps them to realize that there are dangerous places on their way to school and that they must behave safe.

2. STATISTICS

Children carry out surveys and collect statistical data on behaviour of children and adults in road traffic

(Mistakes when crossing the road; wearing of reflexive materials; wearing of helmets; wearing of restrained systems; collection of data from police and doctors…)

Activities for Logico-Mathematical Intelligence:

Statistical data collection
Research surveys (the number of friends who do not look around when crossing;)

The children influence their behaviour through observation.

3. EXPERIMENTS

Children do experiments and verify effects of various factors

a) **"Stopping distance" of various objects on different surfaces**

b) **"Restrained system" – experiment with a restrained and an unrestrained toy**

c) **"Visibility in the dark" – of different colours and reflexive materials**

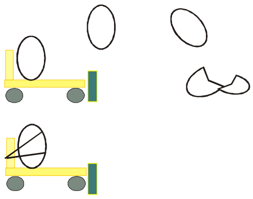
d) **"Turning template" – experiments with turning of short and long toy vehicles in a road curve**

e) **"Cycling helmet" – experiment with a melon in a helmet**

3. EXPERIMENTS

Activities for Logic-Mathematical intelligence:

"Restrained system"

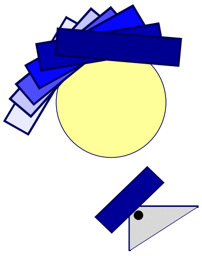


experiment with a restrained and an unrestrained egg

3. EXPERIMENTS

Activities for Logic-Mathematical intelligence:

"Turning template"



4. CHILDREN EDUCATE

Children make examples for their friends using the numbers collected from the surveys and experiments

Activities for Kinaesthetic Intelligence

Performing of situations from traffic environment
Performing of stories for little children

Activities for Musical Intelligence

Auditory games
Song compositions for little children with the RS topic
Music accompanying performed stories

Activities for Interpersonal (empathic) Intelligence

Organizing of excursions
Planning of common activities
Compilation and coordination of a work group
Draft the of school travel plan

5. DYNOMENON

Children are looking for small elements that may cause an accident.
These elements are recorded and stored in a database for future education.

Activities for Intrapersonal intelligence

Children carry out an independent research

Activities for Space intelligence

Searching risk spots

5. Dynomenon

dynamite + phenomenon

Source PdF MU - Cyclist

Children found 12 dynomenons in this situation.

6. TRAVEL PLAN

Children make a plan to support walking and cycling to school, use of public transport and safe use of cars (child restraints and safe parking).

Activities for Natural intelligence

Research of influence of traffic on the environment

Activities for Interpersonal (empathic) Intelligence

Draft of the school travel plan

7. DISSEMINATION

Children write articles about their projects and learn how to involve decision makers and how to inform general public.

Activities for Verbal intelligence

Describing experiences
Designing road safety leaflets
Writing articles for newspaper
Discussions

Conclusion

For the pilot we contacted first schools via e-mail network of the Healthy Cities organization.

Originally, we only planned to involve 5 schools; however, more than 20 schools applied for the project.

Conclusion

Broad range of different activities made project very atrractive for most of the children.
New and new schools apply for the project every month.

Today we have so many schools that we are not able to count them. The project SWTS made its own way to Czech Republic already in the pilot stage.

Aways keep your way safe

Thank you for your attention

heinrichova@cdv.cz

www.cdv.cz

CENTRUM DOPRAVNÍHO VÝZKUMU

Weber, Karin
KuSS,
Austria

Inventory and compiling of a European good practice guide on road safety education (ROSE25)

This project focuses on road safety education (RSE) for children and teenagers. The main intention is the selection of RSE-measures in all Member States (EU 25) and to extract examples of good practice. As the second major step the RSE policy frameworks for all countries will be briefly described and commented. This is the basis and foundation for the ultimate goal of the study: the definition of guidelines for RSE at European level.

Target groups

- ✓ Children and teenagers aged 3 to 17
  moped-users and pre-drivers are included
  the training for car license, motorbike license and novice drivers are excluded
- ✓ Parents (especially parents of „smaller“ children, aged 0 to 3)

Which measures are collected?

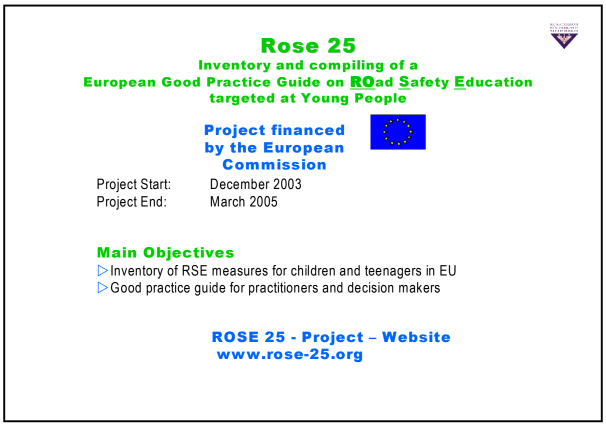
- ✓ Actions/programmes/projects within and outside of the school system (for pedestrians, cyclists, car passengers, pre-drivers, moped users, users of public transport, inline skating etc.)
- ✓ Media (book/booklets, games, CD/MC, film/video tape, Internet, Radio/TV)
- ✓ The focus is on actions/programmes/projects involving face to face contacts
- ✓ Information campaigns using various media without direct personal contacts are not included

Selection of good practice

The selection of examples of good practice follows three steps:

- ✓ Definition of selection criteria done by an international work-team
- ✓ On basis of these selection criteria and the in-depth knowledge of country experts (one in each country) the selection of good practice in EU-25 is done. The country experts provide a description and assessment of each measure using a standardised questionnaire.
- ✓ The final step are analysis of all actions and media as collective task of the work-team taking also recent evaluation studies into account.

With this project the European Commission emphasises the need to collect and exchange good practice in order to launch the discussion on RSE Guidelines at European level. This effort to strengthen European RSE networks as well as to create synergies in RSE research and development is an important investment for the benefit of the young generation. The main results of the project, the recommendations and guidelines will be made available to RSE practitioners in EU 25.



Rose 25 – Project Partners

- ✓ Country experts from all 25 EU-Member States
- ✓ Working group
  - Germany (BAST)
  - Spain (P.A.U.education)
  - Netherlands (TrafficTest)
  - Sweden (VTI)
  - United Kingdom (TRL)
- ✓ Project Lead: Austria (KfV)

3

Rose 25 – Method, Outcome

Method

- ✓ Description of RSE framework in country reports and in a standardised questionnaire on school curricula
- ✓ Description of actions and media in standardised questionnaires
- ✓ Analysis and synthesis in the Working Group

Outcomes

- ✓ Website presenting all 193 actions, 114 media, 25 country reports, 27 questionnaires on RSE curricula www.rose-25.org
- ✓ Final Report
- ✓ Good Practice Guide
  - ➢ 10 steps for successful RSE
  - ➢ Good practice in RSE interventions

4

Common RSE pattern in EU

Despite significant differences regarding quantity and quality of RSE interve there is a common pattern across all EU countries ....

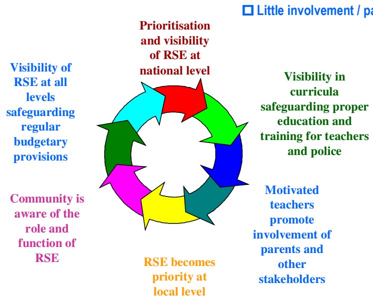
The 4 L's

- ▷ Low priority in traffic safety- and education work
- ▷ Lack of concept and continuity
- ▷ Limited offers for teenagers
- ▷ Little involvement of parents

5

Elements of a Sound RSE Engine

- ☑ Low priority
- ☐ Lack of concept & continuity
- ☐ Limited offers / teenagers
- ☐ Little involvement / parents



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Example of good practice RSE labels for schools (NL)

- ☑ Low priority
- ☐ Lack of concept & continuity
- ☐ Limited offers / teenagers
- ☐ Little involvement / parents

- ▷ Continuous RSE throughout the entire school career (age 4 to 16)
- ▷ Schools receive certificate (RSE-label)
- ▷ Independent commission in charge of consultation and quality control
- ▷ Networking at regional and local level
- ▷ Financial support to schools from the province

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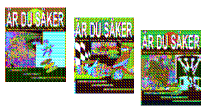


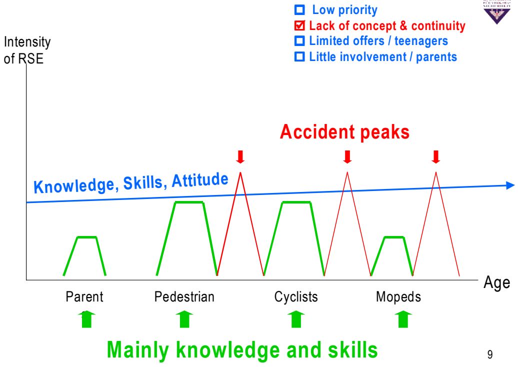
Example of good practice RSE-Teamwork Teaching in Sweden

- ☑ Low priority
- ☐ Lack of concept & continuity
- ☐ Limited offers / teenagers
- ☐ Little involvement / parents

- ▷ Teachers act as an RSE team (4-6 persons)
- ▷ Discussion about how to integrate selected RSE-themes in teacher's subjects
- ▷ Based on a set of three booklets
- ▷ Age groups 12 to 15 (alcohol, responsibility, driving licence etc.)
- ▷ Enhancing active involvement of students
- ▷ Documentation and presentation of the complete process

8

- ☐ Low priority
- ☑ Lack of concept & continuity
- ☐ Limited offers / teenagers
- ☐ Little involvement / parents



9

Example of good practice PRSE as current process in NL

- ☐ Low priority
- ☑ Lack of concept & continuity
- ☐ Limited offers / teenagers
- ☐ Little involvement / parents

Concept development

The process should start with...

- ▷ Definition of target groups from 0 to senior citizens
- ▷ Definition of ‚learning targets' using the Gadget matrix (see Table 59 in Final Report of Rose 25)
- ▷ Inventory and assessment of current RSE-products and projects: Which learning targets are covered? Where are the gaps?
- ▷ Development of missing products, projects and networks

Policy strategies

The whole process should be led by an independent office, which

- ▷ Steers and observes the assessment of existing products/projects
- ▷ Acts as a center of information exchange, know-how, networking etc.
- ▷ Steers and guarantees uniform standards and quality control

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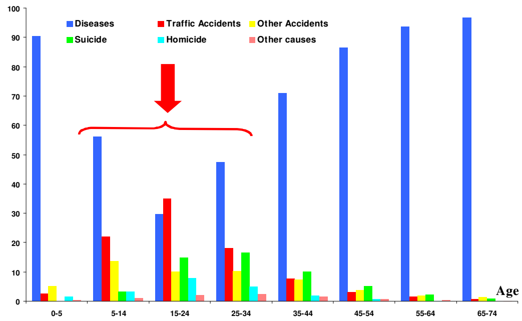
World Wide Fatality Causes (in per cent)



Source: WHO Statistical Information System (WHOSIS), htpp//www3.who.int

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Teenagers - a specific risk group

- ☐ Low priority
- ☐ Lack of concept & continuity
- ☑ Limited offers / teenagers
- ☐ Little involvement / parents

- ▷ Gap between need and availability of attractive projects
- ▷ Strong competition with other curricula priorities
- ▷ Image of RSE: child-centred and old-fashioned topic
- ▷ Other channels than school are necessary
- ▷ Influence of parents and teachers decreases, influence of peers increases

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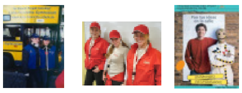
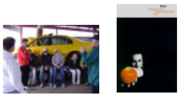
Examples of good practice - Teenagers

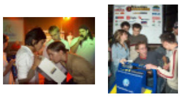
Enhancing responsibility of teenagers



Round tables with experts and persons having first-hand experience



Additional channels for RSE apart from school



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Parents - Involvement in RSE

- ☐ Low priority
- ☐ Lack of concept & continuity
- ☐ Limited offers / teenagers
- ☑ Little involvement / parents

- ▷ Parents should be the first persons teaching RSE
- ▷ Parents are role models for their children
- ➡ Building of attitudes on a longer-term basis **(PRSE)**
- ▷ Main problem is to reach those parents who need it most
- ➡ Intelligent strategies for dissemination necessary!
- ▷ Main topics for parents: in car safety, pedestrian, cyclists

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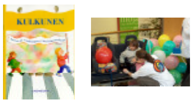
Examples of good practice - Parents

First advice for parents to be and parents of newborns



Guidance when the child makes first independent steps

Involvement in RSE via kindergarten and schools

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Differences in EU

	On the one hand ...	on the other hand ......
Tradition of RSE	Countries with a long-standing tradition	‚Newcomers'
Start of RSE	RSE since the early 1930ies	RSE introduced in 1990ies up to 2002
Offer	Wide range of actions and media – examples in Rose 25 represent a small selection	very limited offer – practically all reasonable interventions have been included in Rose 25
Methods and contents	Traditional RSE and new approaches	Traditional RSE
Evaluation	A few countries quite active	Not yet established

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Contacts

Thank you for your attention!

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17

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SPV,
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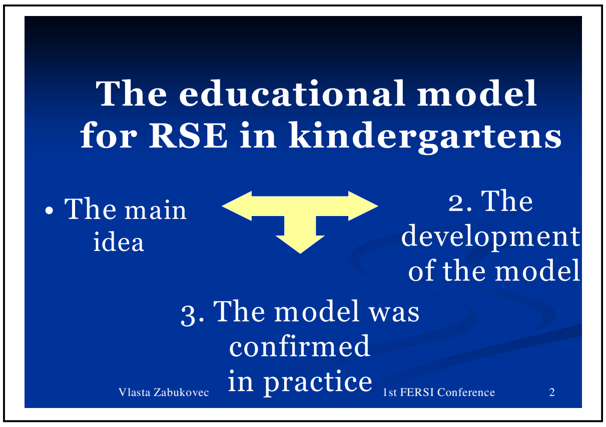
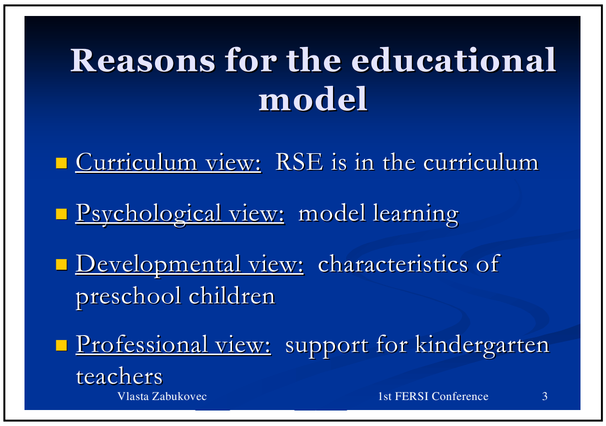
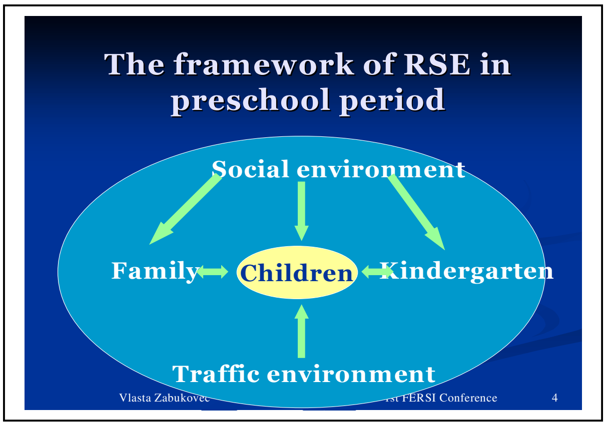
Educational model for road safety education

This presentation deals with an educational model for road safety education in kindergartens, which was developed in two phases. The evaluation of educational programmes for road safety education, which were implemented by kindergarten teachers, confirmed that the methods were too traditional. Consequentially, the kindergarten teachers expressed their wish to make the programmes more active and creative. So the project approach was adopted, where kindergarten teachers, parents and their children together plan, implement and evaluate the projects. Different topics were included, e.g. children as traffic participants, traffic rules, ecological perspective of traffic etc. The evaluation confirmed that kindergarten teachers found this work very successful, especially because children and their parents were more active in this process and gained knowledge and skills of higher quality, both was also more permanent. On this basis, we wanted to implement this kind of work again, and EUCHIRES (European public awareness campaign on the use of seat belts and child restraint systems) was a good opportunity for this. Our project involved the main idea of this European project: child restraint systems and seat belts. Kindergarten teachers gained new knowledge and skills on this topic and transmitted them to children and their parents. But, before the project work in kindergartens started, the preevaluation test was implemented to find out the knowledge and attitudes related to child restraint systems and seat belts. Both, kindergarten teachers and parents were asked to take the test. After the implementation of projects the same questionnaires were applied as post test. The comparison between pre and post test confirmed the improvement of knowledge and skills, both with the kindergarten teachers as well as with the parents. Besides that, the evaluation of project work was also carried out, and the results showed that this kind of work was accepted very positively. The results will be explained in more detail at the conference.







The goals of the educational model

- To give professional support to kindergarten teachers.
- To facilitate project work in a field of RSE.
- To enhance cooperation between different actors: kindergarten teachers, parents, police and other responsible institutions - e.g. road safety councils.

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The way the educational model was developed

- It started in 1998 with the evaluation of RSE in kindergartens.
- 16 kindergarten teachers participated in this project.

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The way the educational model was developed

- The evaluation of curriculum confirmed that:
  - Different topics related to traffic safe behavior were included
  - Didactic approaches: training in real situation, simulations, short lectures and play
  - Didactic materials: books, booklets, films, and pictures
  - The curriculum was realized with cooperation with parents (15%) and the Police (5%)

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Realization of the educational model

- Kindergarten teachers attended an educational course, where different themes with the respect of traffic safe behavior were presented
- The themes were: characteristics of children behavior in traffic situation, children traffic accidents, how to develop traffic safe behavior...
- They also got the knowledge about project work and they had opportunities to develop skills how to do it. The main idea of the project work was to facilitate:
  - active learning methods and
  - cooperation between partners (children, parents, kindergarten teachers, other institutions)

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Realization of the educational model

- After the educational course, kindergarten teachers were obliged to prepare project work in their groups.
- The choice of theme depended on actual problems, noticed in their kindergartens and related to the themes presented at the course.
- They had to prepare, realize and evaluate the project together with children, parents and some other institutions.

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The evaluation of the educational course and the project work

- Proffessional support was identified as very important and useful.
- Kindergarten teachers found the project work convinient for RSE.
- They reported that cooperation between them and partners, engaged in the project, was useful and efficient .
- They also confirmed the improvement of children's knowledge and behavior in different traffic situations.

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The application of the educational model in EUCHIRES campaign

- Because of previous good results, this model was also implemented in the EUCHIRES campaign.
- The main goal of this campaign was senzibilization and information about CRS.

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The educational model in EUCHIRES campaign

- Besides the main goals reported before, there was also another one, very important in this campaign: give kindergarten teachers an opportunity to transmit information about CRS to children and their parents.
- 22 kindergarten teachers with children from 4-6 years old, participated in the campaign.

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The educational model in EUCHIRES campaign

- They attended the educational course with the same themes; besides that, they also got
  - information about CRS and
  - they had special training for developing skills for proper use of CRS.
- After the course they were obliged to organize projects in their kindergarten groups.

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The evaluation of the educational model

- Aspect of the educational course
  - Kindergarten teachers
- Aspect of the project work:
  - Kindergarten teachers
  - Parents

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The evaluation of the educational course

- Kindergarten teachers evaluated the educational course:
  - The content of the course
  - Methods used in the course
  - Specific topic (CRS) with respect to its relevance and usability
  - The assessment of level of their knowledge and skills in order to organize project work.

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The evaluation of the educational course

- The content of the course was evaluated
  - As very good - 65,2% of kindergarten teachers
  - As excellent – 30,4% of them.
- The methods applied in educational course were confirmed as very stimulative and effective.

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The evaluation of the educational course

- The specific topic – CRS - with respect to their relevance and usability (1 – not important, 4 – very important)
  - Information and skills for proper use of CRS – very important - 4
  - The other topics were evaluated a little bit lower, but not lower than 3,57.
- Level of their knowledge and skills in order to organize project work was evaluated as good, but they were sure to need support of a professional team.

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The evaluation of the project work

- Several aspects were evaluated by parents and by kindergarten teachers:
  - The involvement in project
  - The cooperation
  - The way the project was organized
  - The duration of the project
  - Methods used in the projects
  - Assesment of the knowledge

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The evaluation of the project work - parents

- 84% of parents were satisfied with their involvement and 94,4% of them thought that children's involvement was appropriate.
- The quality of cooperation with kindergarten teachers was evaluated
  - as excelllent - 33,2%
  - very good – 23,3%.

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The evaluation of the project work - parents

- They were satisfied with the way the project was organized and they also agreed that the duration of project was appropriate enough.
- The methods the kindergarten teachers used were evaluated as very good.

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The evaluation of the project work - parents

- Their evaluation of gained knowledge was high – the average was more than 3.3; (4 was the highest score).
- The most important changes in knowledge and attitudes:
  - Information about CRS and proper use,
  - Positive attitude towards CRS.

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The evaluation of the project work – kindergarten teachers

- The results were very similar to those of parents.
- They agreed that parents and children had more knowledge about CRS and had more positive attitudes to CRS.
- But they expressed a wish that parents should be more intensive involved through the whole project.

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Conclusions

- The model was confirmed in practice.
- Kindergarten teachers got professional support, which was evaluated as very useful and effective.
- The project work was confirmed as very convenient method in the field of RSE.
- The cooperation between kindergarten teachers, parents and children was established but there is also an opportunity in future to make it more intensive.

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Workshop 8

Driver education and training, licensing

Leitung

Georg Willmes-Lenz (BASt)

Vorträge

Bahr, Michael (BASt)

“Reform of the vocational training of driving instructors in Germany 1999”

Carstensen, Gitte (DTF)

“Driver training – the role of formal education”

Weinand, Manfred (BASt)

“Accreditation of bodies providing driving licence services – procedures, requirements, experiences”

Bahr, Michael
Rederal Highway Research Institute,
Germany

Reform of the vocational training of driving instructors in Germany 1999

The obligatory driver training in Germany can look back on a tradition of about 100 years. Since 1909 learner drivers have to be accompanied and supervised by an authorised person.

The term “driving instructor” (DI) was mentioned the first time at the “regulation on the training of vehicle driver” of 1921. Up to now driver training and the demands on driving instructors have changed fundamentally. Nowadays a driving instructor is more a pedagogically skilled teacher than a technical instructor. This paper will give a short review about the “milestones” of this development.

The year 1969 was very important for the German driving instructor profession, because fundamental regulations were taken into the „law of driving instructors“ (Fahrlehrergesetz).

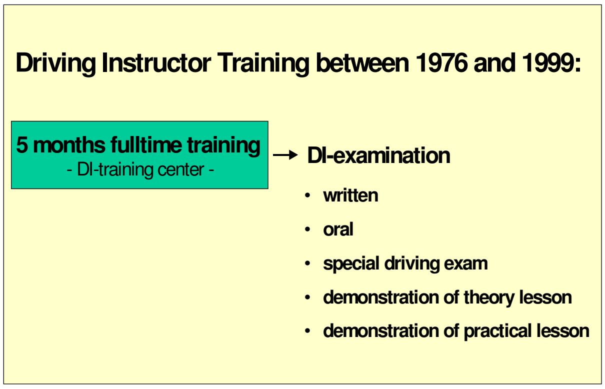
1. Minimum requirements for the access to the DI-profession were legally established. These requirements were not on a very high level. A DI-candidate had to have an age of at least 23 years, he had to be physically and mentally suitable and had to possess all driving license classes and a driving experience on passenger cars of at least 3 years.
2. The official approvement of driving instructor training centres was introduced.
3. Regulations to carry out the driving instructor examination were formulated in the law.

Also in this law aims and contents of driver training had been defined. Driving instructors were obliged to make sure that driver learners obtained a basic education and were able to drive safely and responsibly at the end of the training. A minimum number of theoretical and practical lessons was not defined in the law. The decision about the required length of the training was left to the driving instructors.

7 years later, in 1976, the - so called - “special drives” (Sonderfahrten) were introduced. This is a special part of the practical training. It takes place after the basic training. The learner driver has to drive independently on countryside highways, on motorways and in darkness. The learner driver is of course accompanied by the driving instructor but the driving instructor gives no support to the driving actions of the learner. In 1976 the driver learner had to complete 5 special drives - 2 on countryside highways, 2 on motorways and 1 in darkness.

In 1976 the legal regulations to become a driving instructor were reformed the first time. Higher minimum requirements were implemented. Since then the DI-candidate needs a secondary school certificate plus a vocational education in any other profession. This can be a butcher, baker, motorcar mechanic, haircutter or anything else. If the candidate doesn’t have any vocational education he needs an A-level school certification (in Germany: Abitur).

The main topic of the 1976-reform was the implementation of a compulsory 5 months fulltime formation at a DI-training centre.



The next reform of driver training took place in 1986. The number of special drives was raised to 10 lessons. This led to an increase of the practical training, which was for the average learner driver between 20 to 25 practical lessons in total, 10 to 15 of them being basic training, another 10 special drives. Furthermore the driver learner had to attend 24 theoretical lessons at the driving school. As a third element of the reform new learning goals were implemented: e.g. defensive and environmental safe driving and influence of motivational factors whilst driving.

1986 was also the year in which the driving license on probation was implemented in Germany.

For many years the pedagogical skills of driving instructors had been a critical issue in the discussion about the development of driver training.

One of the main points of criticism concerned the arrangement of the DI-examination. Especially the demonstration lessons used to be criticised by experts and involved persons because they were not performed under real conditions, that means with real learner drivers. In fact the members of the examination-board (a lawyer, an engineer of car mechanics and an experienced DI) simulated the role of the learner drivers. This was not a very valid test situation.

Another point of criticism was that during the complete vocational training DI-candidates never got in contact with real teaching situations in driving schools.

This led to a major reform of the vocational training for DIs in 1999.

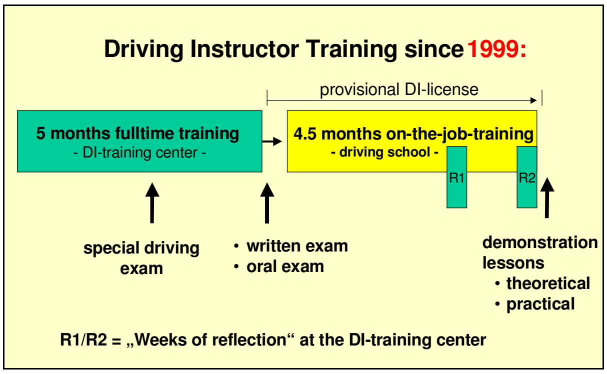
Reform in 1999

The vocational training starts in the same way as before – with the 5 month fulltime training at a DI-training centre. But as one part of the reform, the share of pedagogical, psychological and didactical learning contents has been increased to nearly 50%. Up to 1999 the main focus was laid on traffic regulations and technical issues. Only 24% of the learning contents was on pedagogical issues.
The most visible change of the reform is the 4.5 months on-the-job-training after the 5 months vocational training period in a DI-training centre. During this phase of on-the-job-training the candidate gains experience in real teaching situations in driving schools under the supervision of an experienced DI.

Another topic of the reform consists in a modified DI-examination. The first part of the new exam is a practical driving test.

It takes place during the training period at the DI-training centre. Written and oral exam take place after the 5 months training. After having passed these parts of the examination the candidate receives a provisional driving instructor licence being valid only for the work as DI during the on-the-job-training. Due to this regulations it is possible that a DI-candidate can teach learner drivers without the immediate attendance of the supervisor.

At the end of the on-the-job-training two weeks of training at the DI-training centre are scheduled. The first week is to exchange one's personal experiences with real teaching. The second week is for individual preparation for the last parts of the exam - the demonstration lessons in theory and practice.



These exams take place at the driving school were the candidate has made his on-the-job-training during the last 4.5 months. After having successfully given a theoretical and a practical demonstration lesson the candidate is graduated to a DI. After a minimum working time of 2 years as an employed DI he is allowed to establish his own driving school.
Related to driver training - a part of the 1999-reform was also the introduction of two additional obligatory special drives (in total 12 now), 28 theoretical lessons and additional learning goals (self-criticism, self-assessment and influence of emotions).

Evaluation of the reform

In order to check the effectiveness of the 4.5 months on-the-job-training, the BASt (Federal Highway Research Institute) is currently conducting an evaluation. The University of Erfurt has been engaged to conduct the study.

The general research question was, whether the on-the-job-training-phase contributed to higher didactical and pedagogical skills of newly qualified DIs and in what aspects an increase of skills could be observed.

Special focus was laid on

- methodological and didactical competencies for teaching and guiding groups
- diagnostic skills for assessing the qualification level of learner drivers and
- consulting skills for giving advice on further learning steps to the learner drivers.

The project was divided into a pre-study and a main-study. In the pre-study the general conditions of the vocational training system and the situation of DIs and driving schools were analysed.
In the main study the new vocational training system was analysed on the basis of comprehensive empirical data of the learning and teaching process. All data has been collected

through standard approaches and instruments of empirical training research.

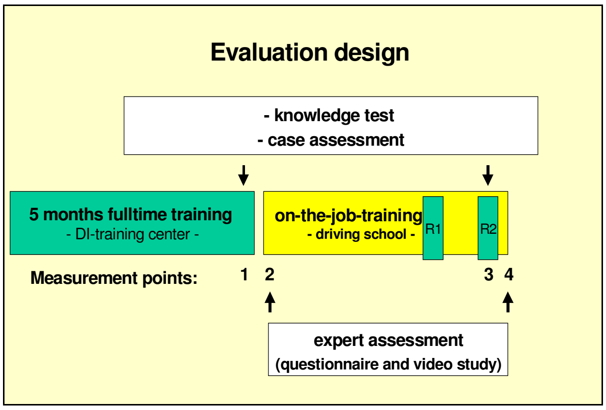
The data of the study cover the vocational education of 410 DI-candidates.

For the data collection 2 educational years were needed, since approximately 300 persons per year participate in the German DI-education.

In the study-design four measurement points were made to collect data. Two measurement points are related to the comparison of skills before and after the on-the-job-training-phase (Measurement-points 1 and 3).
At these measurement points a knowledge test and case-assessments were carried out. The knowledge test included pedagogical, psychological and didactical learning contents. The case-assessment was to evaluate the ability of the candidates to deal with common teaching situations in driving school lessons.

At measurement points 2 and 4 an expert assessment was carried out to evaluate the ability of the candidates to perform theoretical and practical driver training. This expert assessment consists of a questionnaire and a video-study. In this video-study the candidates were filmed during teaching situations at the beginning and at the end of the 4.5 months training period and experts rated their performance.

In addition to the evaluation of the new training effectiveness, acceptance among DI-candidates was analysed. Furthermore data about the examination results of the learner drivers were taken into the analysis.



The **main results of the study** are as follows:

After the vocational training the DI-candidates show a high level of pedagogical knowledge. This means that pedagogical learning goals and contents – which are defined in the legal regulation - are successfully achieved.

The elements of the reform are highly accepted by all groups involved.

The on-the-job-training could be implemented successfully in the way that it was intended by the legislator.
The practical phase contributes significantly to an increase of methodological and didactical competencies for designing, planning and performing driver education.

An increase in diagnostic and consulting skills could not be observed in this study.

Reviewing the results of the evaluation study the following remarks can be made:

In general the reform of vocational training for DIs in the year 1999 can be labelled as successful.
The elements of the reform are suitable to increase the pedagogical skills of DIs.

The results of the evaluation study confirmed the usefulness of an extended practical training-phase for DIs.

The findings provide valuable information for the further development of the DI profession from a technical instructor to a pedagogically skilled teacher. The reform of 1999 contributed to this perspective.

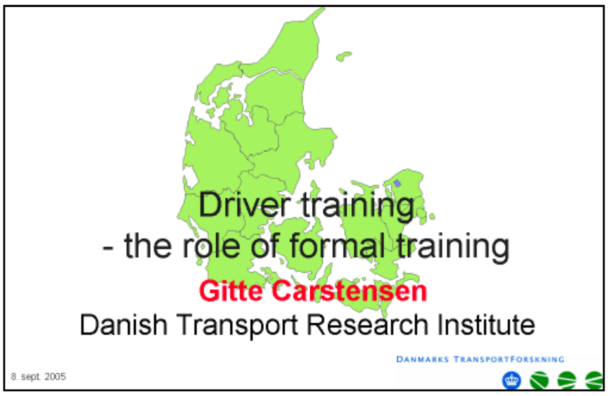
But additional work has to be done: At present experts in Germany think about higher entrance conditions for DI-candidates to ensure an appropriate prequalification of DI-candidates. Some of them recommend an A-level in school-education others prefer a special entrance test which would be open also for individuals who have not reached the highest qualification level in the public school system.

Final comment:

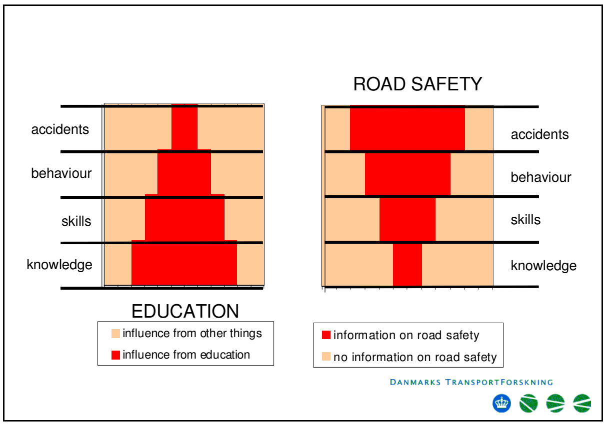
The development of the DI-profession in Germany is on a very high level. But as in many other pedagogical professions and sciences – there is always room for improvement.

Carstensen, Gitte
DTF,
Denmark

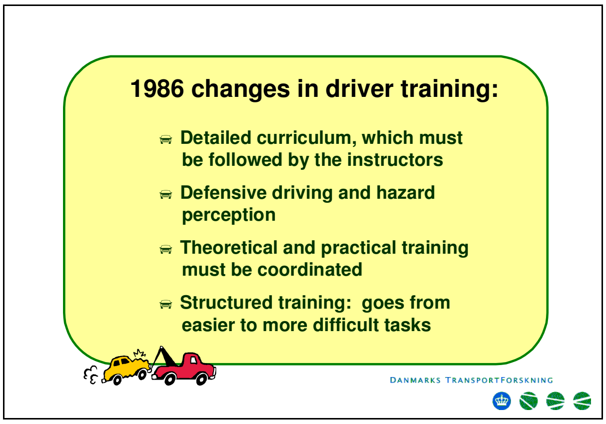
Driver training – the role of formal education



FERSI conference 7.-8. September 2005



It is often said that formal driver training does not work – it has no safety effect. And surely many studies have been made, where no effect was found. One of the central problems here is that the effect, we want to see, is very far away from the action – the training – that we want to evaluate.



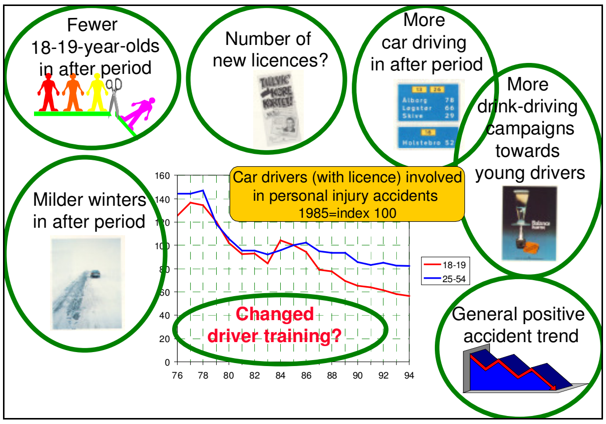
When we teach somebody something it is fairly easy to influence their knowledge. So a lot of what we teach goes on to this level. A fair amount of it continues to influence the skills of the person. When it comes to actual behaviour it is harder to trace the influence of education and there are a lot of other things that influence the behaviour. And finally: There are a lot of other circumstances which are of importance for an accident to happen than just the education that one of the persons involved once received.

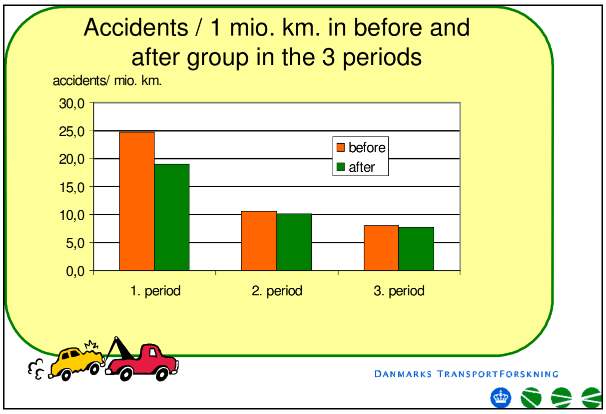
And on the other hand – when we want to know about the status of road safety in an area, the most informative criterion is looking at the accident rate. Of course the behaviour of the road users can inform us too, but to a lesser extent. There is not a direct relationship between the way people normally act and their involvement in accidents. We get even less from looking at skills and least of all from measuring knowledge. Although knowledge is a good basis for safe performance in traffic there are too many other circumstances of importance for safety to make knowledge a good predictor of safety.

This is a basic problem when evaluating the safety effect of education/training and one of the reasons, that it is so difficult to show a safety effect of training.

In Denmark learner drivers are not allowed to train privately aided by relatives or friends. All driver training must be undertaken by authorised instructors. This formal training underwent an extensive change in 1986. The main features of the changes in training are shown above.

Evaluating the safety effect of the change in driver training: looking at accident figures before and after: A relatively greater decrease was found in young drivers accident than in mature drivers accidents after the change. Other things happened in the period studied, which could influence the accident rate of young drivers. For some of these factors we did not have detailed statistical information to make a thorough examination, but the information available indicated, that the relatively greater decrease in accidents among 18-19-year-old drivers could not solely be attributed to these factors.



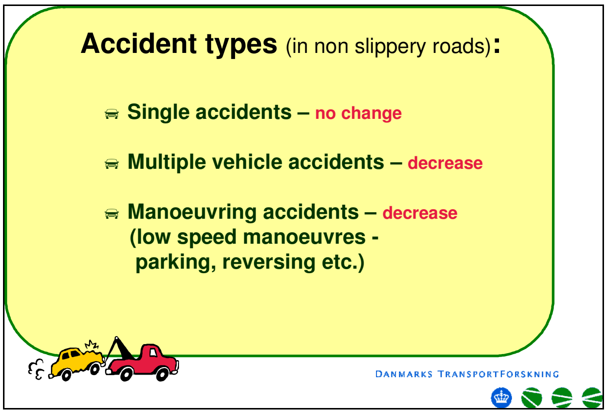


A questionnaire study was conducted, where two groups of new car drivers, who took their drivers license according to the old and the new rules respectively.
They were sent a questionnaire a few months after their driving test, 1½ year after, 3½ years after and finally 5½ years after their driving test. They were asked about the content of training, driving habits attitudes and accident involvement. Approximately 7000 persons were asked to fill in the questionnaires, and there was a very satisfactory response rate.

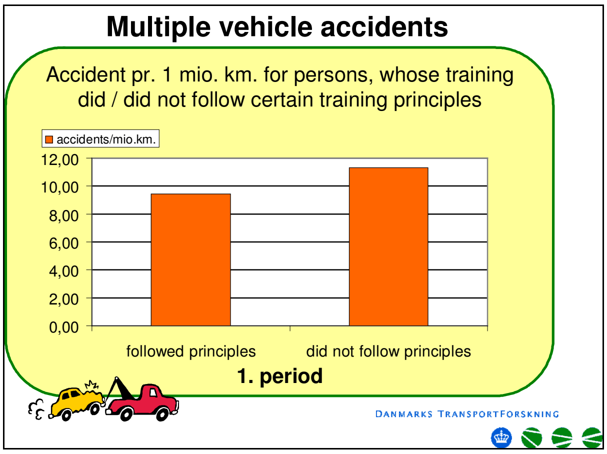
In the questionnaire study we found an actual decrease in accident rate pr km. driven from before to after group. But only in the first period (first 1½ year). Regression analyses showed, that this result was not a result of other factors like sex, age, driving experience etc.

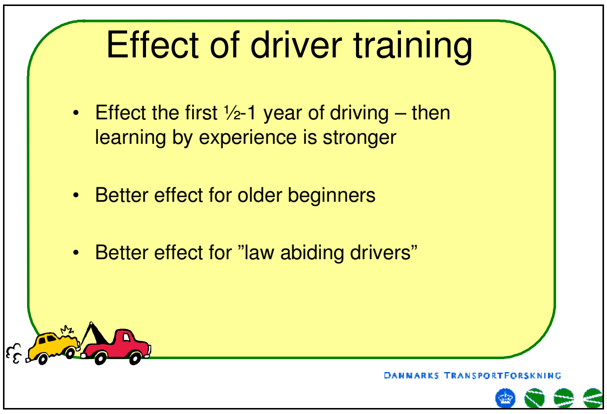
Furthermore, for both groups there is a marked decrease in accident risk with time. This shows that experience is an important factor when it comes to accident risk.

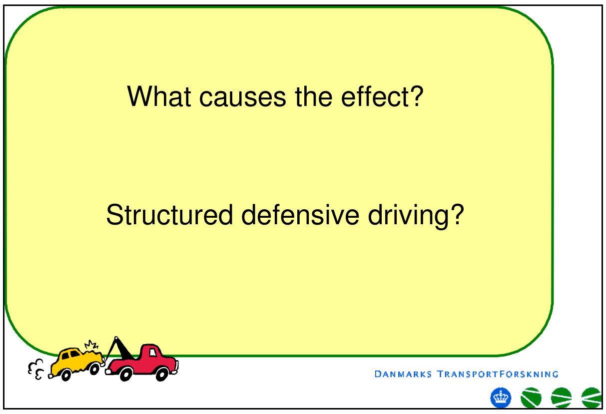
The importance of experience could also be seen from the fact that those, who in a given period drove a lot, had a lower accident risk than those who drove less in the same period.



Kinds of self-reported accidents: There was no decrease – from before to after group – in single accidents. The decrease was found in multiple vehicle accidents and in what can be called manoeuvring accidents - accidents happening during simple manoeuvres at low speed (parking, reversing etc.).
The most interesting decrease of course is the one in multiple-vehicle-accidents.
The questionnaire study gives the possibility of looking directly at the effect of the training content. It was clear, that the actual training in the after-group did not always follow the training curriculum as close as it should. And it was also clear from the before group that some driving instructors were already following the curriculum ahead of time.
Respondents who followed the new training principles had a lower risk of multiple-vehicle-accidents than those, who did not. And this factor is able to explain so much of the difference between before- and after-group, that this difference is no longer statistically significant. Results were supported by regression analysis. There was no relationship between the training variables and single-accidents, which is consistent with the fact that these accidents did not decrease in the questionnaire study.
This is a strong indication that the decrease in multiple-vehicle-accidents – at least in part – has to do with the change in driver training.







So formal training can have an effect. But it probably has to be extensive, and you need a very large data material to show the effect. It is also clear, that the effect is found mainly in the first year of driving. In the long run, what is learnt by experience in traffic seems to overlay the benefits brought about by a structured driver training.

And the effect is probably not for everybody. Some of the results of the study show, that it has a larger effect on older beginners compared to younger beginners. And it seems to work better for the law-abiding beginners than for the law-breaking ones.

For instance results showed, that those, who had been drink driving in their first 1½ year as car driver did not benefit from the training as much as others.

Another illegal group stands out, too: A little group, who on several occasions trained car-driving privately alongside the training in the driving school (9% of the respondents). They had the same accident rate, whether they received the new training or not.

Unfortunately it is not possible to determine with any kind of certainty exactly which elements of the new training are the effective ones. One thing, though, that could be meaningful is the fact, that drivers, who followed the training principles had a higher estimation of their own defensive driving skill than persons, who did not. This difference was largest shortly after the driving test, and diminished with time. And another result of the study showed that persons with a high estimation of defensive driving skill had fewer accidents than persons with a low estimation. This could suggest that the decrease in multiple-vehicle-accidents could have to do with the subject of defensive driving e.g. the increased knowledge about the behaviour of and risks connected with other road users.

Private training

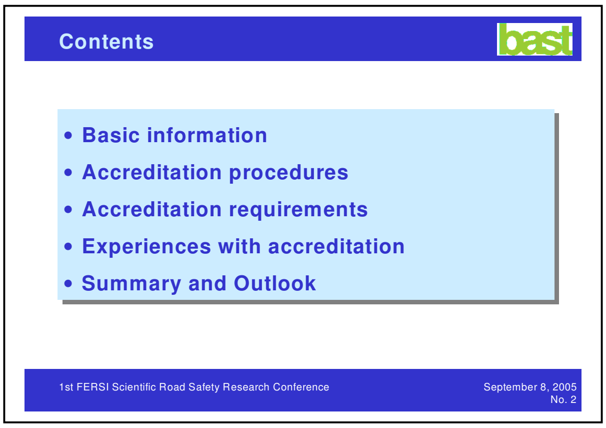
In Denmark there has not been an extensive discussion about private training. If this discussion does come up, it has to bee considered very seriously, whether private training can be allowed, without loosing what has already been achieved. A very central problem is here that it will be difficult for ordinary drivers (parents, friends) to teach structured defensive driving. How you use and direct your attention is probably for most drivers a latent knowledge, that you have never actually formulated, and it will therefore be very difficult to formulate it for someone else. Teaching rules and signs etc is easy – it is teaching defensive driving strategies that is the hard part.

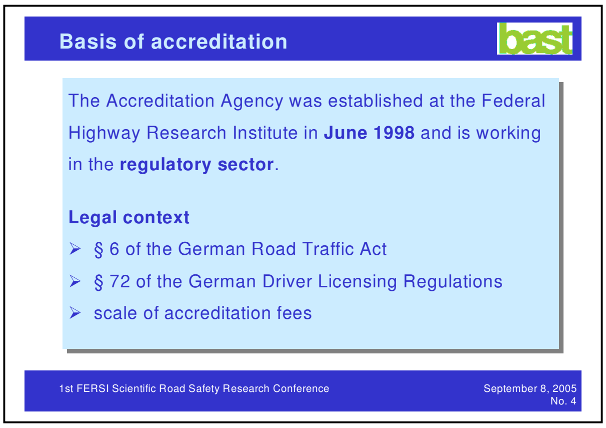
Weinand, Manfred
Federal Highway Research Institute,
Germany

Accreditation of bodies providing driving licence services – procedures, requirements, experiences

Since 1999 the accreditation agency at the Federal Highway Research Institute has been accrediting organizations in Germany which conduct driving tests, driver aptitude tests for traffic offenders or special driver improvement courses which restore driver aptitude. The accreditation is a precondition for the official acknowledgement of bodies providing driving licence services by the Federal States (Bundesländer) and the only executive activity of the Federal Highway Research Institut which is founded on the German Road Traffic Act and the German Driver Licensing Regulations. The objective of accreditation is, by means of assessment and subsequent surveillance, to ensure a steady high quality standard. Under these circumstances the market can rely on certificates or expert opinions issued by the accredited bodies.
At present 36 bodies providing driving licence services are accredited by the Federal Highway Research Institute.

The paper presents the procedures and the requirements of the accreditation agency. It also reports on the experiences with accreditation. Finally, as a result of accreditation, the quality improvements and the recent developments (e.g. oberservation of driving behaviour by psychologists) in the field of driver aptitude testing are discussed.





Basis of accreditation

Standards

- DIN EN 45010 „General requirements for assessment and accreditation of certification/ registration bodies“ (in future: ISO/IEC 17011)
- DIN EN 45013 „General criteria for certification bodies operating certification of personnel“ (in future: ISO/IEC 17024)

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Assignments

Assignments of the Accreditation Agency are the **accreditation** and **surveillance** of

- **organisations which conduct driving licence tests**
- **organisations which conduct driver aptitude tests for traffic offenders**
- **organisations which conduct special driver improvement courses restoring driver aptitude**

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Definitions

Accreditation
is a formal recognition that a body fulfils specific requirements and is competent to carry out specific conformity assessment tasks.

The accredited bodies are designated as **conformity assessment bodies**.

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Definitions

Conformity assessment
is a demonstration that specified requirements relating to a product, process, system, person or body are fulfilled.

A conformity assessment body performs conformity assessment services such as calibration, testing, inspection, management system certification, personnel certification and product certification.

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Main objective

The main objective of accreditation in the field of driving licence services is to

ensure a steady high quality standard of driver licence tests, driver aptitude testing and driver improvement courses so that the market can rely on certificates or expert opinions issued by the accredited bodies.

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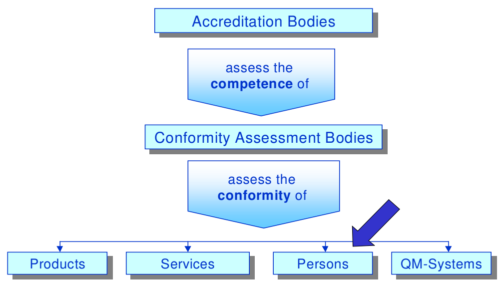
Flowchart of assignments



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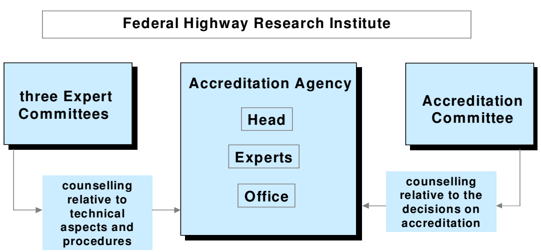
Structure of the Accreditation Agency



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Contents

Basic information

Accreditation procedures

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Accreditation procedure

- Application procedure
- Assessment procedures
- Accreditation
- Periodic surveillance

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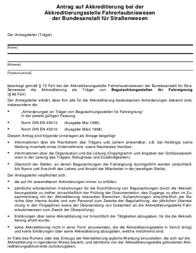
Application procedure

- query
- first meeting
- application and check of the application


Antrag auf Akkreditierung bei der Akkreditierungsstelle Fahrerlaubniswesen der Bundesanstalt für Straßenwesen

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Assessment procedures

- selection of experts

- assessment of quality manual and associated documents
- on-site assessments (central office, selected local sites)
- report

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Accreditation

- decision relating to accreditation
- issue of the accreditation certificate

- publication of accreditation in the internet (www. bast.de)

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Periodic surveillance

- ongoing assessment of revisions of quality documents (quality manual, associated documents)
- yearly on-site assessments
- special checks of expert opinions in the field of driver aptitude testing (every second year)
- additional assessments (if necessary)

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Contents

- Basic information
- Accreditation procedures
- Accreditation requirements

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Basics for accreditation requirements

The accreditation requirements result from

- special acts and regulations
- the European Standards DIN EN 45013 and DIN EN 45010
- specific guidelines and
- scientific findings

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Groups of accreditation requirements

- organisation
- equipment
- personnel
- quality management system
- purchase
- control of inspection, measuring and test equipment
- storage of records
- data protection

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Groups of accreditation requirements

- **customer information**
- **preparation and carrying out of the services**
- **products**
- **statistics**
- **dealing with complaints**
- **development of the services**

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Contents

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Data

- **November 1999**
  Conclusion of the the first accreditation

- **November 2004**
  Conclusion of the first reaccreditation

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Data

Number of accredited organisations:

Sector	**Number**
Driving license test	9
Driver aptitude testing	17
Driver improvement courses	10
Total	**36**

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Experiences

Feedback of the **accredited organisations**:
Overall the work of the Accreditation Agency is perceived as **competent**, **transparent** and **fair**. Accreditation has promoted/ improved

- intense efforts of the organisations to reflect on their own activities, to detect weaknesses and to prevent errors in a systematic way
- the compliance with rules of procedures by the employees
- the quality of the services at large
- unification of quality and assessment standards

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Experiences

Feedback of the **representatives of the Federal States** in Germany responsible for the official recognition:

- positive estimation of the services of the accreditation agency
- great relief of workload concerning their supervision of the organisations
- more uniform quality standards

In the field of driving licence services accreditation is a quality assurance instrument one could hardly do without today (Eggersmann, 2002).

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Experiences

Own experiences with accreditation and ongoing surveillance also show **improvement** and **unification** of **quality standards** particularly with regard to

- spatial and staff-related resources, facilities
- qualifications and vocational training of personnel
- application of suitable procedures
- carrying out and objective evidence of essential quality inspections
- consideration of new scientific findings
- further development of the procedures

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Experiences

In the field of **driver aptitude testing** accreditation has resulted in

- elimination of unsuitable test procedures
- application and improvement of uniform assessment criteria
- improvement of the comprehensibility, the verifiability and traceability of expert conclusions
- responding the traffic authorities' questions in detail
- development of a psychological observation of driver behaviour on road

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Experiences

On the other hand our experiences also show:

- Over the years single organisations reduce their intensive efforts of quality assurance (e.g. due to positive feedback in the past). This development is known as **"saw-tooth quality curve"**.
- Recently the efforts of single organisations in the fields of driver aptitude testing and driver improvement courses to ensure quality are considerably declining by **increasing competition**.

Contents

Basic information

Accreditation procedures

Accreditation requirements

Experiences with accreditation

Summary and Outlook

Summary and Outlook

- The accreditation of bodies providing driving licence services in Germany has proved itself.
- Accreditation not only ensures but in addition improves the quality of the services.
- The market can rely on certificates or expert opinions issued by the accredited bodies because accreditation promotes steady high quality standards as well as uniform procedures and basics for reaching decisions.
- Accreditation ensures that novice drivers and drivers with offences who take part in driving licence tests, driver aptitude tests or special driver improvement courses have equal chances.

Summary and Outlook

- The phenomenon called "saw-tooth quality curve" emphasizes the necessity of regular monitoring by an external body to stop this process at an early stage.
- Considerable reduction of quality standards due to increasing competition is even more problematic. The consequence of this development is a more intensive surveillance by the accreditation body and, if required, the withdrawal of the accreditation.
- Current analyses of the assessment results collected by the accreditation body are necessary for the continuous improvement of the accreditation procedures.

Federal Highway Research Institute

Thank you very much for your attention !

Workshop 11

Alcohol and drugs, fitness to drive

Leitung

Horst Schulze und Anja Knoche (beide BASt)

Vorträge

Bekiaris, E. (CERTH/HIT)

“Fitness to drive of elderly and disabled drivers”

Bernhoft, Inger Marie (DTF)

“IMMORTAL“
Impaired motorists, methods of roadside testing and assessment for licensing

Rehnová, Vlasta (CDV)

“Diabetes Mellitus and ability to drive

Schulze, Horst (BASt)

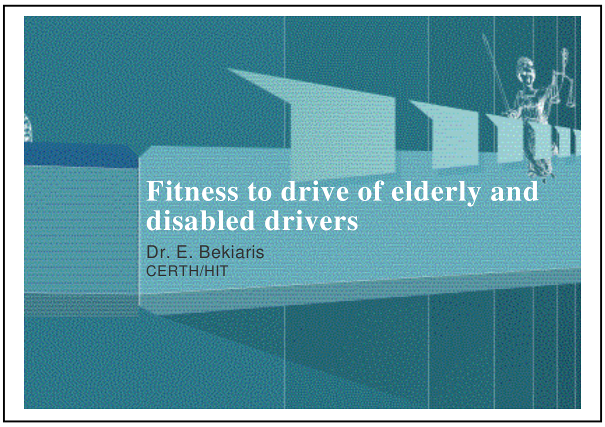
“**DR**iving **U**nder the **I**nfluence of **D**rugs, Alcohol and Medicine (DRUID)“

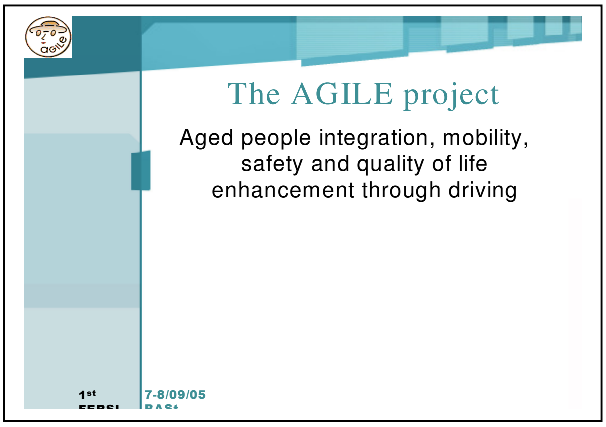
Vanlaar, Ward (IBSR)

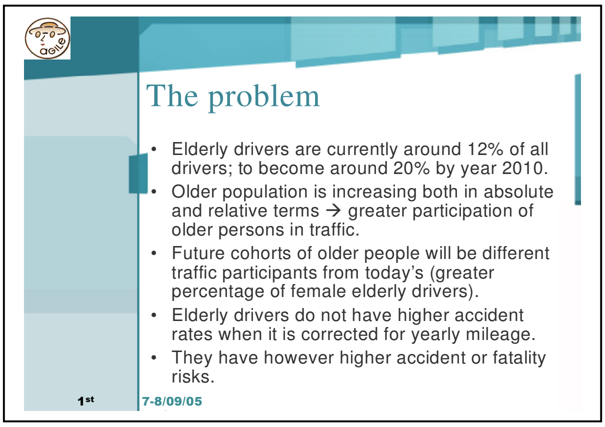
“Preliminary research results of the European alcolock project“

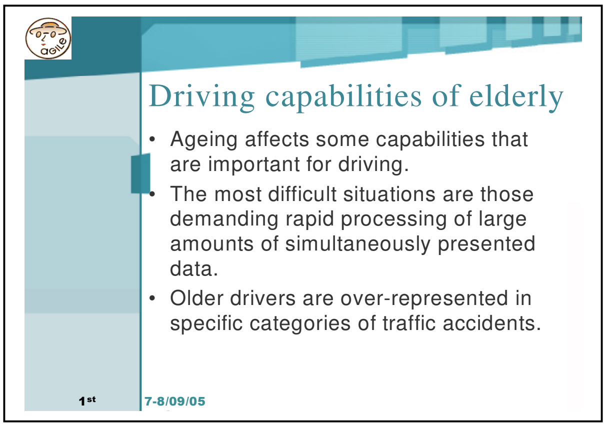
Bekiaris, E.
CERTH/HIT,
Greece

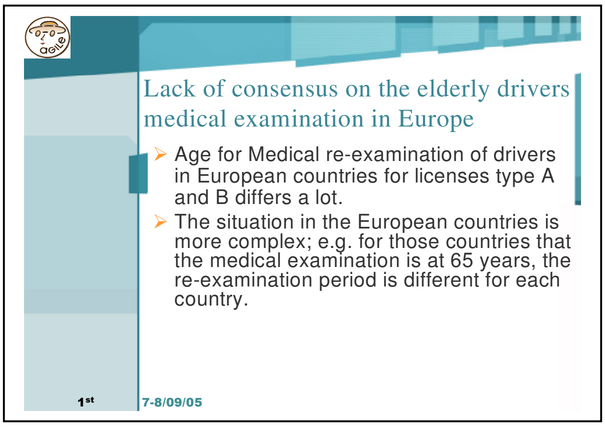
Fitness to drive of elderly and disabled drivers

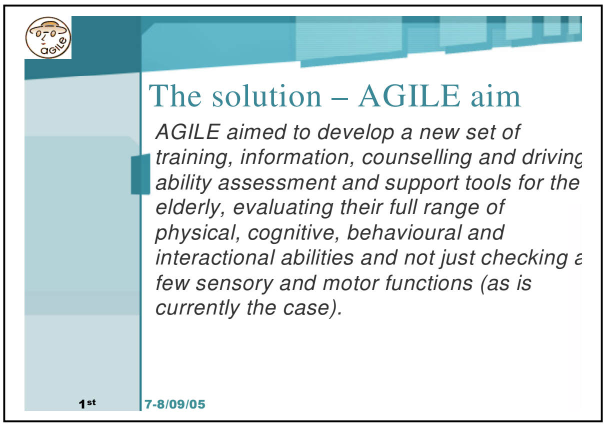












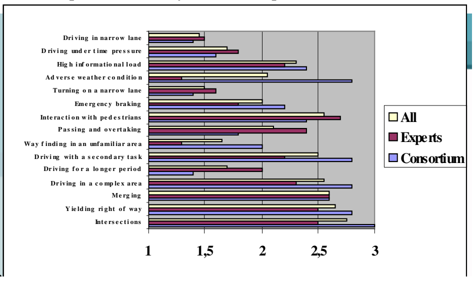
AGILE focus

- Not meant to create a new barrier for elderly drivers.
- Simplify the assessment process for most elderly drivers and help the rest to find appropriate methods and aids to allow them to remain safe drivers.
- Of course, some elderly people will still reasonably and fairly be excluded from driving, if they pose a risk to traffic safety and to themselves.
- Support and access to alternative mobility policies (e.g. public transport passes) will be offered to them.

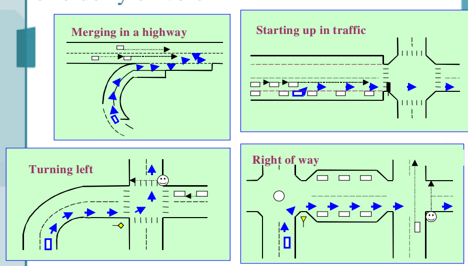
7-8/09/05

Most important driving-related problems of elderly drivers

Scenario prioritisation by external experts & AGILE consortium



Most important driving-related problems of elderly drivers



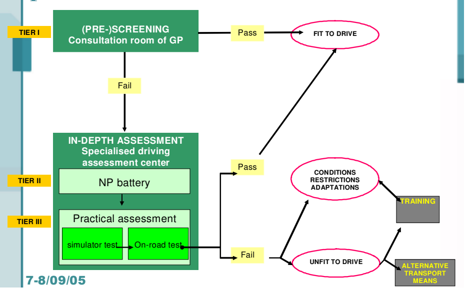
7-8/09/05

AGILE support tools

- Assessments parameters database
- Decision and consultation tool
- Elderly drivers re-training course
- Guidelines on vehicle design

7-8/09/05

AGILE stepwise assessment procedure



7-8/09/05

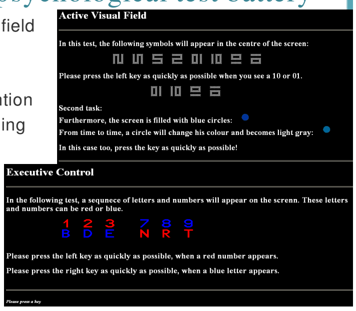
Pre-screening tool

- 2 P&P tests (adapted TRAIL and IADL)
- A PC test: Executive control

7-8/09/05

Neuropsychological test battery

- Active visual field
- Alertness
- Distractibility
- Divided Attention
- Visual Scanning
- Flexibility
- Go/Nogo



7-8/09/05

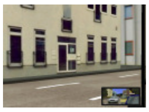
On-road assessment methodology

4 clusters:

- Basic driving skills
- Non-spatial attention skills
- Visuo-spatial attention skills
- Executive functions

7-8/09/05

Driving simulator scenarios



13 Scenarios
- Visibility (2 scenarios)
- Way finding
- Way finding with a navigation system
- ABS
- Yielding (4 scenarios: for jay walking pedestrian, right of way, etc.)
- Intersections of varying complexity (both left and right turns)
- Merging
- Starting up in traffic
- Roundabout

1st 7-8/09/05

AGILE evaluation tools: Reliability and usability tests

- Evaluated in 3 countries (Belgium, Greece and Sweden) with 243 elderly in, using the critical scenarios (merging, overtaking, T-junctions negotiation, gap acceptance, etc.) for the elderly.
- Single tools were evaluated as stand alone, but as part of the overall AGILE system, including pre-screening, neuropshychological test battery, simulators, test drive and decision support tool.

1st 7-8/09/05

Pre-screening tool

Results from Belgium (86 subjects)
- User-friendly and short battery by GP, health care professionals
- detection of at-risk persons
- outcome **predictor** of driving performance
- **sensitive** battery
- screening battery composed of TRAIL-A, IADL, Executive Control

SENSITIVITY %	Misclassified False -	SPECIFICITY %	Misclassified False +	Road safety	Costs
70	6	96,7	2	↓	lowest
100	0	42,5	27	↑↑	highest
85	3	85	7	Safety vs mobility	Cost-efficient

1st 7-8/09/05

Neuropsychological test battery

Results from 3 countries (243 subjects)

	Executive attention	Non-spatial attention	Visuo-spatial attention
Active visual field			Very good correlation
Alertness		Marginal correlation	
Distractibility			Good correlation
Divided Attention	Good correlation		
Flexibility	Good correlation		
Go/Nogo		Fair correlation	
Visual Scanning			Very good correlation

1st 7-8/09/05

On-road results

AGILE protocol results are compared to the reference (TRIP) ones.

- **AGILE - 135 Satisfactory** — **TRIP - 129 Fit, 6 with restrictions**
- **AGILE - 3 Dubious** — **TRIP – 2 Dubious, 0 with restrict.**
- **AGILE - 8 Unsatisfactory** — **TRIP – 4 Unfit, 4 Doubtful fitness**

- **Mobility - Safety balance has to be taken into account**
- ***Mobility:* Optimal identification of true negatives (*specificity*)**
- ***Safety:* Optimal identification of true positives (*sensitivity*)**

1st 7-8/09/05

Provisional on-road protocol cut-off scores

Four cut-off scores are proposed for the on-road protocol:

≤0.41	0.41<x≤0.6	0.6<x≤0.85	>0.85
Not fit	Not fit or fit with restrictions	OK, but treat with caution, i.e. fit, but could need restrictions	Fit

An experienced assessor is needed to take the final decision

1st 7-8/09/05

Re-training course

- Theory 1 (120 min) Obligatory
- Theory 2 (90 min) Non-spatial attentional driving skills
- Theory 3 (90 min) Visuo-spatial attentional driving skills
- Theory 4 (90 min) Executive functional driving skills

- On road session 1 (90 min) Obligatory
- On road session (60 min)
- On road session (60 min)
- Further on road sessions

1st 7-8/09/05

Vehicle design guidelines – Physical aspects (examples)

- Door opening dimensions: horizontal: ≥75cm, vertical: ≥95cm
- Problems in rising more than 30 cm the foot → rotating seats
- Force for controls/buttons: 25 Nt for two fingers and 50 Nt for four fingers
- Easy reach of the safety belts

1st 7-8/09/05

The IDEA project

An Innovative vocational training scheme for assessing the Driving ability of Elderly and disabled

1st 7-8/09/05

The problem

Great variability in Europe with regard to fitness to drive assessment practices of DSN.

Differences in:

- application of legal aspects
- processes and methods
- assessor background

Resulting in different decisions as a function of the country of origin ⇒ lack of equity

1st 7-8/09/05

IDEA aim

IDEA aims to develop a <u>flexible, continuing and standardised vocational training scheme</u> for fitness to drive assessment personnel, using innovative ICT and other tools, such as Internet databases, psychomotor test batteries, driving simulators and expert tools.

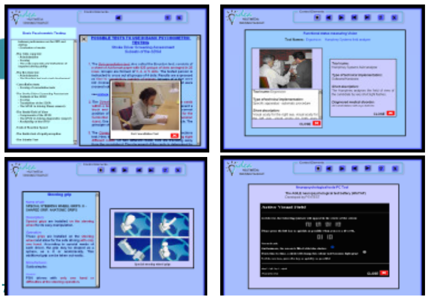
1st 7-8/09/05

IDEA Innovation/output

- New training curricula dedicated to different categories of assessors (MD, Psychologists, experts in driving, etc.)
- Development of innovative ICT training tools to train and assess the assessment personnel of DSN:
  - multimedia training package (incl. assessment forms, tools, guidelines, etc.);
  - driving simulator scenarios;
- Development of modular training curriculum database.
- Open, lifelong learning scheme.

1st 7-8/09/05

MMT screenshots



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Basic training curriculum

Contains training sessions about the general knowledge required for all professional groups working in the field

<u>Aim</u>: to improve communication between the different categories of personnel

<u>Target groups</u>: MD, Psychologists, OT, PT, approved driving inspectors, etc. and administrative personnel

1st 7-8/09/05

Specific training curricula

<u>Target professional categories:</u>

-Medical assessment :
MD

Psychological/cognitive assessment:
(Neuro-) Psychologists

Functional assessment :
OT, PT, trained inspectors, etc.

1st 7-8/09/05

Conclusion

IDEA aims to:

- Promote **vocational training** of fitness to drive assessment personnel (improving quality of the assessment)
- Contribute towards **standardization** in fitness to drive assessment practices
- Project outcomes will be tested in 4 EU countries, with 12 driving assessors in total.

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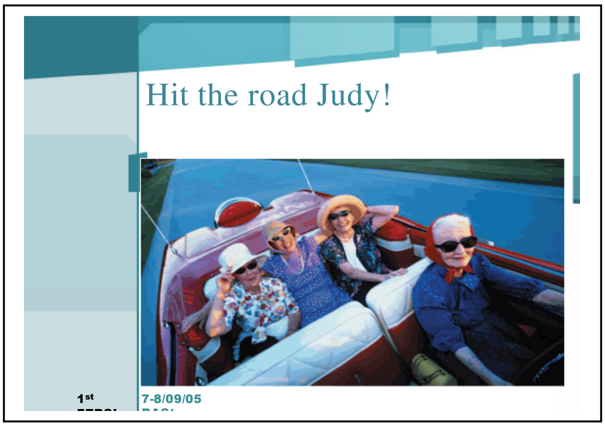
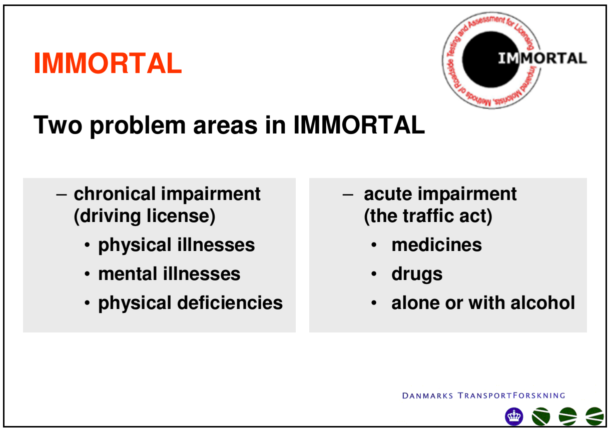

Hit the road Judy!
1st
7-8/09/05

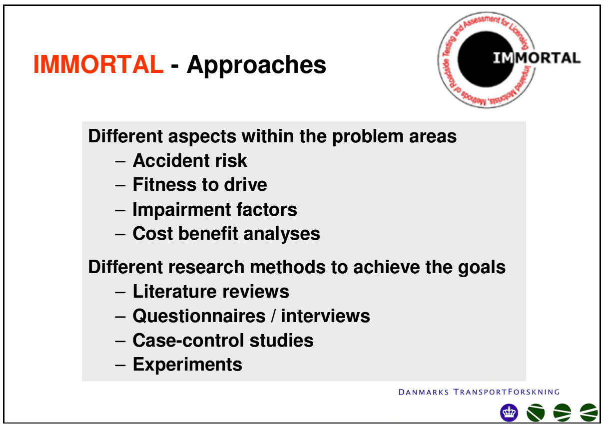
Bernhoft, Inger Marie
DTF,
Denmark

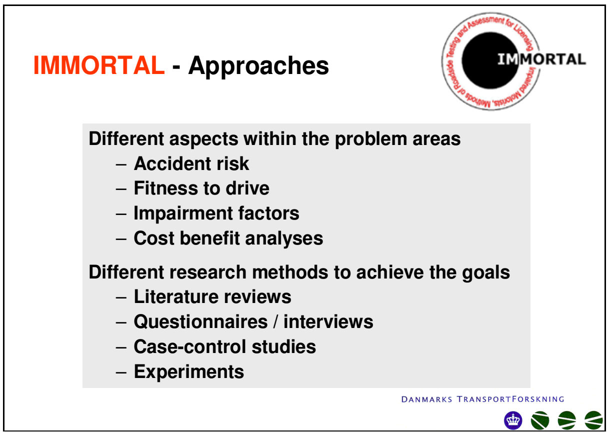
IMMORTAL
Impaired motorists, methods of roadside testing and assessment for licensing

General information

The scientific objectives of IMMORTAL were to investigate the influence of chronic and acute impairment factors on driving performance and accident risk, to recommend criteria for high risk categories of impairment and to provide key information to support formulation of European policy on licensing assessment and roadside impairment testing (including drug screening). Chronic impairment included ageing, mental illness and medical diseases whereas acute impairment included drugs – illegal as well as medicinal – alone or in combination with alcohol (slide 1 - 2).



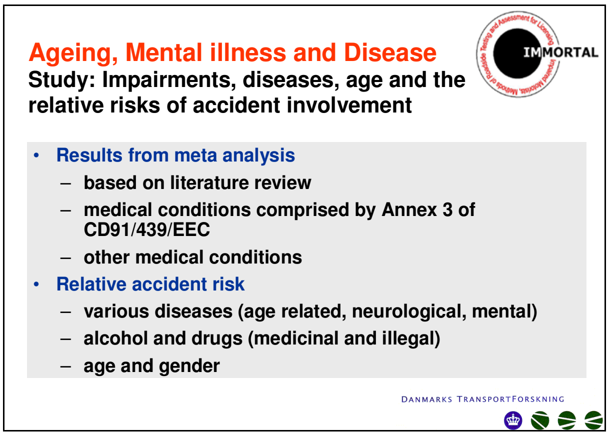


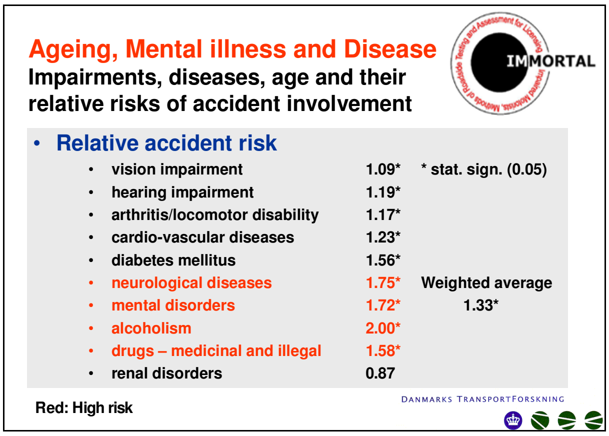


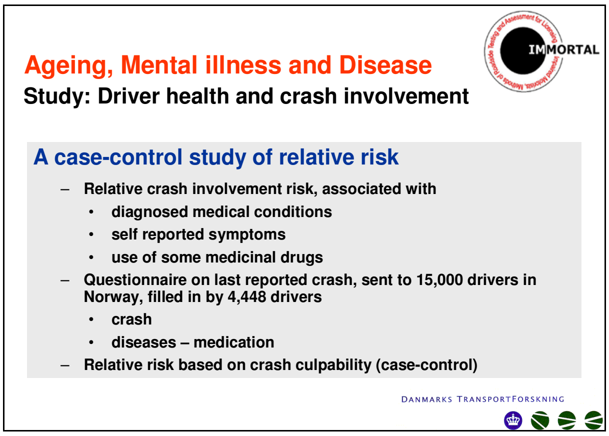
The aims of IMMORTAL covered various aspects in relation to traffic safety and were fulfilled by means of various research methods (slide 3).

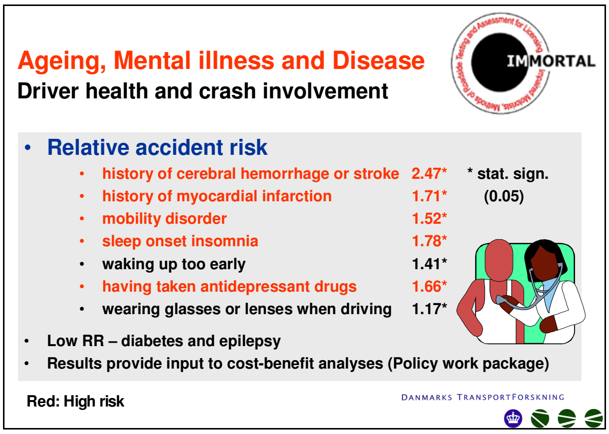
Diseases – chronic impairment

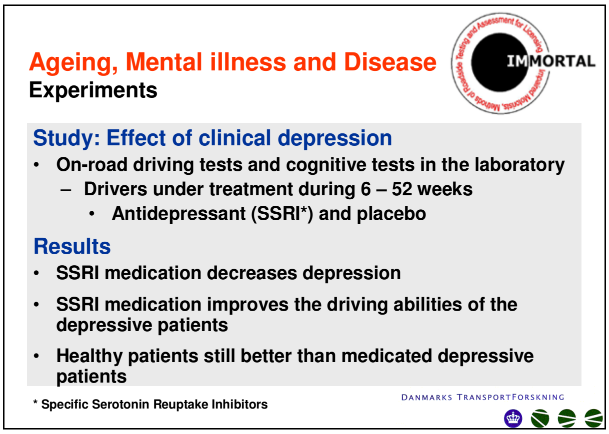
Regarding chronic impairment, a meta analysis and a study based on questionnaires filled in by crash involved drivers indicated that drivers suffering from various disorders showed an elevated accident risk compared to that of healthy drivers (slide 4-7).







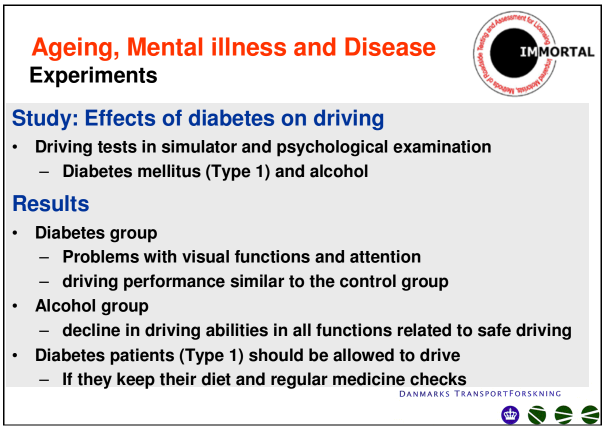




However, an experiment with modern antidepressants showed that the patients might have a higher accident risk without use of their medicine (slide 8).

On the contrary, another experiment with patients suffering form Attention Deficit Hyperactivity Disorder (ADHD) showed motoric disturbances while medicated whereas no significant impairment was found in the group of non-medicated patients.

Furthermore, an experiment with patients suffering from Diabetes Mellitus (Type 1) showed that although the patients had problems with visual functions and attention, their driving performance



turned out to be similar to the control group of healthy drivers. Hence it is recommended that diabetes patients (Type 1) should be allowed to drive if they keep their diet and regular medicine checks (slide 9).

In conclusion, the increased accident risk of drivers with certain medical conditions should form the basis for a more strict licensing policy within the European Union.

Alcohol and other drugs – acute impairment

Case-control studies showed that the accident risk while driving under the influence of combinations of drugs (illegal as well as medicinal) or the combination of drugs and alcohol is extremely high compared to driving while not impaired (slide 10-12).

Alcohol, Drugs and Medicines
Prevalence in the driving population

Percentage of samples positive for:	*NL*	*Norway*	*UK*
Alcohol > 0.2 g/l	2.1	0	
Amphetamines	0.03	0	0.66
Benzodiazepines	2.1	0.2	
Cannabis	4.5	0.5	3.26
Cocaine	0.7	0	1.34
Ecstasy	0.6	0	4.61
Opiates (excluding codeines)	0.06	0.2	0.08
Codeines	0.6		1.61
Tricyclic antidepressants	0.3		
Methadone	0.04		
Samples positive for one or more substances	*9.9*	*1.0*	*10.8*

DANMARKS TRANSPORTFORSKNING

Alcohol, drugs and medicines
Prevalence by age and gender in the Netherlands

Overrepresentation of illegal drugs in young males, 18-24:
- 14.5% positive for a single illegal drug (average 4.8%)
- 1.9% positive for a combination of two or more illegal drugs (average 0.5%)
- 1.7% positive for a combination of alcohol / one or more illegal drugs (average 0.4%)

Overrepresentation of psychoactive medicines in females, 50+:
- 12.9% positive for psychoactive medicines (average 3.3%)

DANMARKS TRANSPORTFORSKNING

A qualitative approach to more knowledge of accident involved drivers split the drivers into three groups: 1. Young, well-functioning men who used illegal drugs either during weekends or in the evening. Generally, they did not mix drugs with alcohol and did not think that the drugs constitute a traffic safety risk in the same way as alcohol does. 2. Middle aged men and women (35-54 years old) who had stopped working because of their alcohol and/or medicine dependency. They did not refrain from mixing their prescribed medicines with alcohol, and they were not aware of the risk this might constitute in traffic. 3. Drivers aged 55 and above who were still working or who had passed the retirement age and whose drug use was restricted to over the counter medicines or prescriptions. They did not combine the medicines with alcohol (slide 13-17).

Alcohol, Drugs and Medicines
Relative risk calculations (case-control study) in the Netherlands

Estimated Odds Ratios			Confidence interval
Negative samples		1	
Alcohol	BAC 0.5-0.8 g/l	8.3	(2.7-25)
	BAC 0.8-1.3 g/l	17.6	(5.5-56)
Drugs	Benzodiazepines	3	(1.3-6.75)
	Codeine	3	(not significant)
	Morphine/heroine	32.5	(1.8-592)
	Cannabis	1.45	(not significant)
Combinations	Drug/drug	24	(11.5-50)
	BAC <0.8 g/l + drugs	12.9	(3.8-44)
	BAC >0.8 g/l + drugs	179	(50-638)

DANMARKS TRANSPORTFORSKNING

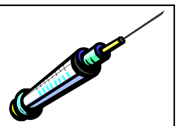
Alcohol, Drugs and Medicines
Study: A qualitative approach to drugs in traffic accidents in Denmark

Interviews with drivers, impaired at the time of crash
- Based on confirmation analysis or self reported drug use

To get information on accident involved drivers
- Drug impairment, medicinal, illegal drugs and alcohol
- The relation between drugs and traffic accidents
- Attitudes to driving under the influence of drugs and medicines
- Knowledge of drugs that may impair driving

DANMARKS TRANSPORTFORSKNING

Alcohol, drugs and medicines
Results



Positive confirmations (23)
- Medicinal drugs
  - 10 benzodiazepines
  - 3 morphine
  - 3 codeine
- Illegal drugs
  - 4 amphetamines
  - 1 ecstasy
  - 11 cannabis
  - 2 cocaine
- 15 positive for 1 drug group
  - + alcohol (5)
- 8 positive for 2 drug groups
  - + alcohol (4)

Selfreported drugs (19)
- Medicinal drugs
  - Antirheumatics
  - Analgetics
  - Antihistamines
  - Antiepilepticum
  - Barbiturates
  - Benzodiazepines
  - Codeine
  - Psychoactive drugs
  - Tranquillizer
- Illegal drugs
  - Cannabis

DANMARKS TRANSPORTFORSKNING

Alcohol, drugs and medicines
Results – accident factors

Mostly driver related factors
- Too high speeds
- Hazardous overtaking
- Lack of attention
- Misjudgement of the situation
- Bad state of mind
- Illness
- Drugs or combined alcohol and drugs

Drivers with impairing concentrations
- Impairment by drugs (and alcohol) is a contributory factor
- Mostly combined with other driver related factors

DANMARKS TRANSPORTFORSKNING

Alcohol, drugs and medicines
Results – characteristics

Young persons
- men, non academics
- well functioning, under education or working
- illicit drugs

Middle aged persons
- mostly men, early retired
- prescribed medicines
- former alcohol dependency or alcoholics

Older persons
- over-the-counter or prescribed medicines
- no alcohol

DANMARKS TRANSPORTFORSKNING

On-road experiments with ecstasy-impaired drivers indicated that this drug might improve road tracking but cause impairment in the car-following task. In addition to this, cognitive tests indicated a reduction in situation awareness while driving under the influence of ecstasy (MDMA). The ability to drive under the influence of the combination of ecstasy and alcohol was also studied. The results showed that driving under the influence of ecstasy, alone or in combination with alcohol must be avoided (slide 18).

Another experiment showed that drivers who took over-the-counter medicine while suffering from a cold might feel capable of driving but in fact were less aware and therefore more dangerous than non-medicated cold-sufferers (slide 19).

Alcohol, drugs and medicines
Experiments

Study: Effect of ecstasy, alone or in combination with alcohol
- On-road driving tests and cognitive laboratory tests
  1. Ecstasy and amphetamines
  2. Ecstasy in combination with alcohol

Results
- Ecstasy decreases awareness and memory
- Ecstasy improves road tracking
- Ecstasy impairs car-following task
- Doses of ecstasy and alcohol decrease driving skills
- Avoid the combination of ecstasy, alcohol and driving

DANMARKS TRANSPORTFORSKNING

Alcohol, drugs and medicines
Experiments

Study: Effect of over-the-counter medicines against cold
- Tests in driving simulator and cognitive laboratory tests
  - diprenhydramine (cough medicine)
  - paracetamol (fever and pain reducing)
  - pseudoephedrine (expectorant)

Results
- Cold sufferers
  - slower reaction times, impaired visual abilities, fatigue
  - less cognitive ressources for secondary tasks
- Medicated persons (both healthy and cold sufferers)
  - impaired driving skills

DANMARKS TRANSPORTFORSKNING

In conclusion, although driving under the influence of drugs, alone or in combination with alcohol, is very dangerous, roadside surveys showed that driving under the influence of alcohol is still by far more frequent than driving under the influence of drugs (slide 20).

IMMORTAL
Conclusions and recommendations

Main problems
- Alcohol and combined use of drugs or alcohol and drugs

Medical conditions must be surveyed
- Restrictions in licensing and individual fitness tests

From a traffic safety point of view
- Therapeutic levels as legal levels for most medicinal drugs

More specific information is needed regarding
- Warnings of prescribed and over-the-counter medicines
- Combined use of drugs and alcohol
- Health consequences of using illicit drugs

DANMARKS TRANSPORTFORSKNING

All IMMORTAL reports are available from the website www.immortal.or.at.

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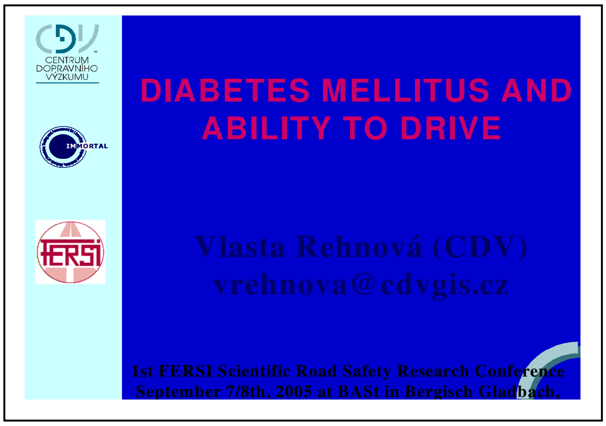
CDV,
Czech Republic

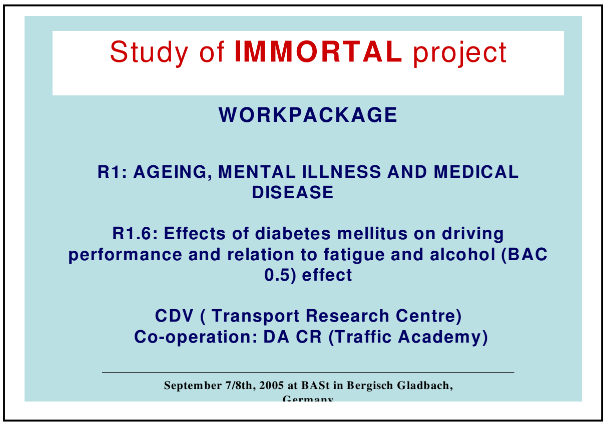
Diabetes Mellitus and ability to drive

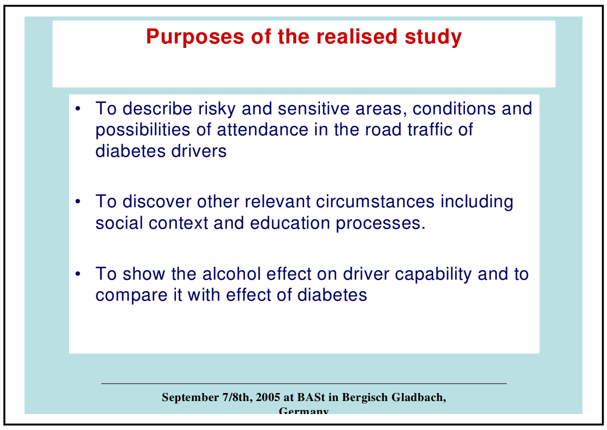
Diabetes Mellitus type 1 constitutes one of risky factors concerning traffic safety, as it results from analyses and studies of IMMORTAL project (Impaired Motorists, Methods Of Roadside Testing and Assessment for Licensing) focused on chronic impairment from ageing, mental illness and medical disease.

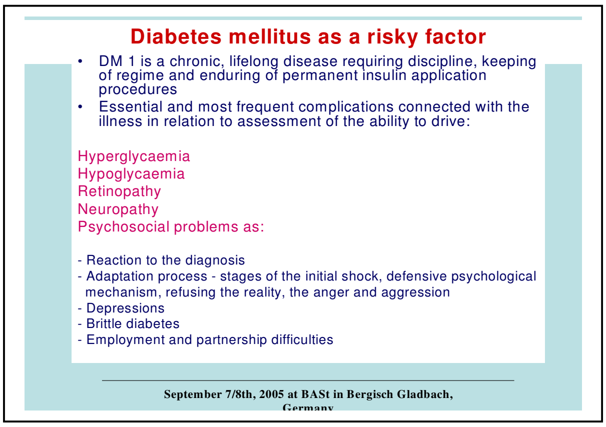
CDV has realised an experimental study included psychological assessment and drive simulator test of the group of diabetes patients – drivers to discover and describe main and more sensitive problems concerning safely driver behaviour of this specific driver population. The study has included also a large personal questionnaire focused on previous drive practice (years, length in kilometres, accidents, offences – types and circumstances), licensing process (difficulties and circumstances), and diabetes parameters (years of illness, doses of insulin, type of application of insulin). Driver simulator test has addressed to driver behaviour in standard and specific traffic situations and environmental conditions.

Results of this study describe diabetes drivers as a group requiring particular approach of capability assessment, continuous education, and specific licensing process. Especially frequency and type of their traffic accidents and offences shows, that specific help is needed also in this point of view.









Methods

- Laboratory psychological assessment of experimental group of diabetes drivers (D)
- Driver simulator test of three groups:
  - diabetes drivers (D)
  - drivers under alcohol effect (A) (BAC 0,05%)
  - control group of non impaired drivers (C)
- All of participants – anonymous voluntaries

Psychological assessment

- Test battery:
  - focus to all of obligatory basic and relevant psychic functions (intellect, attention concentration, visual memory, orientation in space, reactions, structure of personality)
  - self-reported description of driver practice, diabetes parameters, professional and social circumstances of participants.
- Comparison of diabetic's with driver standards of individual tests
- Standard statistical evaluation procedures of significant differences between norms and individual results of diabetes group
- Correlations of obtained results with diabetes parameters – diabetes years, insulin doses and modus of insulin usage (pump)

Driver practice

- Accident rate higher then normal population of drivers (compared with SARTRE data):

  Common driver population
  Involved in a traffic accident in the last 3 years – with damage only ***24%***
  - with injury ***9%***
  Experimental sample of diabetics
  Involved in a traffic accident in the last 3 years – with damage only ***47.6%***
  - with injury ***4.8%***

- Main causes - driver's lack of attention
- Found no case of serious consequences, i.e., damage only
- Found no significant dependencies of the quality of driver's practice on diabetes parameters
- Found relation between insulin application by pump and bad driver practice (total accident rate)

Driver practice

	Men	%	Women	%	Total	%
No. of persons tested	34	80,9	8	19,1	42	100
Traffic accidents: With liability 0	11	32.4	7	87.5	18	42.8
1	17	50	1	12.5	18	42.8
2	4	11.8	0	0	4	9.6
3 or more	2	5.8	0	0	2	4.8
W/o liability 0	15	44.1	4	50	19	45.2
1	13	38.2	2	25	15	35.7
2	5	14.8	2	25	7	16.7
3 or more	1	2.9	0	0	1	2.4
Total: 0	6	17.6	3	37.5	9	21.5
1	10	29.4	4	50	14	33.3
2	10	29.4	1	12.5	11	26.2
3 or more	8	23.6	0	37.5	8	19.0
Traffic offences 0	20	58.8	8	100	28	66.7
1	5	14.8	0	0	5	11.9
2	7	20.6	0	0	7	16.6
3 or more	2	5.8	0	0	2	4.8
Driver's License withdrawn (thereof due to alcohol)	7 (5)	20.6 (14.8)	0	0	7 (5)	16.6 (11.9)
Driver School – prior to diabetes	19	55.9	4	50.0	23	54.8
- as a diabetic	15	44.1	4	50.0	19	45.2

Traffic offences

	Number of	%
Traffic offences in the last 2 years (no. of persons, men only)	14	21,9
Traffic offences in the last 2 years (total number)	26	100
thereof – speeding	15	57,7
- parking offence	9	34,7
- driving through red light	1	3,8
- driving without papers (licence)	1	3,8

Accident circumstances

- Accidents and Annual Season:
  The most critical period with respect to accident frequency (with/without liability) is the summer, then the winter, then the autumn. Spring appears to be the least risky season.
- Causes of accidents with liability:
  1. driver's lack of attention, i.e., driver distracted, together with failure to keep safe distance (over 40% of reported accidents). 2. speeding (nearly 16%).
- Causes of accidents without liability:
  failure to keep safe distance on another driver's part (25%). Combined with lack of attention, this cause accounts for nearly 44% of reported accidents.
- *Notice: In the experimental group, there were 8 persons with two or more cases of involvement in an accident, without liability, i.e., 19% of all participants. This higher incidence is always subject to searching for the indicator of inadequate behavior of the given driver: unwillingness to co-operate, intolerance to the mistakes of others, or lack of ability to anticipate behavior of other participants in road traffic.*
- Consequences of Traffic Accidents:
  In both cases (with and without fault/liability), the consequences were not very serious, except for two cases with a rather serious injury – collision with a pedestrian and with a motorcycle.

Drivers attitudes

- Most frequent use of the automobile: recreation, shopping, culture (88.3%), for going to the doctor's appointment (50%), more often in the case of women (75%)
- Self-assessment as a driver: better or as good as other drivers: 60%, more careful: 38%, and more often following traffic regulations: 26%.
- Feeling safe when driving: always/mostly: 64% (women 87%)
- Feeling of risk: by other traffic participants: 71%, by own driver behaviour: 0%, by "both": 29% of respondents,
- Reasons why diabetics should not drive: – in general: not feeling well, lack of discipline, poor self-control, glycaemia off-balance, other health complications (19% of the respondents, there of more often women: 37%).
- Reasons why I should not drive: serious health complications, diabetes not stabilized, impaired vision, frequent tiredness, lack of self-confidence when driving, fear of not being able to handle a situation, serious traffic accident, physician's recommendation.

Possibility of diabetes driver to modify risk of accident

- Possibility to detect the first symptoms of diabetes attack – regular self-monitoring, training of detection, responsibility, keeping of diet and life regime
- Possibility to react to the first symptoms is real, driver has time enough to break

Symptoms

- Feeling of fatigue, languidness
- Disorder of visual sensitivity
- Headache
- Feeling uncomfortable
- Spasm
- Lost certainty and security of driving

Impact to driver's behaviour

- Reduced psychical performance (current or chronicle)
- Disorders of subtle moving coordination
- Disorders of attention
- Disorders of reactions (mistakes and longer reaction time)
- Disorders and changes of personality (current or chronicle)
- Disorders of self-sentiment (too low/high)
- Depressions and suicidal tendency

Psychological assessment - basic psychical functions

- The common significant impairment was not identified
- Serious deterioration in particular cases
- The most sensitive psychical function - attention and cognitive functions, especially depended on visual perception
- No massive correlation or dependence of psychological characteristics on observed diabetes parameters
- Tendencies:
- Diabetes years to lower verbal IQ, space orientation and imagination, and slower reactions.
- Insulin units/day to lower quality of attention.
- Pump application to better performance IQ, visual memory, space orientation, but high number of error reactions.

Psychological assessment - personality

- Alarming significant impairment of
  - emotional instability
  - emotional and internal modus of perception of life reality
  - tendency to fatalism and depression
  - lower self- control
- Correlations or tendencies:
- Diabetes years to rationality, extroversion and self-control.
- Insul.units/day to psychoticism, impulsiveness, lability, anxiety, fatality, paranoia.
- Pump application to lower responsibility

Categories followed during simulated test

- General level of driving skills: assessment of basic driver tasks as preparation before starting drive, technique of drive, traffic signs observation, orientation in traffic situations

(2) Ability to avoid risk situations: looking up them (numbers, relevance) and quality of prepared solutions

(3) Ability to act in standard risk and critical situations: assessment of reaction to arisen risk traffic situation correctly and in time, ability to use the experience from this situation in repeating of the same situation

(4) The behaviour on the end of series of simulated attacks by other drivers: measure of effort to manage this situation, manifestation of fatigue, vegetative manifestations

Experimental Group – Diabetes

The participants in this group demonstrated:
- a nearly identical common driving ability as the control group - even better results in the category of critical situation avoidance
-ability to handle critical situations was considerably weaker (*as the probants in this test group demonstrated a definite tendency to aggressiveness, as observed*).
-The greatest deviation from the control group was observed towards the end of the cycle of simulated test tasks following a series of simulated attacks by other participants of traffic
- Towards the end of the test, the probants demonstrated decline of concentration and onset of fatigue. Tendency to pseudokinetosis was higher.

Experimental Group - Alcohol

The participants in this group demonstrated:
- All of the indicators followed show evident decline of driving ability by about 35%.
-Their driving technique was unrefined and they were rough to the vehicle.
-They had a higher disposition towards confrontational traffic behaviour and showed signs of distraction.
-Their conduct in critical situations revealed inappropriate reactions, aggressiveness, and a tendency to make excuses or jokes for their disabilities based on objective causes.
- Early onset of fatigue was evident.
-Tendency to pseudokinetosis was nearly none.

Conclusions from this Study

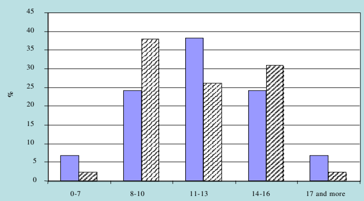
- No possibility to classify DM patients across-the-board as unable to drive a motor vehicle
- But critical results were obtained individually
- Limitations of this study:
  - The relative fitness and compensated DM 1,absence of health complications was selection criterion of DM participants - we are not able to describe difficulties of drivers impaired by de-compensated DM 1 or by later complications
  - Not representative example because of reluctance/anxiety of DM drivers to participate

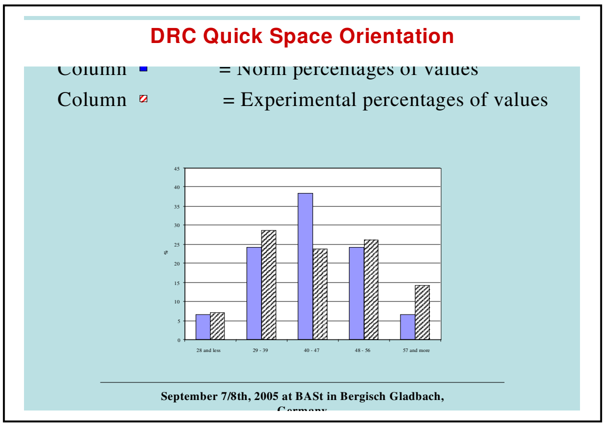
Recommendations

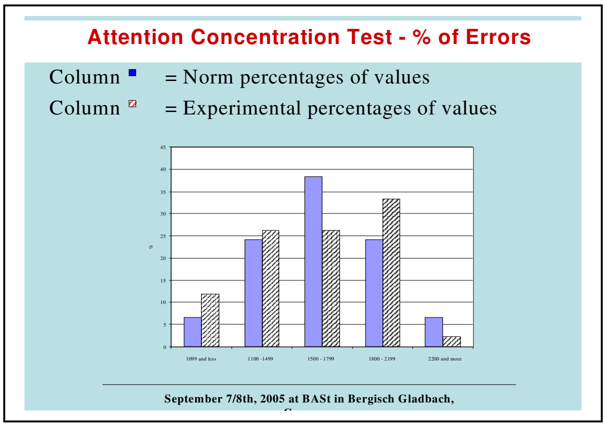
- Individual and continuous approach of medicine/psychological assessment of diabetes applicants of driver licence and periodical assessment of diabetes drivers.
- Obligatory psychological assessment (as the first assessment of diabetic applicants and periodic one of diabetic drivers)
- Checking of stabilized diabetes and kept proper regime must be required obligatory
- Special educative programs for diabetes drivers
- Patients with DM 2 are more risky due to frequency of hypoglycemia, applying similar measures to DM 2 patients is recommended by doctor.

VP (Visual Memory)

Column ■ = Norm percentages of values
Column ▨ = Experimental percentages of values




DRC Quick Space Orientation
Column = Norm percentages of values
Column = Experimental percentages of values
45
40
35
30
25
20
15
10
5
0
%
28 and less
29 - 39
40 - 47
48 - 56
57 and more
September 7/8th, 2005 at BASt in Bergisch Gladbach,


Attention Concentration Test - % of Errors
Column = Norm percentages of values
Column = Experimental percentages of values
45
40
35
30
25
20
15
10
5
0
%
1099 and less
1100 -1499
1500 - 1799
1800 - 2199
2200 and more
September 7/8th, 2005 at BASt in Bergisch Gladbach,

Schulze, Horst
Federal Highway Research Institute,
Germany

DRiving Under the Influence of Drugs, alcohol and medicine (DRUID)

bast

DRUID

„**DR**iving **U**nder the **I**nfluence of **D**rugs, Alcohol and Medicine“

EU 6. Framework Programme
Integrated Project

Dr. Horst Schulze
Head of Section „Traffic Psychology, Traffic Medicine“

Background

bast

- Over 40,000 people killed and 1.7 million injured in road accidents in the EU
- White Paper: 50% reduction of fatalities until 2010
- ~20% of accidents under the influence of psychoactive substances
- Fragmentary knowledge of prevalence and risk of illegal drugs and medicines
- Different legislative and preventive approaches in Member States

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Section "Traffic Psychology, Traffic Medicine" 2

Basic Idea

bast

- Bringing together the competence and expertise of European research
- Giving scientific support to the EU transport policy
- Reducing the danger of psychoactive substances in traffic

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Section "Traffic Psychology, Traffic Medicine" 3

Goals

bast

- To establish an empirically founded "yardstick" for impairment
- To determine prevalence rates of DUI and to compare Member States
- To estimate risks and to define thresholds for the most relevant psychoactive substances
- To define best practice of controls and countermeasures
- To establish an applicable classification system for psychoactive medicaments
- To develop guidelines and to disseminate the information

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Section "Traffic Psychology, Traffic Medicine" 4

Consortium

bast

- Co-ordinator: BASt
- > 30 partners
- > 20 Member States
- Duration 48 months

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WP 1

bast

Methodology and Research

- Methodology and Meta-analyses
- Experimental studies (on-road, simulator)
- Risk estimation
- Recommendation of thresholds

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WP 2

Epidemiology

- Uniform study design and research protocols
- Study types: e.g.
  - *Prevalence studies*
  - *Case-control-studies*
  - *Culpability studies*
- Methods: e.g.
  - *Roadside surveys*
  - *Hospital studies*
  - *Interviews*

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WP 3

Enforcement

- Roadside testing devices for oral fluid
  - User requirements
  - Scientific evaluation
- Cost-benefit-analysis

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WP 4

Classification

- Expert consensus
- European categorisation system for medicinal drugs
- Future framework for classification and labelling

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WP 5

Rehabilitation

- Validation of existing rehabilitation schemes
- In-depth-studies on reasons for recidivism
- Criteria for uniform quality standards of rehabilitation measures

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WP 6

Withdrawal

- Evaluation of strategies for conditional withdrawal (interviews, questionnaires)
- Recommendation of measures preserving mobility and reducing accident risks

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WP 7

Dissemination and Guidelines

- Development of guidelines for physicians and pharmacists
- Information material for the general public and health care professionals
- Dissemination

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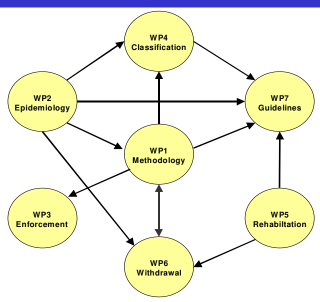
Interrelations



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Current status

- Positive evaluation by EU
- Revised proposal accepted
- Pending:
  - Improvement of geographical balance
  - Acquisition of additional partners from new Member States
- End of negotiations: October 2005
- Expected start: January 2006

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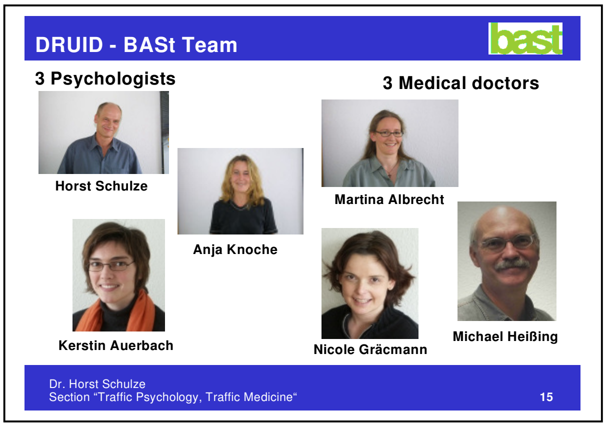
DRUID - BASt Team
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3 Psychologists
3 Medical doctors
Horst Schulze
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Kerstin Auerbach
Martina Albrecht
Nicole Gräcmann
Michael Heißing
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bast
Many thanks for the excellent support!
See you at the Kick-off-meeting!
Dr. Horst Schulze
Section "Traffic Psychology, Traffic Medicine"
16

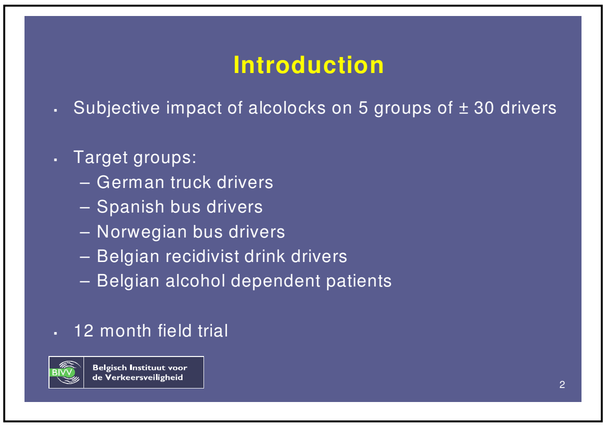
Vanlaar, Ward
IBSR,
Belgium

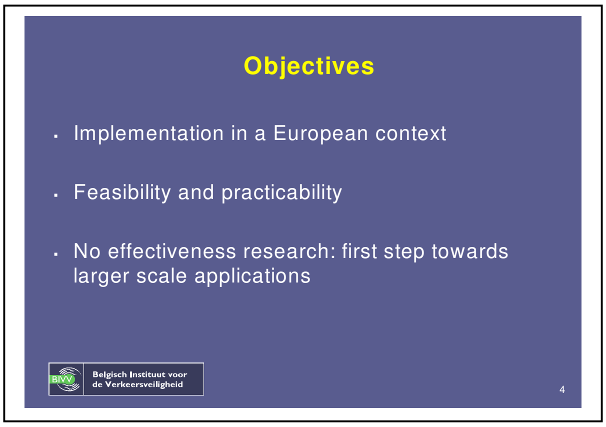
Preliminary research results of the European alcolock project

On January 1st 2004 the European alcolock project started. It is borne by a consortium of 5 European institutes and granted funding by the Directorate-General Energy and Transport of the European Commission.

The main objective of this project is to contribute to a reduction of the number of victims on European roads by preparing and facilitating legal implementation of alcolocks in the European Union through research on the psychological, sociological, behavioural and practical impact on drivers whose vehicles are equipped with an alcolock.
The main target groups in this research project are recidivists, alcohol dependent patients, bus drivers, transport drivers and related subjects of each of those groups. The project is conceived as a small-scale field trial and exploratory empirical field data are gathered.

The field trials are not finalised yet and therefore only preliminary data are gathered to date. Despite the premature status of the empirical findings, some interesting conclusions can be formulated. Due to their status, however, these conclusions are not yet part of a structured debate. One striking finding is the suspicious attitude of several involved parties vis-à-vis different aspects of alcolocks. These aspects include technical aspects, aspects regarding tampering or circumvention and aspects regarding the appropriateness of alcolocks as a sentence.





Objectives

- In-depth investigation
- Subjective impact of the alcolock:
  - Psychological
  - Sociological
  - Behavioral
  - Practical

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Core design

- Installation during 12 months
- Data:
  - Interviews before, during and after alcolock use
  - Alcolock log data
  - Meetings and minutes: implementation process

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Preliminary results of commercial / non-offender trials

SPAIN

- Negotiations with local companies, politicians, trade unions, etc... => installation of devices in December 2004
- Transport company in Valladolid: 15 devices, 30 drivers

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Preliminary results of commercial / non-offender trials

- No indications of drink driving history
- A priori attitudes of drivers (pre-interviews):
  - 17 positive
  - 3 indifferent
  - 2 negative
  - 8 no opinion
  - Mean usefulness score: -0.68
  - Mean satisfaction score: -0.41

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Preliminary results of commercial / non-offender trials

GERMANY

- Technical and organizational problems => installation of devices in November 2004
- 15 volunteers in large transport company ("voluntary" group)
- 19 drivers of a small transport company ("obligatory" group)

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Preliminary results of commercial / non-offender trials

- A priori attitudes of drivers (pre-interviews):
  - 8 positive
  - 27 neutral
  - 5 negative
  - mean usefulness score: -.77
  - mean satisfaction score: -.07
- 36 percent has an alcoholic drink more than once/week

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Preliminary results of commercial / non-offender trials

- Preliminary (!) alcolock data:
  - Persons with one/more BAC > .5 g/l (.05 g/dl): 10
  - Total number of high BAC (> .5 g/l) events: 34
- Interview data high BAC events:

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answer	no. of answers
testing the device/try it out	11
don't remember anymore	6
moving vehicle for a short distance	3
resting + drinking alcohol	3
this cannot be"	2
"it was another driver"	1
alcohol-containing medicines	1
eating (without alcohol)	1

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Preliminary results of commercial / non-offender trials

NORWAY

- installation of devices in November 2004
- 15 public busses in Lillehammer, 30 drivers
- A priori attitudes of drivers (pre-interviews):
  - 72% alcolock OK if works as intended
  - 8% positive / 8% alcolock unnecessary / 4% alcolock is problematic when changing drivers
- Anticipated effect of alcolock:

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% of target group answers	Alcolock is good for company image	Alcolock is good for bus driver's image
Yes	79	71
Neither - nor	4	14
No	18	14
Total	100	100

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Preliminary results of non-commercial / Belgian trials

- Original objective (30/30)
- Alcohol dependent patients (7):
  - DSR-IV-R criteria for substance dependence (alcohol)
  - Evidence of drink driving problems in case history
  - Abstinence for at least 2 months
  - Voluntary participation

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Preliminary results of non-commercial / Belgian trials

- Recidivist drink drivers (30)
  - Repeat offenders or one offence with BAC > 1.2 g/l (.12 g/dl)
  - Alcolock proposed by judge as alternative measure, free (no costs)
  - Supervision by justice assistants and probation commissions

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Preliminary results of non-commercial / Belgian trials

- Same core procedures as for commercial trials
- But: driver improvement course before installation and after 6 months

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Preliminary results of non-commercial / Belgian trials

- Preliminary data:
  - Heterogeneous group:
    - 33 man, 6 women
    - 4 < 30 years; 4 > 60 years
    - Mostly multiple offenders but also some single offenders
    - About 50% > 8 on AUDIT
    - About 50% has an alcoholic drink at least once/week

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Preliminary results of non-commercial / Belgian trials

- Acceptance data:
  - Mean usefulness score = 1.5
  - Mean satisfaction score = .05

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Preliminary results of non-commercial / Belgian trials

- after +- 6 months of alcolock use of 40 participants
  - 533 breath tests > .2 g/l (threshold value of devices)
  - 193 breath tests > .5 g/l (legal limit)
    - 14/39 participants had no tests above legal limit
  - Worst case: 96 tests > .2 g/l and 53 tests > .5 g/l

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Preliminary results of non-commercial / Belgian trials

Frequent occurrence of repeated failed tests:

- » Trying over and over
- » Drivers reasons:
  - Frustration, avoid taxi
  - Completely inadequate estimation of one's own BAC

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Conclusion

+ 6th month of a 12 month trial
+ Only a fraction of the entire data is known and/or analyzed
+ Final report European trial available by July 2006
+ Symposium Brussels, June 2006

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- Grant number SUB-B27020B-E3-ALCOLOCK-2003-S07.26578 of the European Commission Directorate-General for Energy and Transport.
- The sole responsibility for the project and for this presentation lies with the authors. The commission is not responsible for any use that may be made of the information contained in this presentation.

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General Topic „Technical applications“

Workshop 3

Road infrastructure safety

Workshop 6

ITS and HMI

Workshop 9

Enforcement

Workshop 12

Speed management

Workshop 3

Road infrastructure safety

Leitung

E. Bekiaris (HIT) und Roland Weber (BASt)

Vorträge

Allenbach, Roland (bfu)

“Road safety in Swiss motorway tunnels“

Bekiaris, E., Gaitanidou, E., Kalogirou, K. (HIT)

“The use of telematics in enhancing infrastructure safety – the IN-SAFETY approach“

Gaudry, Marc (INRETS)

“Road characteristics, risk, uncertainty and speed”

Kennedy, Janet (TRL)

“Managing risk on UK roads“

Matena, Stefan (BASt)

“Road classification practice in Europe and the chance of implementing standardised and self-explaining roads (presentation from the project RIPCORD)“

Allenbach, Roland
Bfu,
Swisse

Road safety in Swiss motorway tunnels

Motorways are the safest roads. While motorway tunnels were clearly safer than open motorways at the end of the 1980s, the difference between them in terms of accident-victim rates and the severity of accidents has diminished. A research project was conducted to find measures to increase road safety in tunnels to supplement the recommendations of the Tunnel Task Force which was founded in 1999. The empirical part of the investigation was planned, firstly, as a retrospective survey and, secondly, as an analysis of accidents with a statistical evaluation. A survey conducted among all cantonal road authorities inquired about the defects and influences that appeared relevant to the people responsible for the tunnels and tunnel safety. The aim of the accident analysis and its statistical evaluation was to determine whether or not and to what extent any features based on design and operation had an influence on accidents and, in particular, on the number of casualties. The main results were: The tunnel length has a significant influence even when adjusted for exposure (AADT) both on the risk of accident as well as on the risk of injury. An increase in traffic density increases the risk of collisions and the risk that persons will be injured. Tunnels with uni-directional traffic when compared with tunnels with bi-directional traffic have half the risk of accident and casualties. The proportion of heavy goods vehicles in AADT merely has a marginally significant influence on the risk of injuries but not on the risk of accidents. The width of the shoulder has turned out to be a significant accident predictor.

Road safety in Swiss motorway tunnels

1st FERSI Scientific Road Safety Research Conference
September 7th/8th, 2005, Cologne

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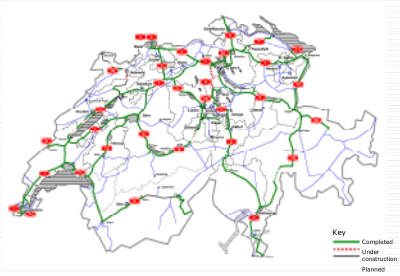
Motorway network 2004



2005-09-07-FO / 2

The motorway network: salient features

- Length 1,600 km
- Number of tunnels 186
- Longest tunnel 16.9 km (Gotthard)
- Shortest tunnel <100 m

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Tunnel vs. open road, 1992 - 2002

	Total	Open road	Tunnel
Accident rate 1999 (accidents per 1 million km)	0.46	0.47	0.35
Casualty rate 1999 (injuries and fatalities per 100 million km)	19.6	19.6	19.8
Severity 1992–2002 (fatalities per 100 injuries)	2.7	2.7	2.8

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Task Force measures (examples, extract)

- Road users
  - Supplementing the driving test
  - Recommendation on how to react in fire situations
  - Intensifying checks on heavy goods vehicles
  - Training for drivers of hazardous materials vehicles
- Operations
  - National Swiss coordination office for tunnel safety
  - Safety officer for each tunnel (> 600m)
  - Documenting and evaluating fires

Task Force measures (cont.)

- Infrastructure
  - Revision of the guidelines for single tunnels
  - Second tunnel as an emergency exit
  - Transverse links (every 300 m or 900 m)
  - Central reservation crossovers at tunnel entrances
  - Number of tubes based on daily traffic volume
  - International uniformity of emergency route signs
- Vehicles
  - Fire extinguishers in heavy goods vehicles

Goals of the study

- To determine the level of safety in tunnels in comparison to open roads
- To obtain information as to which factors (specifically in relation to operation and infrastructure) significantly influence safety in tunnels
- To provide pointers for measures to supplement those of the Tunnel Task Force

Method: variables included

- Design
  - Vehicle clearance envelope (height, width)
  - Lane width
  - Shoulder design (height, width)
  - Bends in tunnel (‡ angle variation per length)
  - Illumination (entrance, transit)
  - Longitudinal inclination (descent, incline)
  - Number of tubes
  - Length
- Operation
  - Traffic volume (AADT)
  - Heavy goods vehicles (proportion of AADT)
  - Posted speed limit

Method: definition of criteria

- Accidents
  - Number of accidents per 1 million vehicle kilometres: accident rate
  - $A_R = \frac{A \cdot 10^6}{(AADT \cdot L[km] \cdot 365)}$
- Casualties
  - Number of injuries and fatalities per 100 million vehicle kilometres: casualty rate
  - $C_R = \frac{C \cdot 10^8}{(AADT \cdot L[km] \cdot 365)}$

Method: sample

126 tunnel structures

Length category	Single tunnels (with contraflow)	Twin tunnels (without contraflow)	Total
0.2 – 0.6 km	41 %	56 %	52 %
0.6 – 2 km	32 %	34 %	33 %
2 – 4 km	16 %	8 %	10 %
> 4 km	11 %	2 %	5 %
Total	30 %	70 %	100 %

Results: bivariate analyses

Independent variable	Accident rate	Casualty rate
Tunnel length	r = -0.232**	r = n. s.
Number of tubes	r = 0.212*	r = 0.201*
Shoulder width	r = -0.427**	r =-0.314**
AADT	r = 0.463**	r = 0.452**
Heavy goods vehicles	r = -0.228*	r = 0.213*

Results: bivariate analyses

Independent variable	Accident rate	Casualty rate
Bends in tunnel	r = n. s.	r = n. s.
Longitudinal inclination	r = n. s.	r = n. s.
Shoulder height	r = n. s.	r = n. s.
Lane width	r = n. s.	r = n. s.
Headroom	r = n. s.	r = n. s.
Posted speed limit	r = n. s.	r = n. s.
Light density	r = n. s.	r = n. s.

Results: multivariate analyses

Independent variable	Accident rate	Casualty rate	Valid value range
Tunnel length*	-32 %	-20 %	0.2 – 17 km
Number of tubes	-45 %	-53 %	1 or 2
AADT*	+77 %	+38 %	2000 - 10^5
Heavy good vehicles (proportion of AADT)	n. s.	+31 %	2.5 – 23 %
Shoulder width	-43 %	n. s.	0.5 - 2.8 m

* Adjusted for exposure

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Recommendations

- Marking lights/reflectors
- Profiled edge markings
- Breakdown bays/breakdown lanes
- Automatic detection of disruptions in traffic flow
- Monitoring safe distances between vehicles and speeds
- Traffic management to avoid traffic jams
- Trickle system/shift in the flow of heavy goods vehicles
- Overtaking prohibited for heavy goods vehicles
- Shoulder width (> 1 m)

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Conclusion

Swiss motorway tunnels are safe

but

The potential for catastrophes is latently existing

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Bekiaris, E., Gaitanidou, E., Kalogirou, K.
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IN-SAFETY project: Towards road fatalities reduction through the enhancement of forgiving and self-explanatory roads

Summary

Road safety engineering measures may reduce casualties by 6.5%. IN-SAFETY R&D project, co-funded by EC, aims to use intelligent, intuitive and cost-efficient combinations of new technologies and traditional infrastructure best practice applications, in order to enhance the forgiving and self-explanatory nature of roads. This will be achieved by activities, such as building consensus on priorities for regulation and standardisation processes, the development and testing of new simulation models and risk analysis tools to estimate the safety of roads, training tools and curricula for road, TMIC and tunnel operators, issuing priority implementation scenarios, guidelines for research and policy recommendations for cost-efficient road environment development.

THE PROBLEM

Over 42,000 road users are killed in European Union (EU) countries annually and around 3.5 million are injured, when under-reporting is taken into consideration. This accounts for an annual cost of over 160 billion Euros and untold pain and suffering of the victims and their relatives (1). Looking at fatality numbers, car occupants are the largest single casualty group. They comprise 57% of total EU road deaths, with the majority of car occupant casualties sustained in side and frontal impacts. Looking at fatality risk however, the traffic system is less safe for the more vulnerable road users, where the risk of death on EU roads is substantially higher than for car occupants. Indeed, for pedestrians and cyclists the risk is 8-9 times higher and for motorcyclists it is 20 times higher.

A study in one EU Member State has reviewed the effectiveness of casualty reduction measures nationally since 1980. This has demonstrated that the greatest reduction was achieved from vehicle crash protection (15%). Drink/drive measures have resulted in a reduction of 11%, while road safety engineering measures in a reduction of 6.5%.

The rather small impact of road and infrastructure related measures on accident reduction until now may be well attributed to the high cost of such measures. Thus, although a study in Greece has identified hundreds of "black-spots" in the main national road network several years ago, the authorities have intervened with local road works in only very few of them (2).

Thus, infrastructure improvements and enforcement campaigns are not expected to significantly contribute towards the 50% reduction of road fatalities, as is the target by EU for 2010. The use of new technologies may become the catalyst towards achieving this goal, especially since the combination of new technologies with existing infrastructure, or with limited improvements of it, may lead to much more cost-effective solutions.

IN-SAFETY Project objectives

IN-SAFETY project aims to use intelligent, intuitive and cost-efficient combinations of new technologies and traditional infrastructure best practice applications, in order to enhance the forgiving and self-explanatory nature of roads, by:

- Building consensus on priorities for regulation and standardisation processes with a view to integrate the deployment of ADAS and IVIS on existing road infrastructure.
- Assessing the potential and cost-effectiveness of combined use of such new technologies (ADAS, IVIS) and innovative HMI concepts, to promote the self-explanatory and forgiving character of road environments, including highways, rural roads urban environments.
- Creating comprehensible pictograms to substitute verbal messages as used on roads, focussing on requirements of the TERN (Trans European Road Network), optimising them for impaired visibility conditions and animating them for improved comprehension.
- Optimising verbal messages, which cannot be substituted by pictograms, with regard to comprehension and harmonization, taking into account the official languages of the EU and the national languages of NAS, their (dis-)similarities and commonly understood international key words.
- Setting up a terminological database for multilingual navigation services.
- Proposing a most suitable typeface for both traditional static and variable

- messages, based on LED and fibre optical displays.
- Proposing rules for the appropriate structuring of information on displayed messages.
- Developing and testing new simulation models (microscopic and macroscopic) and risk analysis tools, to pre-estimate and validate the safety and functionality of road environments.
- Harmonising vertical and horizontal signing and furthermore personalising their information to the specific needs and wants of each user.
- Issuing priority implementation scenarios, guidelines for further research and policy recommendations for cost-efficient road environment development, road safety assessment and inspection, including new technological elements.
- Developing and testing new models and tools for performing safety impact related risk analysis of road infrastructure.
- Developing training tools and curricula for road and TMIC operators, focusing on the use of new technologies and telematics.

The project work is based on a balanced amalgam of analysis of previous work results and concept, test and report of innovative concepts, in terms of combinations of new technological elements with traditional road infrastructure. These new concepts, will be realised and extensively tested in 4 inter-related pilots Europewide, covering all road types and including among others key drivers' cohorts, such as tourists, elderly and novice drivers.

IN-SAFETY PROJECT WORKPLAN

IN-SAFETY aims to promote the building and maintenance of European roads, according to the concepts of forgiving and self-explaining roads, concluding into relevant implementation scenarios, training curricula and best practice guides.

To achieve this goal, work starts with the identification of the elements that make a road environment of forgiving nature and the possible ideas of creating such an environment by integrating traditional road elements with in-vehicle and infrastructure based telematics, including all-

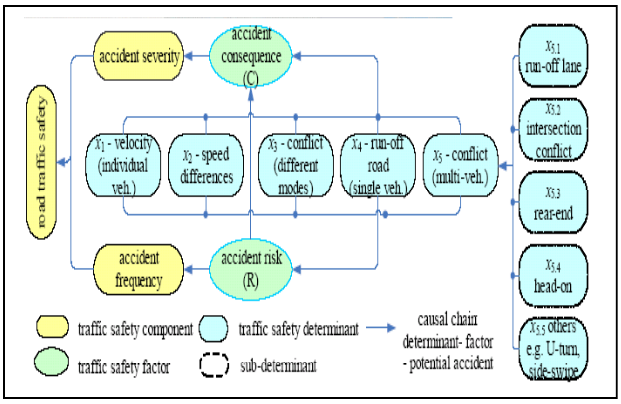

Figure 1: Relationships between road traffic safety, components, factors and determinants (6).

weather VMS'es, in-vehicle simulation of rumble strips, localised accident-ahead and traffic jam warnings, dynamic navigation principles, ADAS and IVIS.

As it can be seen in Figure 1, there is an effort to define the relationships between road traffic safety components, factors and determinants. The above proposed schema uses as guiding principles for identifying the relevant factors and determinants three major principals. First, all traffic safety related situations should be covered; second, overlaps between determinants should be avoided as much as possible and third, a convenient and transparent framework for comparison analysis should be provided.

In parallel, work is also conducted on the self-explanatory road environments, focusing on innovative combinations of traditional, horizontal and vertical, signing with telematic signs. Emphasis is on signing standardisation elements, use of best practice on pictograms and the wording of verbal messages, provision to the driver of information by alternative means in a comprehensive and coherent way, but most importantly on an information personalisation scheme that is based on intelligent agents and thus may adapt the provide input to specific driver cohorts (i.e. elderly, disabled, tourists) or particular driver wishes and preferences through a personalised driver information system (Figure 2).

A number of new tools to support road design and safety assessment is being developed, taking into account new technologies and the above concepts. They include micro and macro simulators, which incorporate various driver behaviour models and can predict safety effects, human behaviour inclusive risk analysis tools (e.g. the DRAT-Darmstadt Risk Analysis Tool, Figure 3), training schemes for road and tunnel operators, as well as simulation models to influence route choice in a road.

The proposed solutions and the developed tools will be then extensively tested in a series of pilots, including on-road tests in Turin, Italy, Athens, Greece and Stuttgart, Germany and a dynamic driving simulator test on critical scenarios evaluation and urban tunnels in Linkoeping, Sweden. The evaluation of pilot results will lead to the optimisation of the developed tools as well as the valuation of the proposed strategies.

Environment	**Self-explanatory road (SER)**	**Forgiving Road (FGR)**
Definition	Road designed and built in such a way as to induce adequate behaviour and therefore avoid traffic error.	Road designed and built in such a way as to interfere with or block the development of traffic error, and to avoid or mitigate negative consequences of driving error.
Example	Have a recognisable road layout dependent on the road category.	Roads have structural layout elements that reduce the consequences of accidents once they happen.

Table 1: Definitions for self-explanatory and forgiving road environments.

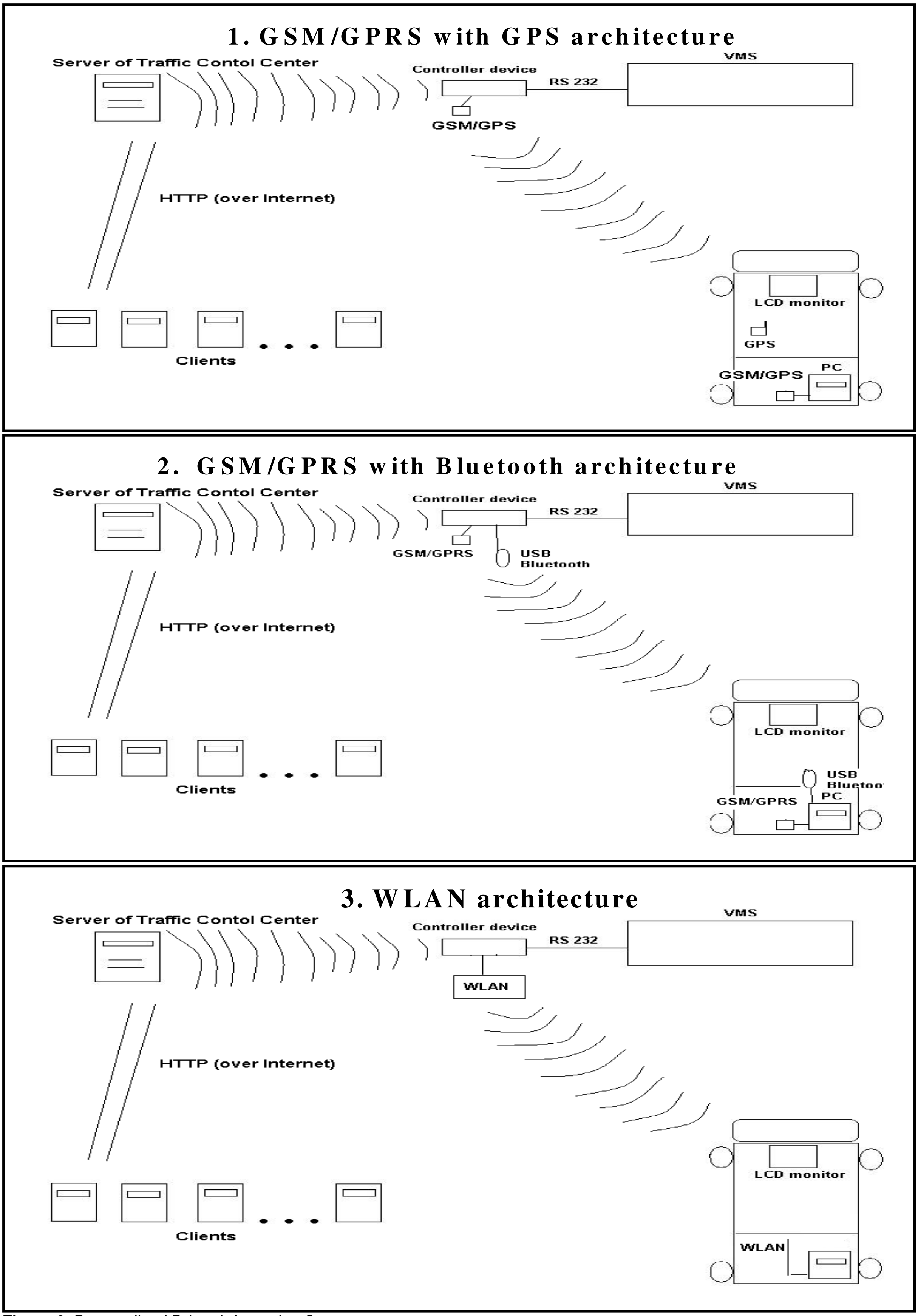

Figure 2: Personalised Driver Information System –
Three proposed architectures (7).

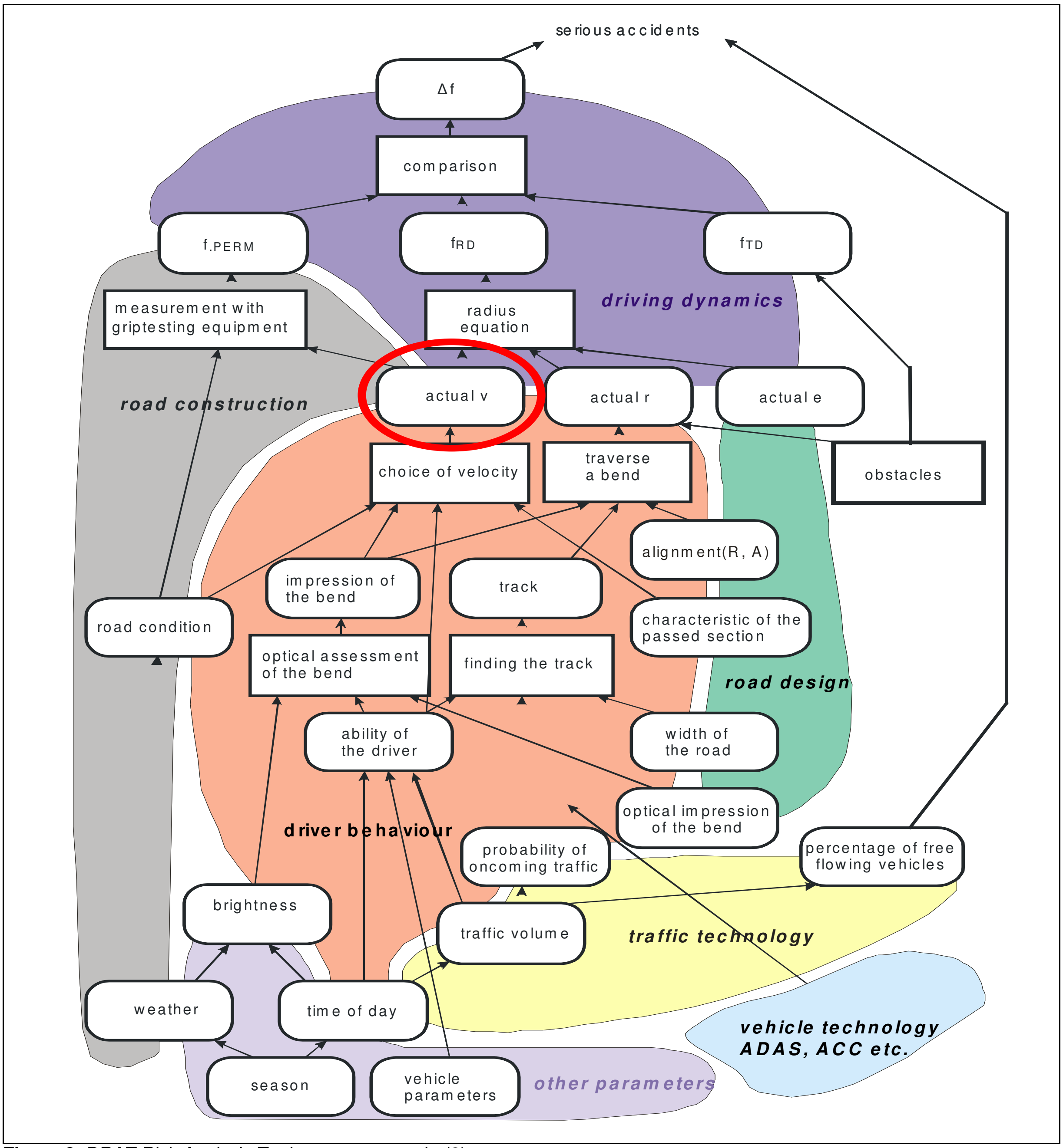

Figure 3: DRAT Risk Analysis Tool concept example (8).

Based on the findings and their assessment, implementation scenario priorities, application guidelines and further research priorities will be issued. For each scenario, all relevant parameters will be defined, e.g. type of road, type of vehicle, specific traffic scenario, weather conditions, traffic density, etc. These scenarios are going to be validated and prioritised using the AHP multi-criteria analysis methodology. In addition, a best practice guide on horizontal, vertical and telematic signing will be developed. These will all lead to policy recommendations, regarding required legislation, incentives, promotion actions, PPP's and business models; and accreditation and homologation schemes for the training schemes, all based on a detailed cost-benefit and cost-effectiveness analysis.

Business models will also be taken into account. Key actors in the business models will include the driver, the infrastructure including the Traffic Control Centres, the industry, the content enablers, as well as the service providers for the various applications elaborated within IN-SAFETY. For example, “Willingness to invest” is considered one of the most vital parameters for the industry, which is determined by product as well as market related factors. A relevant scheme can be seen in Figure 4.

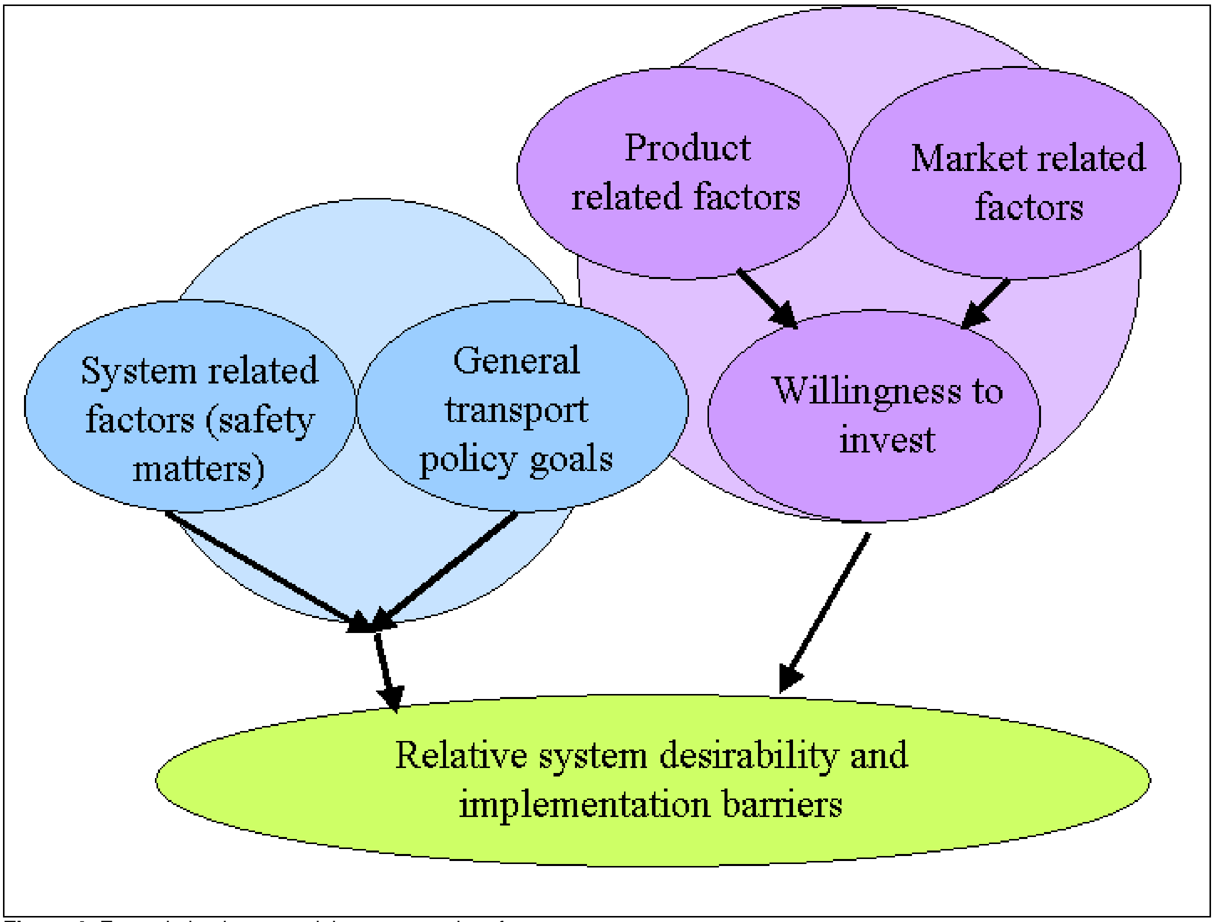

Figure 4: Example business model parameters interference.

The project work covers all types of road environments in good balance. Several relevant ideas and tools for each, are offered in the following table:

Road Type	Forgiving Road Elements	Self Explanatory Road Elements
Urban and PeriUrban	Intelligent Traffic Lights (for VRU's)	Personalised traffic info on parking, route guidance, traffic jams, etc.
Urban/ Periurban Tunnels	Speed and sharp curve warnings, in GPS absence	Traffic info on tunnel conditions (traffic density, weather, etc.)
Rural	Virtual Rumble Strips Combination with external navigation maps for speed and overtaking recommendations.	Extended navigation info on sharp bends, etc.
Highway (including long tunnels)	Virtual Rumble Strips combination with lane recognition cameras for road departure monitoring.	Personalised traffic info from VMS. Personalised warnings on accidents and traffic jams ahead. All weather VMS.

Table 2: Examples of IN-SAFETY ideas and tools per road type.

CONCLUSIONS

Transportation is a driving force behind economic development and the well-being of all people around the world. Modern life demands growing mobility. Frequently, it is secured through ever-increasing use of private cars. The resulting burdens on a transport infrastructure that is already heavily stretched are multiplying. Despite major expenditures on new road infrastructures, traffic congestion continues to rise. Past gains in road safety and environmental improvements are decreasing. It is unlikely that such problems can be solved by simply building more roads or by relying on past approaches. Innovative efforts are clearly needed on a broad front. Among them is the concept – and the practice – of Intelligent Transport Systems (ITS). ITS can open up new ways of achieving sustainable mobility in the communications and information society.

Since ITS became official in 1991, USDOT reported the received benefits of ITS applications in the nation as follows (3):

- Advanced traffic surveillance and signal control systems have resulted in travel time improvements ranging from 8% to 25%.
- Freeway management systems, primarily through ramp metering, have reduced crashes by 24% to 50% while handling 8% to 22% more traffic at speeds 13% to 48% faster than pre-existing congested conditions.
- Incident management programs can reduce delay associated with congestion caused by incidents by 10% to 45%.

However, ITS applications cannot provide significant positive impact, when implemented isolated from the overall infrastructure or in a non-compliant infrastructure. In fact, the combination of ITS and infrastructure measures results in much higher cost-effectiveness, as the following Table shows, comparing the cost of keeping up with travel growth with infrastructure development alone versus the combination of infrastructure and ITS.

On the other hand, experience shows that pure infrastructure measures often can't be realized due to many different reasons, often because there are legal or economic problems. This applies especially on low volume rural roads but also to roads in heavily built-up urban areas. Advanced technologies and refined analysis methods may help to improve the situation even there.

Cost effectiveness of infrastructure development and combined ITS and infrastructure development		
	Build Only	**ITS+Build**
Build Part		
Increase throughput by	30%	10%
Freeway lane miles built	17,651	5,884
Arterial lane miles built	26,643	8,881
Cost per freeway lane mile ($ millions)	$4.50	$4.50
Cost per arterial lane mile ($ millions)	$1.30	$1.30
10-year freeway capital cost ($ billions)	$79.43	$26.48
10-year arterial capital cost ($ billions)	$34.64	$11.55
Annual O&M costs per lane mile	$2,818	$2,818
20-year freeway O$M costs ($ millions) $721	$721	$240
20-year arterial O$M costs ($ millions) $721	$1,089	$363
Total build costs ($ billions) non discounted	**$115.88**	**$33.63**
Total build costs ($ billions) discounted	**$86.57**	**$28.86**
ITS Part		
Increase throughput by		20%
ITS infrastructure capital cost ($ billions)		$19.30
O&M / capital cost ratio		10%
ITS infrastructure O&M costs ($ billions)		$27.99
Total ITS costs ($ billions) non discounted		$47.29
Total ITS costs ($ billions) discounted		$27.60
Total ITS+build costs ($ billions) non discounted		**$85.91**
Total ITS+build costs ($ billions) discounted		**$56.46**

Cost effectiveness of infrastructure development and combined ITS and infrastructure development		
	Build Only	**ITS+Build**
Life cycle cost ratio non discounted		**0.74**
Life cycle cost ratio discounted		**0.65**

Table 3: Cost of keeping up with travel growth; Build only versus ITS+Build, data summary from ITS applications in 38 large and 12 medium metropolitan areas of the US (4).

When safety comes into question, the modern technology applications seem to predict significant effects, as displayed in the table below.

Still, it is well known that in actual conditions and under different penetration schemes and ADAS/IVIS combinations, safety effects may be reduced or even averted by driver behaviour adaptation or other factors, such as organisation and legal barriers and incomprehensible, poorly discriminable, poorly understandable and irrelevant considered signs. All these will be taken into account within IN-SAFETY.

Safety benefits given in terms of percent reduction in accidents		
Advanced signal control	75% to 78%	Japan
Adaptive signal control	18%	US
Adaptive signal control	30%	Europe
Ramp metering	24% to 50%	US
Speed enforcement cameras	20% to 80%	US
Speed enforcement cameras (UK)	50%	Europe
Controller motorway	30%	Europe
Collision warning	33% to 40%	USA
Weather monitoring and VMS	30% to 40%	Europe
Driver monitoring	Up to 41%	Europe
Emergency response	7% to 12%	Europe
Dynamic route guidance	1%	US
Incident and emergency management	15%	US
Crash avoidance systems	up to 17% (nationally)	US
Safety benefits given in terms of percent reduction in rescue time		
AVL/CAD	40%	US
Incident and emergency management	20%	US
Incident and emergency management	43%	Europe

Table 4: Safety benefits of various ITS systems, as reported from different pilot projects worldwide (5).

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Gaudry, Marc
INRETS,
France

Road characteristics, risk, uncertainty and speed

This paper presents a method to analyze the user's attitude toward speed and road safety in relation to traffic, road design and surface characteristics using a unique data set pertaining to some 80 variables observed on 50 000 sections of the French road system.

We formulate a simultaneous equations structure to account for the trade-offs, dependent upon user preferences, among road comfort, speed and uncertainty. This structure also makes it possible to understand whether and how public interventions on the infrastructure, from design to signage, may lead to safety gains, or not.

Our formulation notably distinguishes between two components of observed objective risk outcomes, namely calculated risk linked to speed, and uncertainty or “ dangerousness ”, in the manner of Frank Knight. We also use for the first time a new empirical measure of “ perceived risk ”, expected maximum insecurity (EMI), derived from random utility theory and with uncertainty at its core, facilitating the identification of the role of perceived risk among the determinants of speed choice.

The estimation structure consists of three equation groups : the first two explain accident frequency and severity with discrete choice Logit models easily admitting of non linearity and choice-based sampling. The speed equations of the third group, explaining both the mean and the variance of speeds, also consist of non linear flexible-form regression models.

In particular, the accident and severity equations retain as explanatory variables some 30 of the 80 infrastructure factors. These variables describe speed, traffic volume and composition, road hierarchical and lane class status, vertical and horizontal geometric profile and alignment characteristics of the section itself, including its geographic orientation, and of its position in a sequence of sections, as well as its own length and numerous structural and surface characteristics.

Our choice-based sampling approach permits future completion of the data base at low cost, in order to correct potential biases due to missing variables concerning vehicle, driver characteristics and climate that may not be orthogonal to the speed, traffic, road geometry, structure, orientation and surface factors at our disposal.

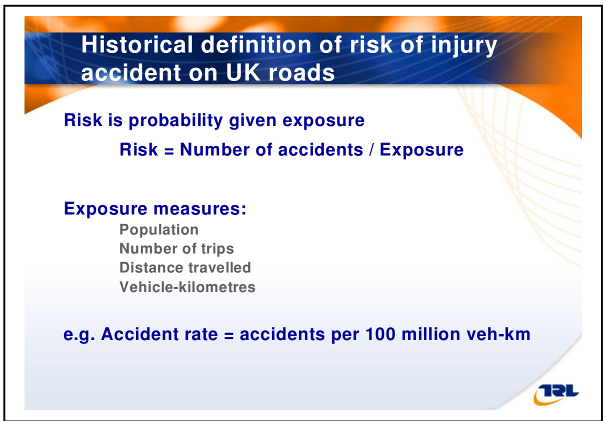
Kennedy, Janet
TRL,
United Kingdom

Managing risk on UK roads

Road safety increasingly involves risk assessment and management rather than simply accident analysis and safety audit. This means that not just the probability of an accident occurring but also the consequences of that accident and its acceptability are taken into account.
Risk assessment can be quantitative, semi-quantitative or qualitative, depending on the availability of data and the type of outcome considered. For an individual road, the number of fatal and serious casualties per 100 million vehicle-kilometres is an appropriate measure as it allows the comparison of different roads and provides a basis for comparison with related third party risks.

As an example, a risk assessment methodology for the safety barrier requirements of roadside objects is being developed that will quantify any changes in risk to road users from introducing new equipment alongside roads, for example, passively safe infrastructure. At the same time, it will be possible to quantify risk to third parties such as those from errant vehicles reaching a building, a railway or another road. The risk of an incident in a tunnel such as a fire can be compared with that of a road accident in the same tunnel.
As part of the risk assessment, it is necessary to assess the tolerability of risk. The usual methods in road safety are 'bootstrapping', professional judgement and cost-benefit analysis. 'Bootstrapping' uses the levels of risk tolerated in the past to evaluate future risk. Professional judgement is used by practitioners to determine the acceptability of risk within their areas of expertise. Risk assessment can form a basis for investment decisions, by providing practitioners with a methodology for prioritising sites for remedial action, for example via cost-benefit analysis.

Once risks have been assessed, the next step is to control them. Risk assessment and management should be seen as one element of an overarching safety management system.



Types of risk assessment

- Qualitative
- Semi-quantitative e.g. risk matrix
- Quantitative
  - Fault tree analysis - frequency of undesired event occurring
  - Event tree analysis - potential consequences surrounding undesired event and their probability of occurrence
- Risk=probability of hazard occurring x consequences
  - E.g. Safety risk = probability of a fatal or serious accident per 100 million vehicle-kilometres
  - Or use equivalent fatalities

Risk Assessment Matrix

LIKELIHOOD	Negligible	Minor	Serious	Single fatality	Multiple fatalities
Likely	C	B	A	A	A
Probable	D	C	B	A	A
Possible	E	D	C	B	A
Improbable	E	E	D	C	B
Remote	E	E	E	D	C

CONSEQUENCES (Severity)

Probability of hazard occurring

Probability Category	Description	Frequency
1	Frequent – likely to occur several times	1 in 10
2	Probable – an event that has occurred or is expected to occur	1 in 100
3	Occasional – an event that is likely to occur	1 in 1000
4	Remote – unlikely although conceivable	1 in 10,000
5	Improbable – unlikely that the occurrence will be experienced	1 in 100,000
6	Extremely Remote – so unlikely that probability is close to zero	1 in 1 million

Consequences of hazard occurring

Severity category	People	Economic	Assets	Environment	Reputation
1	Multiple fatalities	Total loss	Extensive damage	Catastrophic	Major international impact
2	Fatality	> £1 million	Major damage	Widespread damage	Major national impact
3	Severe	< £ 1 million	Localised damage	Severe	Considerable impact
4	Major	< £100,000	Minor damage	Major	Limited impact
5	Minor	<£10,000	Slight damage	Short term damage	Slight impact
6	Insignificant	<£1000	Little or no damage	Minor	Negligible impact

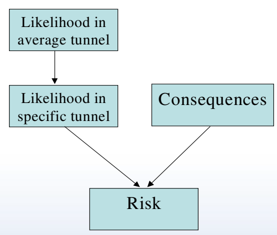
Cost per casualty – fatal £1.4m, serious £0.15m, slight £11,000, damage only £1500

Example of hazard identification – risk of road accident in tunnel

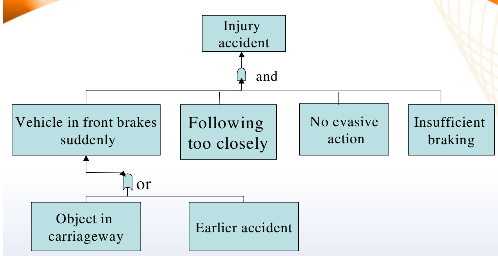
Accident types in tunnel or on approach / exit

- Single vehicle collisions (e.g. vehicle hitting kerb, side wall or roof)
- Shunts or side collisions
- Head-on collisions (if bi-directional)
- Pedestrians

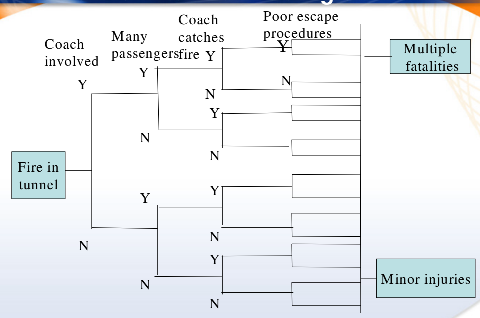
Example of risk assessment – safety risk in tunnel



Example of possible fault tree for rear shunt accident in tunnel



Example of possible event tree for accident in tunnel leading to fire



Predicted incident frequency and "risk" in tunnel

Accident / incident type	Frequency (incidents per year)	Fatal and serious casualties per 100 million veh-km
Shunt / lane changing	0.4	3.9
Single vehicle	0.1	1.4
Head-on	0.4	6.4
Pedestrian	0.03	0.5
Fire	0.12	4.8

Example of Risk Assessment Methodology for errant vehicle

- **Risk of hitting structure**
  - Probability of leaving carriageway – flow, alignment
  - Probability of reaching object – speed, dimensions, setback, intervening ground etc
  - Consequences
- **Risk to 3rd parties**
  - Railway or other road below
  - Crossover of median restraint (injuries to vehicle occupants on opposite carriageway)
  - Public building close to road
  - Maintenance / emergency workers
  - Roadside vehicle / pedestrians

Tolerability of risk

- Risk assessment technique action plans
- Professional judgement
- Bootstrapping
- UK Health and Safety Executive tolerability criteria
- Cost benefit analysis

Risk control

- Eliminate risk
- Combat risk at source by engineering control measures – traditionally prescriptive
- Minimise risk e.g. reduce exposure to hazards
- Mitigate the consequences (e.g. traditional or passively safe)

Risk Control Framework

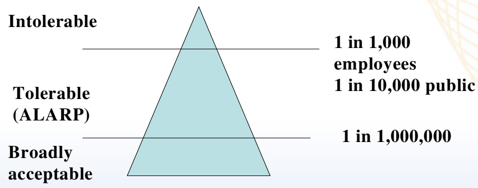
Hazard	Control	Probability of occurrence	Severity	Exposure	Risk to individual	Number at risk	Total risk

For each control measure:

- Check risk is tolerable
- Evaluate benefit / cost

Criteria given by UK Health and Safety Executive

Chance of death per exposed individual per ye

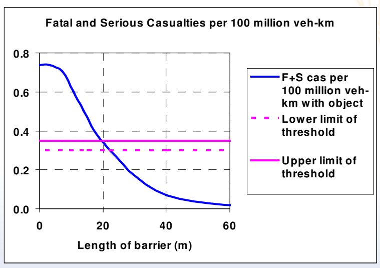


ALARP = As Low As Reasonably Practicable

UK gantry hit

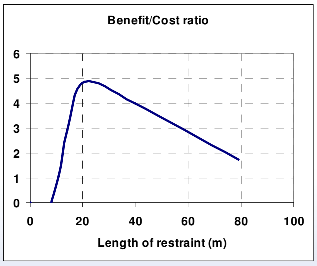
- How long does the barrier need to be?
- What level of containment is needed?

Example: Concrete plinth for gantry at 5.5m



Restraint to be at least 20m in length (ahead of object)

Concrete plinth for gantry – Benefit/Cost ratio



Optimum restraint length 21m ahead of object to satisfy risk criterion

Road safety is no accident

End of Presentation

Presented by Janet Kennedy
Principal Scientist
Tel: 01344 770953 Email: jkennedy@trl.co.uk

Matena, Stefan
Federal Highway Research Institute,
Germany

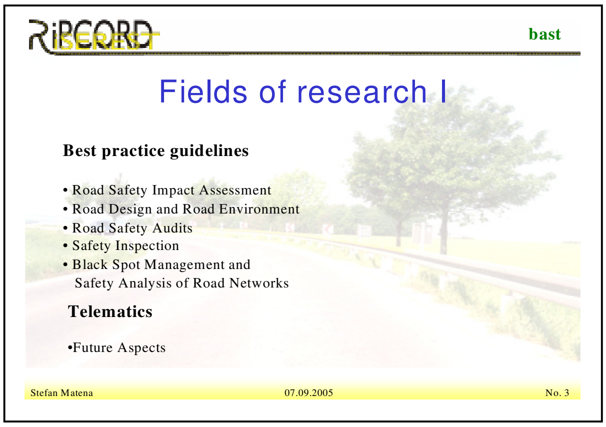
Road classification practice in Europe and the chance of implementing standardised and self-explaining roads (presentation from the project RIPCORD)

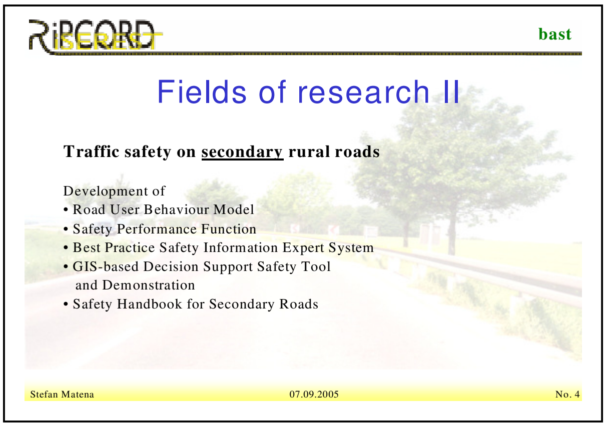
Regarding traffic safety, rural roads are a comparatively unsafe road type. European statistics still show a percentage of road casualties on rural roads of nearly 70%. A large proportion of these accidents is caused by inappropriate behaviour of the drivers.

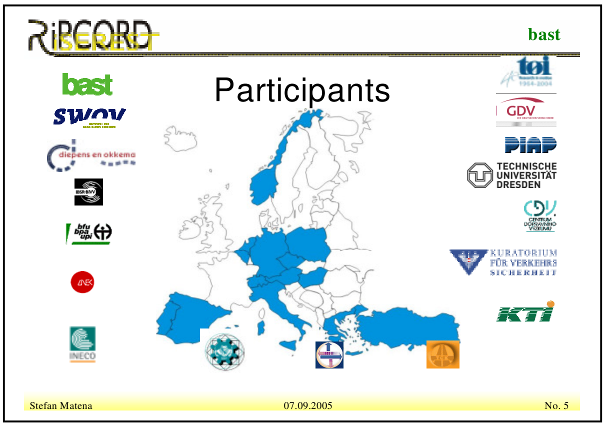
The concept of self-explaining roads is perceived to have an influence on the driving behaviour of the drivers - e.g. choice of speed - and could thus reduce the number of accidents. The idea behind this concept is that if drivers intuitively know how to behave, the number of accidents would decrease. To come up to the effect, roads will have to have a standard design in accordance with the function of the road. Therefore it is necessary to define few types of roads, which are among themselves as uniform as possible and as distinctly different from other types of roads.
In most European Countries, road design is strongly influenced by a various number of different road types, which are in some cases influenced by numerous levels of road authorities. A European approach to develop self-explaining roads therefore has to consider current practices of categorisation and design in the member countries.

Within the 6th RP project RiPCORD-iSEREST, a survey on the current practice on road categorisation and the effects of the categorisation on road design has been carried out. First results indicate that the practice of categorisation and the number of categories used widely differ between countries.

This presentation gives an overview on current road categorisation practice and the chance of implementing self-explaining roads.



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Participants
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SWOV
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GDV
PIAP
TECHNISCHE UNIVERSITÄT DRESDEN
KURATORIUM FÜR VERKEHRS SICHERHEIT
KTI
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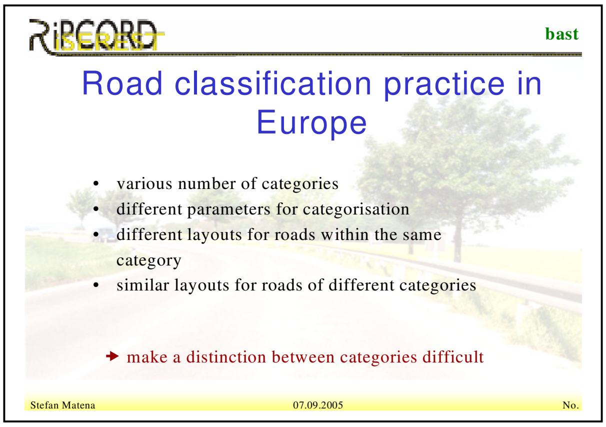
RiPCORD iSEREST
bast
Road classification practice in Europe
various number of categories
different parameters for categorisation
different layouts for roads within the same category
similar layouts for roads of different categories
make a distinction between categories difficult
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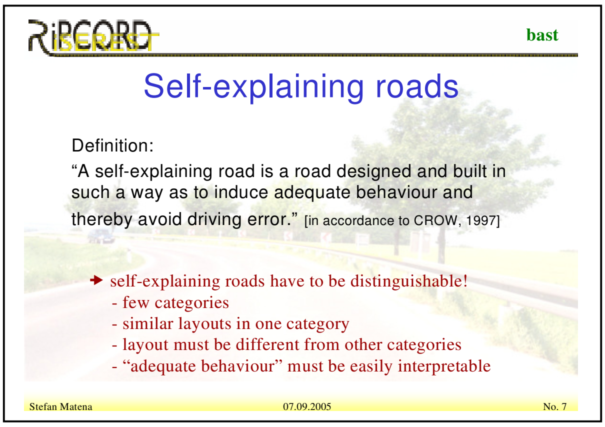
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Self-explaining roads
Definition:
"A self-explaining road is a road designed and built in such a way as to induce adequate behaviour and thereby avoid driving error." [in accordance to CROW, 1997]
self-explaining roads have to be distinguishable!
- few categories
- similar layouts in one category
- layout must be different from other categories
- "adequate behaviour" must be easily interpretable
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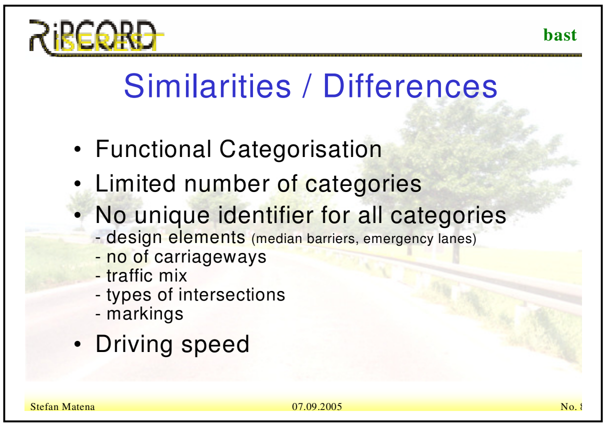
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Similarities / Differences
Functional Categorisation
Limited number of categories
No unique identifier for all categories
- design elements (median barriers, emergency lanes)
- no of carriageways
- traffic mix
- types of intersections
- markings
Driving speed
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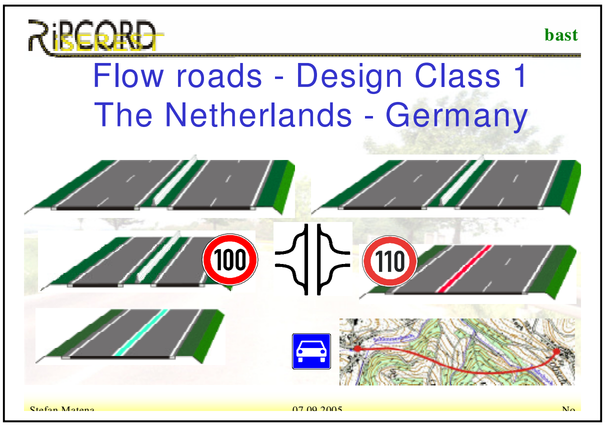
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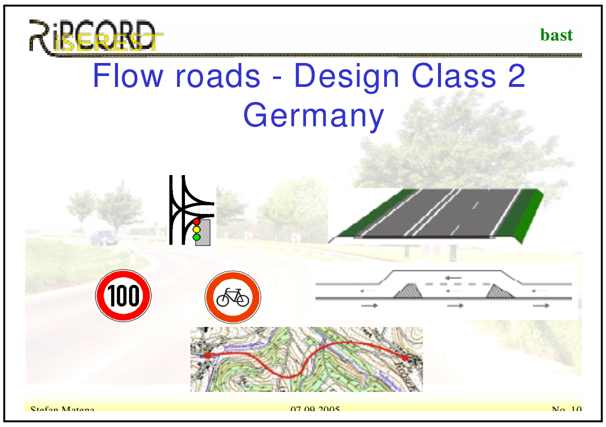
Flow roads - Design Class 1
The Netherlands - Germany
100
110


RiPCORD iSEREST
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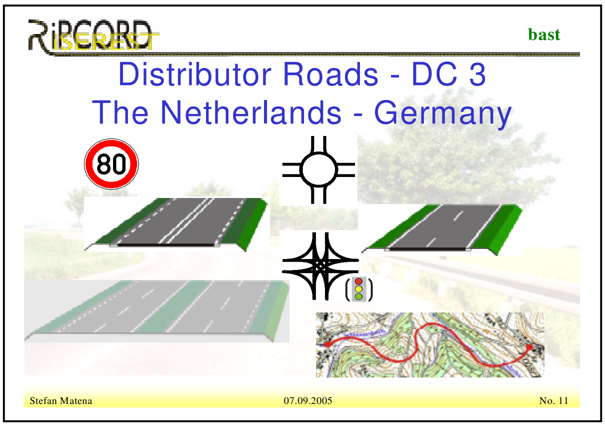
Flow roads - Design Class 2
Germany
100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Distributor Roads - DC 3
The Netherlands - Germany
80
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RiPCORD iSEREST
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Access Roads - Design Class 4
The Netherlands - Germany
60
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bast
Further research steps
• Identifiers for self-explaining roads
• Application on existing road network
• Handling of roads not matching the categories
• Best practice guideline October 2007
www.ripcord-iserest.com
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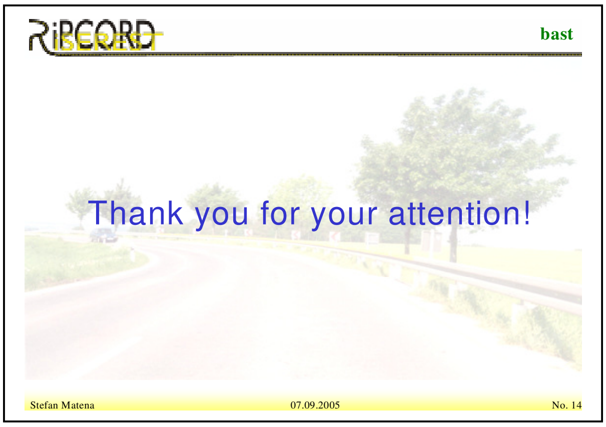
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Thank you for your attention!
Stefan Matena
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No. 14

Workshop 6

ITS and HMI

Leitung

Jean-Pierre Medevielle (INRETS) und Marion Wiethoff (SWOV)

Vorträge

Bauer, Anne (BASt)

“Impact of cruise control on traffic safety, fuel consumption, and environmental pollution - First results from IMPROVER subproject 3 “

Bekiaris, E., Gemou, M., Panou, M. (CERTH/HIT)

“Towards an integrated in-vehicle HMI for ADAS and its application for lateral collision warnings“

Gelau, Christhard (BASt)

“Overview on the ‘Network of Excellence’ HUMANIST”

Gelau, Christhard (BASt)

“Experts perform safer: effects of learning on the efficient use of in-vehicle technology while driving“

Bauer, Anne
Federal Highway Research Institute,
Germany

Impact of cruise control on traffic safety, fuel consumption, and environmental pollution

- First results from IMPROVER Subproject 3 -

Introduction

The **IMPROVER project** (Impact Assessment of Road Safety Measures for Vehicles and Road Equipment) is a study commissioned by the European Commission (Directorate General Energy and Transport) to examine several aspects of road safety. This project that consists of four independent subprojects is not part of the framework program of the EC. BASt is the co-ordinator of the whole project as well as of subproject 3 that deals with the impact of Cruise Control (CC) on traffic safety, fuel consumption, and environmental pollution.

Cruise Control is a driver assistance system that automatically maintains a driving speed that has been determined by the driver. This system is deactivated as soon as the driver brakes. It is possible to drive faster than the set speed without deactivation of the system by pressing down the accelerator. CC must not be confused with a speed limiter which strictly prohibits to drive faster than a fixed or driver selected speed limit.

Currently, the type approval of vehicles equipped with CC is not subject to any specific national or international regulation.

Potential benefits of CC are an enhancement of driving comfort, a voluntary compliance with speed limits, a reduction of fuel consumption and a reduction of exhaust gas emissions. On the other hand, the driver might be tempted to accept smaller between-vehicle distances because he tries to avoid braking. Furthermore, in case of emergency braking, the reaction time might be prolonged because the driver took his feet away from the pedals and / or because the driver was inattentive.

A further development of CC is 'Adaptive' or 'Intelligent Cruise Control' (ACC). This advanced driver assistance system combines CC with an automatic maintenance of a predefined distance to the preceding vehicle. In this way, ACC is able to compensate for some disadvantages of CC. On the other hand, there may be additional risks like an over-reliance of the driver on the system and an over-estimation of the system functions. In contrast to the 'simple' CC system, a lot of research has been done to evaluate the more complex ACC system. It has to be noticed that the effects of CC might be completely different from that of ACC. Therefore, it is not possible to simply transfer the results of research on ACC to CC.

The number of vehicles equipped with CC is much greater than that of vehicles equipped with ACC. According to the DAT-Veedol-Report (2002), in 2001, 14% of the vehicle fleet and 15% of the new vehicles in Germany were equipped with CC. Especially in trucks, a CC system is installed because it it is believed to allow for a compliance with legal speed limits saving fuel at the same time. Currently, it is not known whether the activation of a CC system contributed to (severe) accidents because this information is not gathered in the accident statistics.

In the following presentation, first results of IMPROVER subproject 3 are represented. The project is scheduled to end in May 2006.

Bekiaris, E., Gemou, M., Panou, M.
CERTH/HIT,
Greece

Towards an integrated in-vehicle HMI for ADAS and its application for lateral collision warnings

1. Introduction

Today, many Advanced Driver Assistance Systems (ADAS) and In-vehicle Information Systems (IVIS) exist, aiming at supporting the driver and thus enhancing the road safety. However, each one of these systems, comes with its own HMI which is common for all drivers, independent of personal limitations or preferences that are significantly different for different driver groups (such as young, elderly, disabled, etc.) and even for drivers belonging to the same group). Moreover, there are conflicts reported between different independent systems, which unavoidably increase the workload and distraction of the driver, causing negative results to traffic safety.

There is a clear need for integrated and personalised information provision coming from the vehicles ADAS and IVIS. AIDE Integrated project (IST-1-507674-IP) designs, develops and validates a generic adaptive integrated driver-vehicle Interface aiming to the reduction of driver workload and to the enhancement of safety. Within AIDE, a review of existing HMIs of various systems was performed, as a first step, in order to identify the gaps and drivers needs from the existing in-car driver support systems.

Results form 8 European projects that have been evaluated in the past are included, regarding user acceptance of the system. The results are coming from drivers that participated in trials and were then asked to evaluate a system. Four templates were produced and used, one per HMI type: visual, acoustic, haptic and combinational. The projects that were examined on the user needs of **specific driver cohorts**, are listed below:

- Novice drivers (TRAINER, IN-ARTE, TRL project report)
- Elderly drivers (EDIT, TELSCAN, AGILE, TRAVELGUIDE)
- Disabled drivers (TELAID, TELSCAN, CONSENSUS, TRAVELGUIDE)
- Foreign drivers (TRAVELGUIDE)

Each of the above projects evaluated specific ADAS/IVIS functionalities; the HMI assessed corresponds to a different system. 13 principles on HMI and 50 guidelines have been collected and/or issued from a wide literature survey.

Furthermore, a questionnaire-based survey was conducted with 16 experts (coming mainly from the industrial sector) aiming to identify from an automotive expert point of view, which are the most important user needs and expectations towards future HMI and how to design optimized, adaptive interfaces (HMI) for easy, safe and effective use.

In parallel, tests on alternative HMI mock-ups have been executed with drivers in the context of LATERAL SAFE (LS) subproject of PReVENT IP in three Pilot sites (VOLVO, VTEC and CERTH) to identify which is the most optimum solution for each of the three intended application targeting lateral safety. These applications are namely:

a) A Lateral and rear area monitoring (LRM) application enhancing the driver's perception and decreasing the risk of collision in the lateral and rear area of the vehicle; in particular when the driving task is critical because of limited visibility or critical workload of driver's attention.
b) A Lateral collision warning application (LCW) that detects and tracks obstacles in the lateral and rear field and warns the driver about an imminent risk of accident (collision, road departure, merging etc.). This application can be stand-alone or improved by the surrounding model developed in the monitoring application.
c) A stand-alone lane change assistance system (LCA) with integrated blind spot detection assisting the driver in lane change maneuvers while driving on roads with more than one lane per direction.

All HMI pilots have been performed upon common application scenarios and common evaluation methodology defined in the context of LS subproject.

In CERTH/HIT Pilots, that were executed in a semi-dynamic simulator, HMI alternatives were evaluated by users upon the determined warning strategies addressing cautionary and imminent warnings. Cautionary warnings were provided when $1<TTC\leq 4$ and imminent warnings when $TTC\leq 1$, where TTC is the Time to Collision of the ego vehicle with the surrounding vehicles.
The HMI alternatives that were evaluated for the cautionary level of warnings are the following:

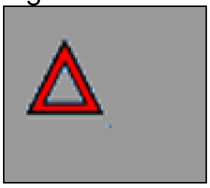
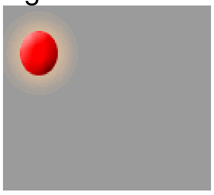
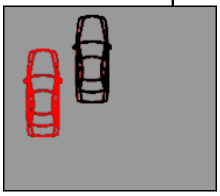
Symbols of Warning		
(a) Triangle	(b) Configuration with leds	(c) Two vehicles in parallel
		

Table 1: HMI alternatives for the cautionary warnings.

All above warnings were provided in the outer side of the side mirror of the ego-vehicle.

Additionally the warnings provided for the imminent risks were the following:

- an auditory warning (Wierwille sound, indicating imminent danger, in general), and
- a visual warning (three lights, two for the left/ right side of the vehicle and one for the area behind it), in order to direct driver's focus of attention to the appropriate road area.

The visual warning used for the imminent case is presented below.

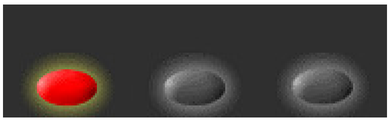


Figure 1: Imminent warning implemented below the central mirror in the CERTH/HIT simulator.

In total, 18 subjects, 10 male and 8 female were reandomly assigned in three experimental groups. Within Group 1, each of the three possible causes for system provision of a cautionary warning was indicated by a different warning symbol. Within Group 2, there was a more generic discrimination of traffic situations and warning symbols (discrimination between lane change driving task, irrespectively of the relative position of the other vehicle, and drifting of the other vehicle). Finally, within Group 3, a single warning symbol was provided in any case of traffic danger.

Their average driving experience was 10.89 years, with a standard deviation of 3.69 years. Their average last year mileage was 15,888 km, with a standard deviation of 5,707 km. 9 of the subjects currently driver a car type A, 8 a car type B and one a car type C. Only one of the subjects had previous experience with ADAS, and that was a cruise control system.

The typical traffic scenarios that were tried in the HMI tests, were: (a) lane change-1, where the driver of the **ego-vehicle** (the black one) intends to enter into a lane which is occupied by another passing vehicle, (b) lane change-2, where the driver of the **ego-vehicle** (the black one) intends to enter into a lane whilst another vehicle is stagnating on the blind spot of the subject vehicle and (c) drifting of another vehicle to the lateral area of the ego-vehicle whilst the driver moves on his/her lane. These traffic scenarios are graphically presented in the following table.

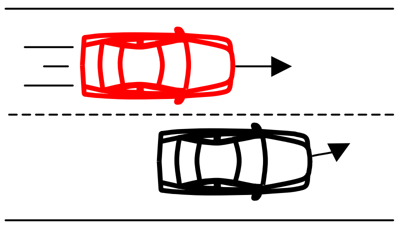
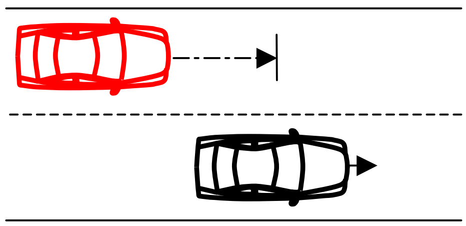
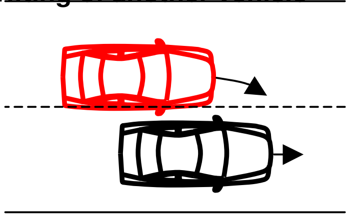
Traffic scenario	Related warning system	Danger of incident risk	
		Cautionary warning	Imminent warning
(a) Lane change-1 	LCA	TTC = 4sec	TTC = 1sec
➢ **Lane change-2**  (stagnation to the blind spot)	LCA-blind spot		
(c) Drifting of another vehicle 	LCW	TTC = 4sec	TTC = 1sec

Table 2: Related warning systems and type of warnings (imminent vs cautionary) in respect to traffic situations and relative position of other vehicles.

5 traffic scenarios were presented within each test ride in total, addressing the above cases (
Table 2).

Lane change imminent: The driver has to overtake a very slowly moving truck, while on the left lane there is a row of vehicles moving at 70km/h and at a distance of 20 m. This condition generates more imminent warnings, as the time gap of the vehicles row is short (~ 1 s).

Blind spot: A vehicle stagnates at the blind spot of the ego-vehicle. After a while there is a very slowly moving truck on the right lane and the ego vehicle has to successfully overtake it. This scenario was to generate both imminent and cautionary warnings. The imminent warnings were generated in case of lane change intention.

Drifting imminent: A vehicle in the left lane suddenly starts drifting towards the ego-vehicle with a lateral velocity of 1.5 m/s.

Lane change cautionary: The driver has to overtake a very slowly moving truck, while on the left lane there is a row of vehicles moving at 60km/h and at a distance of 30 m. This condition generates more imminent warnings, as the time gap of the vehicles row is longer (1.8 s).

Drifting cautionary: A vehicle in the left lane suddenly starts drifting towards the ego-vehicle with a lateral velocity of 0.5 m/s.

The road type used for the simulator scenarios was a motorway with two lanes per direction. Each lane has a width of 3.9 m. The total driving distance was 6776 m per ride.
The subjects were instructed to drive normally at the right lane, trying to enter the vehicles row on the left lane.
Prior to the test, subjects had to drive a warm up session. This was on the same road as the experimental test ride, with a vehicle row on the left lane, driving at 60 km/h, at a distance of 30 m. Subjects were getting warnings by the system, the same as those to be provided by the experimental ride, so that they could get acquainted with the system. Subjects were asked to try to perform successful lane changes, entering the vehicle row on the adjacent lane.

All users in all Pilots sites performed trials with the foreseen scenarios, with and without warnings. The main validation objective of the HMI tests was the verification of the needs and acceptance of the LS HMIs concept (individual applications), before and after the tests performance. The HMI evaluation was subject to both subjective and objective measurements. For the identification of a priori user needs, a series of pre-test questionnaires was distributed to the foreseen trials users, whereas for the final subjective assessment of the LS HMI(s) acceptance, a series of post-test questionnaires was distributed to the end-users. A cross reference was performed between the two stages of trials. In addition, the dependent variables for evaluating driving performance were:

- the number of received warnings and level of compliance;
- the number of accidents or successful manoeuvrings;
- the minimum TTC and headway values when performing a manoeuvre;
- the timing for taking an evasive action in case of other vehicle drifting.

2. Results on ADS/IVICS HMI of users and experts

2.1 Users' results

The main results are presented per HMI type, as well as per driver cohort.

- Visual HMI:
  - Visual warnings should be used as secondary warnings, accentuating the content of the other warning modes.
  - Icons in HUDs should correspond to the actual obstacle size, where possible.
  - Flashing LEDs should be placed at the rear view mirror (higher detection rates) or to the side of the windows or at side mirrors (for directional warnings; lateral functions).
  - Visual warnings are not adequate for drowsy drivers.

- Acoustic HMI:
  - A tone preparing the driver for a speech message is needed, to attract attention.
  - A 'repeat' button for the repetition of the last speech output is needed.
  - Different sounds for different warnings may be used, but no more than two, so that the driver can remember what each one means.
  - The type and intensity of the auditory warning must always be relevant to how serious is the situation and the risk the car is exposed to.
  - The type of sound must coincide with the nature of the warning, e.g. for lane departure warning an appropriate sound would be a directional rumble strip sound.

- Haptic HMI:
  - Rumble strips sound emulation is sufficient; there is no need to actually vibrate drivers seat.
  - Seat belt vibrations is a discrete warning mode that has been so far under-researched.
  - Vibrations should have adjustable frequencies and intensities, depending upon the situation and the driver's characteristics.

- Combinational HMI:
  - In cases that an imminent risk or risk cause does not exist, the visual warning should exclusively be activated, whereas for really critical simulations, additionally acoustical and haptic warnings are needed.
  - An acoustic signal preceding a visual message is helpful to attract attention to the visual message.

Concerning the novice drivers specifically, the following main points were identified:

- There is an indication on the use of 'hidden' mode of warning (i.e. haptic or acoustic sounds; not explicit voice or written messages), due to 'passenger effect'.
- There is a need for earlier warnings, especially in the longitudinal axis, because of lack of attentional focus and proper scanning techniques.

- Preference for icons over text is shown, but for lane departure, both text and audio messages are preferred.

For the elderly drivers, the most important user needs are listed below:

- Elderly drivers reaction time is typically (not always) longer than the mean driver (up to twice as long), thus there is a need of early warnings.
- Radio and mobile phone, SMS, etc. operations cause proportionally higher workload to them.
- Large buttons (24mm) for ADAS/IVICS operation are proposed, when fast actions are required (i.e. 4mm).
- The operation of large buttons increases steering frequency. On the contrary, small buttons may lead to temporary "frozen" position of the steering wheel. A good, compromise solution is to use buttons of 10mm.
- The ACC headway parameter must be adjustable (particular motor problems may require earlier warnings). Drivers with special needs prefer longer headways (difference up to 0.7 seconds from the average headway).
- Controls requiring simultaneous pushing and rotation should be avoided.
- For operations requiring precise selection (i.e. ISA/ACC speed), discrete rotary controls are better than push buttons.

Finally, limited information on tourists drivers' needs could be gathered, which follows next:

- The radio function causes some extra workload.
- Multilinguality and personalisation of traffic info services are rated very high.
- Preference is on icons than text, due to language barriers.
- Preference is on earcons than voice messages, due to language barriers.

A final issue of critical importance though that should be stressed out, is that when developing a multi-ADAS HMI, the first step is to prioritize the importance of each ADAS/IVIS system and thus the most critical warning in terms of driver safety.

2.2 Experts results

The following conclusions can be drawn concerning the experts' assessment on the user needs on in-vehicle HMI, which are presented per system functionality.

- Lateral Control Systems

Usually, no device is demanded by the system for the input, while for the output most popular device proposed was the led light on the outer driver's mirror. More preferences are shown in the figure below.

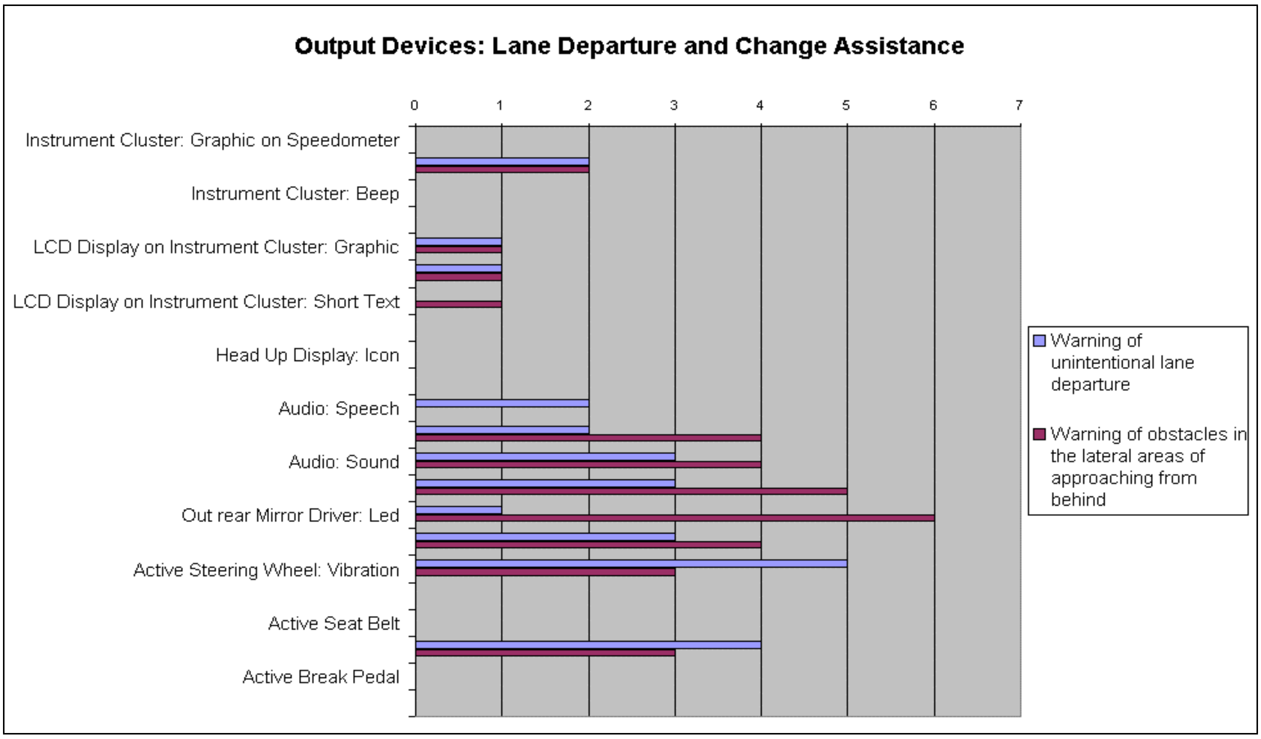


Figure 2: Output devices ranking by experts, for Lane Departure and Change Assistant systems.

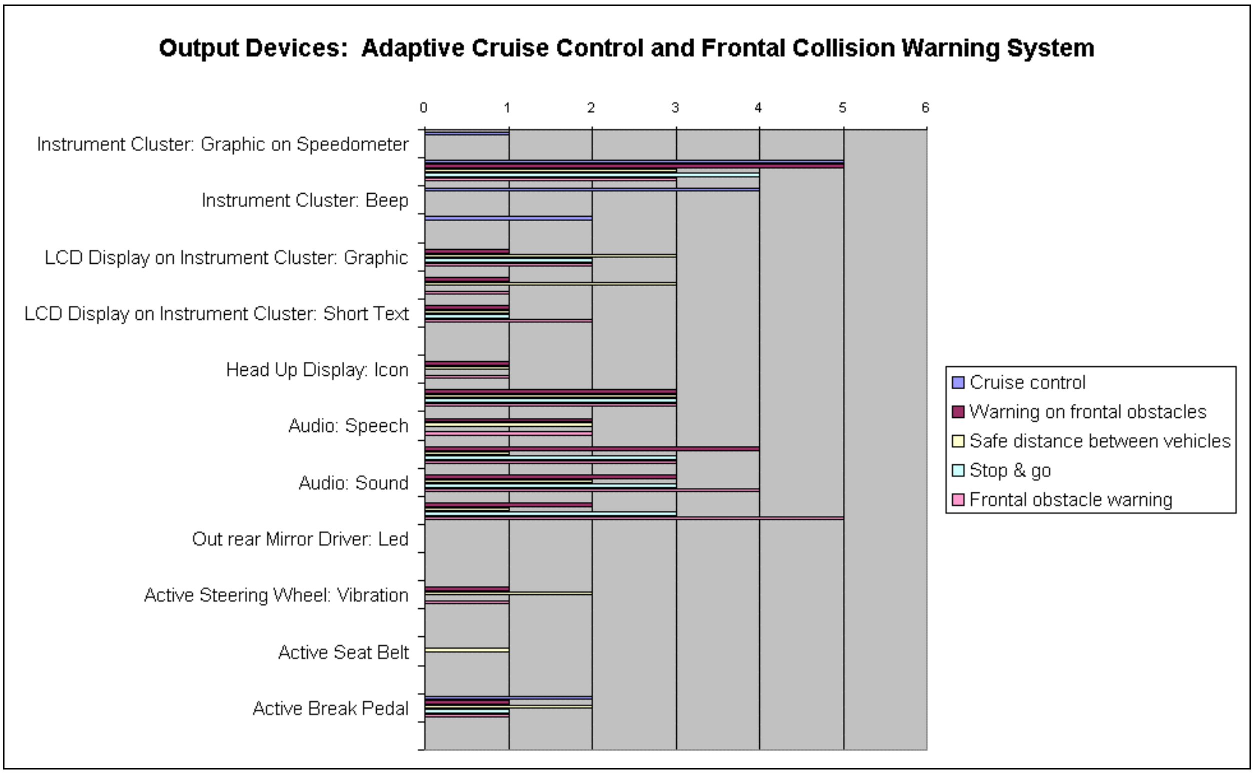


Figure 3: Output devices ranking by experts for Adaptive Cruise Control and Frontal Collision System.

Looking at the above figure, it can be said that for lateral control systems auditory and haptic modes of warning are preferred over visual ones.

- Longitudinal Control Systems

The most wanted input mode is buttons located either on the steering wheel or on the dashboard. When it comes to the output devices proposed there is a great variety, as shown in the following figure:

- Vision Enhancement Systems

The proposed input devices are lit buttons on the dashboard, while for the output devices there is a preference for the graphics on Head Down Display, but for the Vulnerable Users and Pedestrians Detection systems, auditory modes of warning are also on the top of the preferences.

- Driver Monitoring Systems

For such systems, no device is demanded by the system for the input. As for their output devices, auditory modes in terms of beep and other sounds, as well as haptic ones are the ones that have been more highly rated (Figure 3).

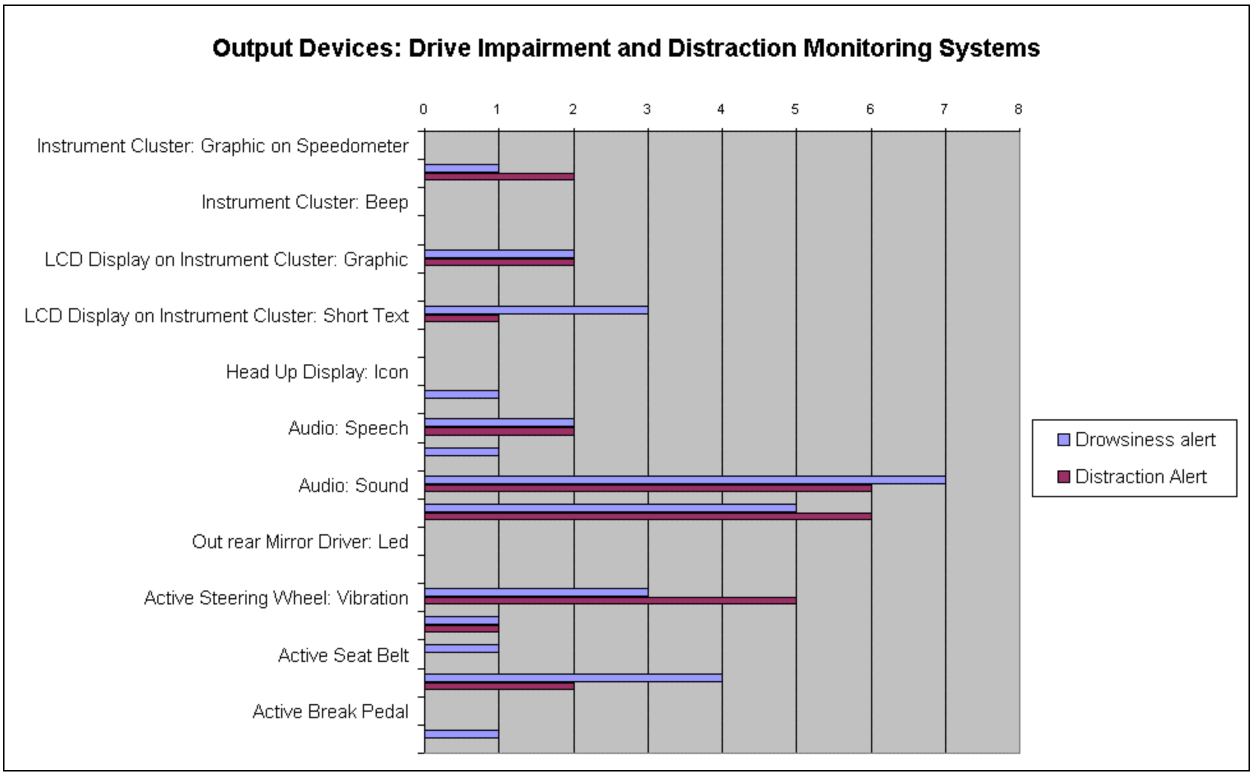


Figure 4: Output devices for Drive Impairment and Distraction Monitoring systems.

Finally, for the adapted, integrated HMI, the experts' opinion in threefold:

1. Keep eyes on the road:

- The visual interface should be located within the field of view of the driving task, utilising peripheral vision friendly visual icons, and microphons in a location where speaking is possible in the direction of the field of view.

2. Keep hands on the wheel:

- Buttons and switches should be placed on the steering wheel.

3. Keep mind on driving:

- Primary driving modalities must be placed close to the view on the road (HUD or side mirrors); secondary functions can be provided with rotary, simple buttons or visual displays in the centre of the dashboard, accessible even to the co-driver.
- Frequently used functions (i.e. weather, radio/CD) must be of direct access with the help of respective buttons.
- Priority setting should be possible for the incoming message and possibility of switching from one channel to another, according to driver needs.

3. Results from PREVENT-LS CERTH/HIT pilot

The following table gathers all derived results from the CERTH/HIT HMI tests according to the users' subjective ratings, presented in the above section. It refers to the results addressing only the HMIs used for the cautionary level. The users' ratings have been classified per characteristic scenario performed, addressing respectively the three LS applications (LCA, LCA-BLIND SPOT and LCW), per parameter evaluated and per HMI tested per case.

Scenario	Parameter	Cautionary warnings		
		Triangle Mean (SD)	Light Mean (SD)	Cars Mean (SD)
LCA-Blind spot –Lane change 2 scenario	**Time Consuming/Noticeability**	0.67 (1.21)	1.50 (0.55)	0.83 (1.17)
	Interference with driving task	0.00 (0.89)	-0.17 (1.47)	0.17 (1.47)
	Confusion	1.17 (0.98)	0.17 (1.33)	1.67 (0.52)
	Layout	0.83 (1.47)	0.00 (1.10)	1.00 (0.89)
	Comprehension	1.00 (1.55)	0.33 (0.82)	1.50 (0.84)
	Adequateness of symbols	0.83 (0.98)	0.17 (1.47)	1.00 (1.26)
	Direct and clear indication of action	1.33 (1.21)	0.33 (1.86)	1.50 (1.22)
	Acceptance-Usefulness	1.07 (0.68)	0.77 (1.13)	1.23 (0.56)
	Acceptance-Pleasantness	1 (1.01)	0.38 (1.15)	0.83 (0.72)
LCW-Drifting scenario	**Time Consuming/ Noticeability**	0.83 (0.98)	0.67 (0.82)	0.83 (0.98)
	Interference with driving task	-0.83 (0.75)	0.17 (0.41)	0.00 (1.10)
	Confusion	1.00 (1.67)	0.67 (0.82)	0.33 (0.52)
	Layout	0.17 (1.33)	0.67 (0.82)	-0.50 (0.84)
	Comprehension	1.17 (0.75)	0.83 (0.98)	-0.17 (0.75)
	Adequateness of symbols	1.17 (0.75)	0.50 (0.84)	-0.17 (1.33)
	Direct and clear indication of action	1.33 (1.63)	0.67 (0.82)	0.00 (1.26)
	Acceptance-Usefulness	0.87 (1.04)	0.83 (0.98)	1 (0.89)
	Acceptance-Pleasantness	0.83 (1.03)	1.2 (0.66)	1.23 (0.56)
LCA-Lane change 1 scenario	**Time Consuming/ Noticeability**	0.83 (0.98)	0.00 (0.63)	0.33 (0.52)
	Interference with driving task	-0.33 (0.82)	-0.33 (1.03)	0.17 (0.98)
	Confusion	1.17 (0.98)	0.00 (1.26)	0.17 (0.98)
	Layout	1.17 (0.75)	-0.50 (0.84)	0.33 (0.52)
	Comprehension	1.33 (0.52)	0.00 (1.26)	0.50 (0.55)
	Adequateness of symbols	1.33 (0.82)	0.33 (0.82)	0.33 (0.52)
	Direct and clear indication of action	1.83 (0.41)	-0.17 (1.33)	0.83 (0.98)
	Acceptance-Usefulness	1.5 (0.49)	0.33 (1.03)	0.67 (0.82)
	Acceptance-Pleasantness	1.21 (0.83)	0 (1.37)	1 (0.59)

Table 3: Consolidated results from CERTH/HIT HMI tests regarding HMIs used for cautionary warnings (scale -2: Lowest rating to +2: Highest rating).

In compliance with the CERTH/HIT Pilot results (subjective and objective), some recommendations follow below for the cautionary warnings:

- The outer part of the side mirror seems to be an appropriate location for the HMI LCA/LCW information/warnings.
- All tested solutions for the cautionary warnings have been rated positively in general; however, the "cars" symbol could be preferable if possible, except from the "drifting" scenario that is covered by LCW application.
- The type of the traffic scenario does not seem to play a significant role, in relation to the warning provided.

A similar table follows below regarding the users' subjective ratings regarding the imminent warnings. The reason for which the imminent warnings (light in the central mirror and warning sound) have not been evaluated per application scenario is the fact that the users' ratings were almost the same with no significant variations per scenario for the HMI used for the imminent warnings. Thus, the following table presents the average ratings for all scenarios tried per evaluation parameter.

Parameter	Imminent warnings	
	Light on central mirror	Warning sound
Time Consuming/ Noticeability	0.67 (0.91)	-0.12 (1.50)
Interference with driving task	0.41 (1.54)	-0.33 (1.03)
Confusion	0.94 (1.34)	0.72 (1.02)
Layout	-0.18 (1.42)	0.28 (1.07)
Comprehension	-0.12 (1.50)	1.11 (0.90)
Adequateness of symbols	0.12 (1.45)	0.67 (1.37)
Direct and clear indication of action	0.12 (1.69)	0.89 (1.23)
Acceptance-Usefulness	0.50 (1.11)	0.84 (1.04)
Acceptance-Pleasantness	0.47 (0.80)	0.07 (1.11)

Table 4: Consolidated results from CERTH/HIT HMI tests regarding HMI used for imminent warnings (scale -2: Lowest rating to +2: Highest rating).

Respectively, some recommendations follow below for the imminent warnings for the LCA and LCW applications:

- The "central mirror light" is considered at rather inappropriate in all scenarios cases and would have no impact at all, as stated during the evaluation, if there was no warning sound additionally.
- Wierwille warning sound is evaluated as intuitive enough.
- Despite the fact that especially in the "light" and "cars" group, the average minimum headway is not affected, it seems that the system, interfaced though the specific HMIs, has a positive impact on driving behaviour and safety in general. The same is also noticed in the minimum TTC to the forward car during the lane change, which was enhanced in the total sample, and within each group.
- In general, it seems that there is no significant change according to each experimental group concerning the results, which means that the users' were not affected in the evaluation of the HMIs they tested, if they had tried one, two or all three alternative systems per scenario, which rather strengthens the validity of the results presented above. The level of explicitness does also not play a significant role in any of the six aspects of workload. Thus, an as common as possible HMI should be used for the LCW and LCA applications, which is rather convenient, since it could offer a unique, cheaper and easier to be implemented solution.

In addition to the above mentioned, we should emphasise that these results have been consolidated with the results derived from the tests realized in the other Pilot sites (VTEC, VOLVO), to lead to the final recommendations and proposed solutions for the LS applications HMIs. Moreover, the limited number of the scenarios used during the evaluation is a factor implying that the results produced may be applicable for the specific scenarios used in the trials but should be generalized with caution for the applications as a whole. Additionally, in most cases, the variations in the users' ratings before and after the system's use are not such significant, which makes us conclude that the system may have a positive impact in general; however not a significant one. In fact, even in subjective ratings; fewer subjects select the negative effects after the ride. Finally, it should be also underlined that the above presented results should be filtered via the consideration that the use of the simulator may have an effect on the users' ratings (both subjective and objective), since it cannot reflect 100% the system, although the level of immersiveness with the user is considered to be quite good.

4. Conclusion

Validation studies of ADAS/IVIS HMI assessment have resulted in the urgent need for an improved HMI development, especially an integrated (multi-system) driving support system. Three issues must be considered as best practices for a successful multi-system HMI and these are the prioritisation of the most critical functions, the minimisation of erroneous messages and the possibility of customisation effects of the user to the system. Finally, the personalisation of warning/information messages to the driving habits of each driver is a key issue towards the reduction of road accidents.

This is the trend that is being adopted by almost all current initiatives which aim to implement road safety systems. As an example, in PReVENT IP, the link to AIDE IP concept around HMI implementation is a foreseen milestone and a coordinated attempt of integrating the HMIs of as many as possible subsystems according to the strategies and recommendations derived by AIDE has been already initiated.

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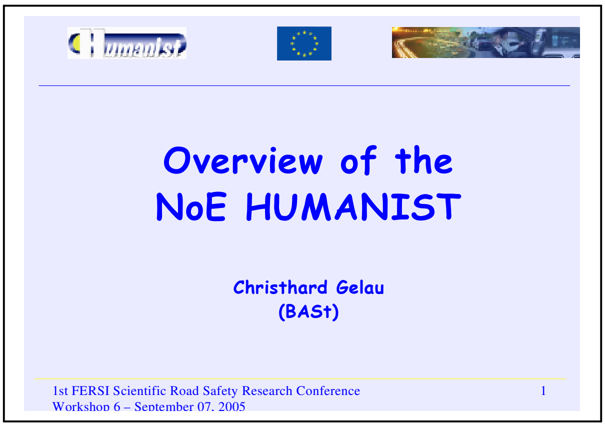
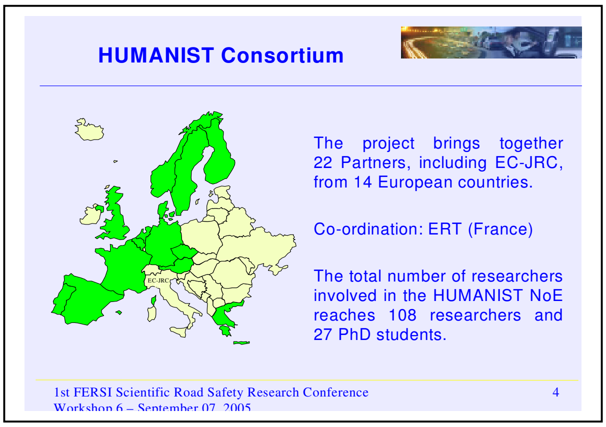
Overview on the 'Network of Excellence' HUMANIST

Modern In-Vehicle Information and communication Systems (IVIS) as well as Advanced Driver Assistance Systems constitute a real opportunity to support mobility and to improve road safety. Nevertheless, it is necessary to conceive them according to users' needs and requirements, in order to ensure their acceptability and to detect potentially undesirable effects of their implementation and use. In Europe considerable Human Factors and Cognitive Engineering competencies exist but these are scattered. To overcome this fragmentation of research capacities the "Network of Excellence" (NoE) HUMANIST gathers the most relevant European research institutes involved in Road Safety and Transport to improve road safety by promoting human centred design for IVIS and ADAS. The overall goal of the NoE HUMANIST is to create a European Virtual Centre of Excellence on HUMAN centred design for Information Society Technologies applied to Road Transport (IVIS and ADAS), with a coherent joint program of activities, gathering research, integrating and disseminating activities. This presentation gives an overview on the organisation of the NoE HUMANIST, the progress made so far and activities planned next.





HUMANIST Consortium

The competencies of the Humanist NoE researc

Scientific disciplines
- Human factors
- Ergonomics
- Cognitive sciences
- Engineering
- Social Sciences

Fields
- Road safety
- System design and evaluation
- Accident analysis
- Drivers training

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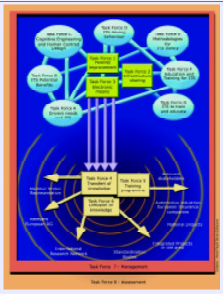
HUMANIST organisation

To progress towards the creation of an European Virtual Centre of Excellence,

HUMANIST Consortium has built a coherent joint program of activities, covering **research, integrating, spreading and management activities**.



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HUMANIST organisation

Research Task Forces
- to cover all the areas of knowledge required to investigate the various aspects of Human Centred Design.

Integration Task Forces
- to manage and to consolidate the NoE research structure.

Dissemination Task Forces
- to spread widely the knowledge from the NoE towards the relevant stakeholders.

Management Task Forces
- to assess the quality and the sustainability of the Network integration.

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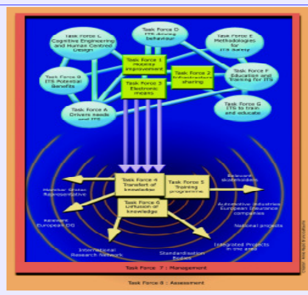
HUMANIST organisation



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HUMANIST organisation Research Task Forces

Production of states of the art research

Identification of main gaps in scientific knowledge

Definition of new relevant research issues

Converge towards a harmonious research programme with complementary approaches

Annual researcher exchange programme

Annual infrastructure sharing programme

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HUMANIST organisation: Integration Task Forces

Joint PhD Directions

Post-doc Positions

Mobility improvement

Inventory of infrastructures

Research infrastructure sharing

Common methodologies

Coordination of Exchange

Inventory of ethical laws

Induce and manage processes of change towards a durable integration of research capacities

Common database

Electronic means for knowledge sharing

Collaborative environment

e-learning

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HUMANIST organisation: Dissemination Task Forces

Members States representatives

Final users

Relevant European DGs

Insurance companies

Setting up of a User Network

Training actions

Events Organisation

European Universities

Exchange and interact with the outside world

Transport Service Sector

Scientific productions

Dissemination material

RTD Projects in the area

Electronic dissemination tools

Automotive industries

eSafety initiative

Standardisation Bodies

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HUMANIST organisation: Management Task Forces

A periodic internal review process

Elaboration of a business plan

Assess and guarantee the quality and the sustainability of the Network integration

An external review at the end of the 48 months

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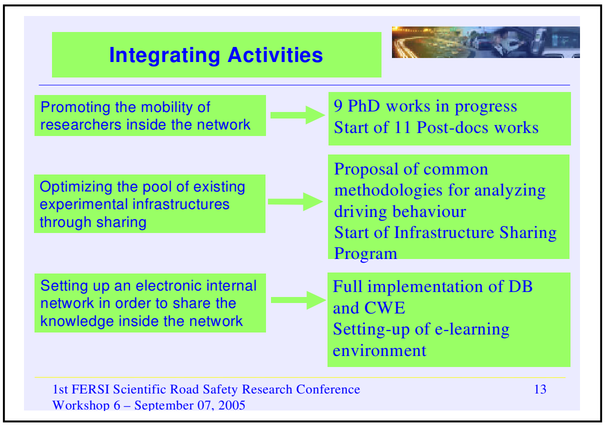
Integrating Activities
Promoting the mobility of researchers inside the network
9 PhD works in progress
Start of 11 Post-docs works
Optimizing the pool of existing experimental infrastructures through sharing
Proposal of common methodologies for analyzing driving behaviour
Start of Infrastructure Sharing Program
Setting up an electronic internal network in order to share the knowledge inside the network
Full implementation of DB and CWE
Setting-up of e-learning environment
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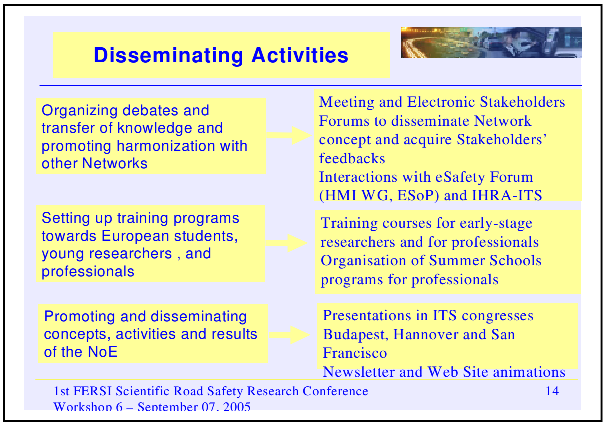
Disseminating Activities
Organizing debates and transfer of knowledge and promoting harmonization with other Networks
Meeting and Electronic Stakeholders Forums to disseminate Network concept and acquire Stakeholders' feedbacks
Interactions with eSafety Forum (HMI WG, ESoP) and IHRA-ITS
Setting up training programs towards European students, young researchers , and professionals
Training courses for early-stage researchers and for professionals
Organisation of Summer Schools programs for professionals
Promoting and disseminating concepts, activities and results of the NoE
Presentations in ITS congresses Budapest, Hannover and San Francisco
Newsletter and Web Site animations
1st FERSI Scientific Road Safety Research Conference
Workshop 6 – September 07, 2005
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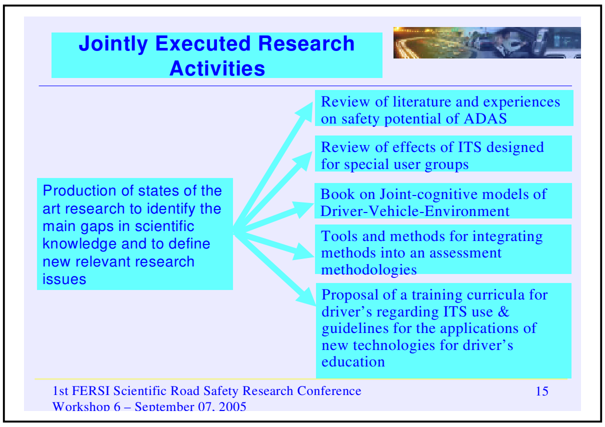
Jointly Executed Research Activities
Production of states of the art research to identify the main gaps in scientific knowledge and to define new relevant research issues
Review of literature and experiences on safety potential of ADAS
Review of effects of ITS designed for special user groups
Book on Joint-cognitive models of Driver-Vehicle-Environment
Tools and methods for integrating methods into an assessment methodologies
Proposal of a training curricula for driver's regarding ITS use & guidelines for the applications of new technologies for driver's education
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Jointly Executed Research Activities
Annual programmes of researcher exchange
Annual programmes of infrastructure sharing
Selection of Post-docs topics & Infrastructure Sharing activities according to TFs A to G needs and work plan
Production of new knowledge and scientific results
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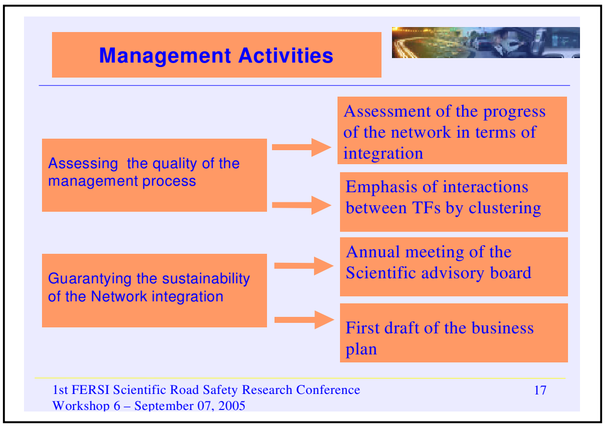
Management Activities
Assessing the quality of the management process
Assessment of the progress of the network in terms of integration
Emphasis of interactions between TFs by clustering
Guarantying the sustainability of the Network integration
Annual meeting of the Scientific advisory board
First draft of the business plan
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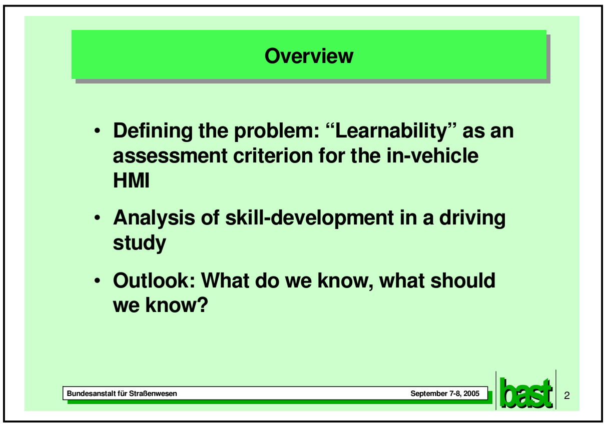
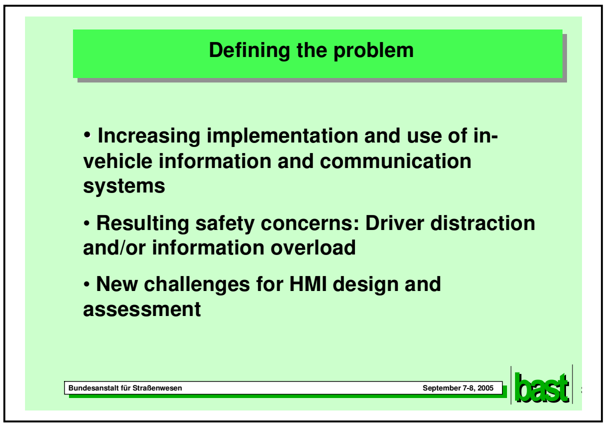
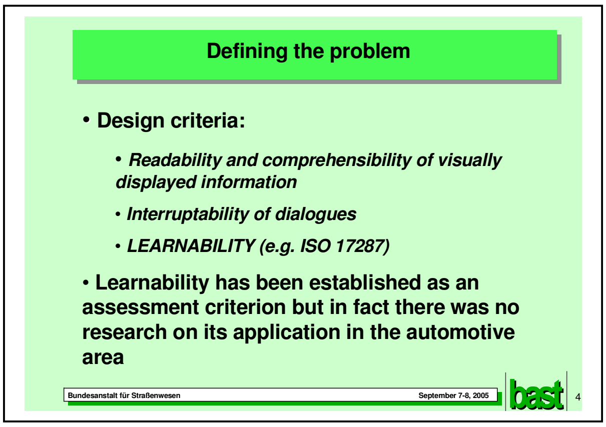
Gelau, Christhard
Federal Highway Research Institute,
Germany

Experts perform safer: effects of learning on the efficient use of in-vehicle technology while driving

In-vehicle information and communication systems (IVIS) are becoming more and more a standard equipment in modern cars. Despite of their obvious benefits there are concerns about risks arising from potential distraction and the additional workload imposed on the driver when these systems are used while driving. Thereby the human-centred design of the Human-Machine-Interface (HMI) has been recognised as the key factor in balancing the demands for increasing functionality with the workload imposed on the driver by the primary task of driving. One factor which has a major impact on the extent to which an HMI task is distracting or overloading is the degree of learning experiences or expertise the driver has acquired when performing the task. From all this follows that the learnability of a task, i.e. the extent to which rapid learning is supported by HMI design, is a crucial aspect for the assessment of the HMI of IVIS. For this reason research efforts were initiated by BASt which intended to examine the concept of learnability in some detail. More precisely, in a series of experiments the process of skill-development when performing destination entry tasks was investigated while driving a car on a test track as well as under static conditions (laboratory, parking vehicle). Results of all experiments provided evidence that the so called "Power-Law-of Practice" seems to be a model which describes the process of learning HMI tasks of IVIS with sufficient precision and might form the basis for the development of innovative assessment tools. This conclusion is also supported by results of a second project which was jointly funded with the German Association on Automotive Research (FAT e.V.) and which demonstrated that the "Power-Law-of Practice" is also valid for processes of acquiring a cognitive representation of hierarchical menu structures.







Defining the problem

- **Goals:**
  - ***To demonstrate the impact of skill development (learning) on safety relevant aspects of driving behaviour***
  - ***To demonstrate impact of HMI design on learnability***
  - ***To validate a model of skill development as a theoretical framework for HMI assessment ("Power-Law-of-Practice")***

Model of skill development

- **"Power-Law-of-Practice":**

  T = A + B (trial) $^{-b}$
  - » T = Task Time,
  - » A = maximum level of performance (constant)
  - » B = task/person specific parameter
  - » b = learning parameter
- **Theoretical basis for:**
  - Prediction of skill development
  - Comparison of HMI concepts by means of learning parameters

Driving study *

2 Navigation systems with different HMI concepts
System A: Remote control; spell and select
System B: rotating single press button; intelligent speller

Subjects: 12 experienced drivers
35 - 55 years of age; > 100.000 km; 6 male, 6 female

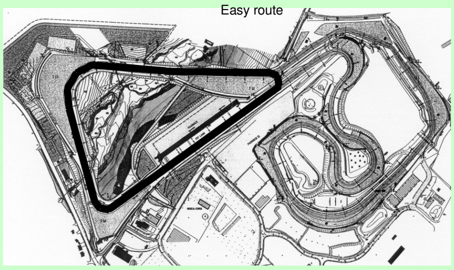
100 (68) destination entries while driving on a test track with a constant speed of 40-50 km/h

Test track: easy route of 1.5 km vs.
winding route: 1.2 km with turning manoeuvres and stop signs

* Study performed by Chemnitz University of Technology by order and funding of BASt

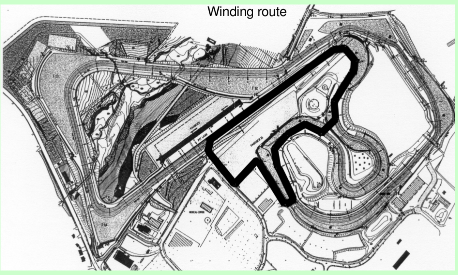
Driving study

Easy route



Driving study

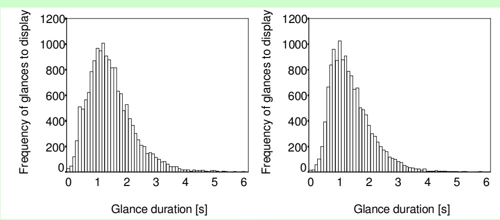
Winding route



Driving study

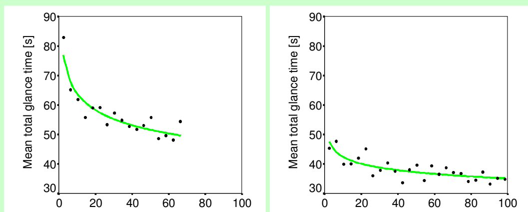
Video recordings

Results: Glance duration



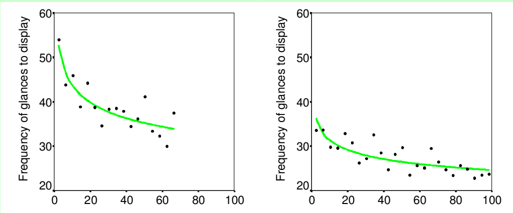
System A System B

Results: Total glance time



System A System B

Results: Glance frequency



System A System B

What do we know, what should we know?

- Skill development needs to be taken into account when assessing IVIS for their distraction potential
- Variance explained by different power functions in the driving study **63%** (System A) and **83%** (System B)
- „Power-Law-of-Practice" not only valid for visual-manual tasks but also for more cognitive HMI tasks (Joint project with FAT e.V.)
- Results are supplemented by accompanying studies in a parking car and in the lab in order to explore: learning transfer, predictability of power functions, age effects

Thank you for your attention!

Workshop 9

Speed enforcement

Leitung

Pekki Kallberg (VTT) und Jacek Malasek (IBDIM)

Vorträge

Lipphard, Detlev (BASt)

“Stationary monitoring with speed cameras in Germany

Ragnøy, Arild (TOI)

“Experiences with automated speed enforcement and reduced speed limits on rural two-lane roads in Norway”

Lipphard, Detlev
Federal Highway Research Institute,
Germany

Stationary monitoring with speed cameras in Germany

The purpose of stationary speed monitoring systems is to monitor whether speed limits are complied with at particularly dangerous locations and in particularly dangerous sections of the road network. There can therefore be no question of them being "radar traps" which “rip off“ drivers. Instead, this efficient, automated instrument leads to local speed limits being complied with only a short time after the system has been installed. The consequences are a decrease in accidents of 50 to 85 percent, with a particularly large decrease in serious accidents. The presentation also for the first time compiles an overview of the current locations of the approximately 2,100 speed-monitoring systems in Germany, broken down according to federal states, road categories and speed limits. Finally, it takes a brief look at current research projects on traffic monitoring in Europe. In the efforts to achieve the ambitious objective of halving the number of fatalities by 2010, the European Commission’s hopes are resting in particular on intensifying and harmonising traffic monitoring, as there is still a great deal of untapped potential for additional safety in this area of activity and it is possible to see successes quickly.

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“Stationary monitoring with speed cameras in Germany”

- Definition / Goal
- Effects / Principles
- Locations
- EU-perspectives

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Section U1 Safety Concepts, Safety Communication
May 2005
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Source: GDV

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Source: bast

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“Stationary monitoring with speed cameras”
Definition

- automatical local system
- where severe accidents have been caused by exceeding speed limit
- placed to perform a targeted enforcement
- in rural areas (e.g. road avenues) or in towns

Goal

- observance of the designated speed limit at a specific site
- permanent threat of punishment

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Effects

- enforcement of existing speed limits (e.g. 50 km/h, 70 km/h, 100 km/h)
- declining of serious accidents by **50 % to 85 %**
- declining of accident costs to **25 %** of their level before installation
- within a road segment of **1000 m** (500 m before and 500 m after location)

Principles

- every 5 to 15 boxes: one camera
- mainly on "black spots"
- visibility, no "speed trap"

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Federal State	Number	%
Baden-Württemberg	562	*26,4*
Bavaria	13	*0,6*
Berlin	0	*0*
Brandenburg	161	*7,6*
Bremen	6	*0,3*
Hamburg	18	*0,8*
Hesse	259	*12,2*
Mecklenburg-Vorpommern	74	*3,5*
Lower Saxony	113	*5,3*
North Rhine-Westphalia	767	*36,1*
Rhineland-Palatinate	18	*0,8*
Saarland	0	*0*
Saxony	93	*4,4*
Saxony-Anhalt	10	*0,5*
Schleswig-Holstein	11	*0,5*
Thuringia	22	*1,0*
Germany	**2.127**	***100,0***

Locations of fixed speed cameras in German federal states
(produced after www.radarfalle.de)

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Road category	Number	%
Motorway	38	*2,9*
National Highway	983	*73,9*
Country road	284	*21,3*
County road	25	*1,9*
Sum	**1.330**	***100.0***

Locations of fixed speed cameras in Germany classified by road categories
(produced after www.radarfalle.de)

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EU-perspectives

- 3rd Road Safety Action Plan: halving the number of fatalities until 2010
- "Commission recommendation of 6 April 2004 on enforcement in the field of road safety" (speeding, alcohol and non-use of seat belts)
- emphasis on enforcement because off quick effects
- basis: Cost-Benefit-Analysis of enforcement measures in the EU-15-countries
  > Cost-benefit-ratio for speeding countermeasures in Germany: **6. 7**

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Project "PEPPER"

Police **E**nforcement **P**olicy and **P**rogrammes on **E**uropean **R**oads

- standards for data collection systems
- innovative technologies
- best practices
- cross-border enforcement

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Ragnøy, Arild
TOI,
Norway

Experiences with automated speed enforcement and reduced speed limits on rural two-lane roads in Norway

Automated speed enforcement based on detection of spot speeds is used extensively in Norway, and results from a recent evaluation study will be presented. A pilot project with enforcement based on average speed will be described. The presentation will also include results from an assessment of crash risk before and after lowering the speed limits on rural two-lane roads by 10 km/h.

Speed cameras in Norway
Effects on speed

Results from a project carried out at
Institute of Transport Economics, Oslo

TØI-report 573/2002
Arild Ragnøy

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Speed cameras in Norway

- Speed cameras in Norway since 1988
- In 2005 some 250 cameras (more to come)
- PRA and local Police

3 criteria's must be fulfilled:
Accident density > 0.5 per km
Accident rate > similar kind of road
Average speed > speed limit

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Speed cameras in Norway

Ministry of Transport and Communication and Police Directorate:

- Before and after analysis with comparison sites on road sections with speed cameras based on automat measurements of speed
- Measuring speed at the speed camera post using a laser pistol

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Speed cameras in Norway

Road No Place	Before		After		Total	
	Number of hours	Number of vehicles	Number of hours	Number of vehicles	Number of hours	Number of vehicles
E6 Østfold	6880 7355	1791047 2069215	10477 12248	3193729 3946986	17357 19603	4984776 6016201
E 18 Østfold	13130 14470	2541883 2894911	8867 10720	1612859 2052232	21997 25190	4154742 4947143
E6 Hedmark	27317 27640	5591645 5219949	49104 49104	9781560 9478345	76421 76744	15373205 14698294
Total	96791	20108650	140520	30065710	237311	50174361

Number of vehicles and hours registrated on the three sites

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Speed cameras in Norway

To ensure the quality of the data (quality assurance)

- More than 2/3 were discorded
- The final study consisted of :
  - 6,8 mill vehicles in the before period
  - 9,5 mill vehicles in the after period

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Speed cameras in Norway

The cut were made due to:

- Data consisted of "irregularities" of any kind
- Speed was lower than normal
- Variation of speed was too large between two following hours

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Speed cameras in Norway

	Speed limit km/h	Traffic direction from	Numb of sites	Number of vehicles BEFORE	Average speed BEFORE km/h	Number of vehicles AFTER	Average speed AFTER km/h	Before - after Difference km/h	Difference comparison sites km/h	Calculated net effect of cameras km/h
E6 Østfold	90	Oslo	4		85.72		80.61	-5.11	-1.28	-3.83
		Sweden	4		89.37		83.32	-6.05	-1.31	-4.74
Sum			8	3131434	**87.52**	6482637	**82.04**	**-5.48**	-1.30	**-4.18**
E18 Østfold	80	Oslo	2		74.24		68.88	-5.36	0.26	-5.62
		Sweden	3		75.58		69.87	-5.71	0.11	-5.82
	Sum 80		5	845311	**75.06**	483764	**69.52**	**-5.54**	0.19	**-5.72**
	70	Oslo	2		65.11		60.65	-4.46	0.26	-4.72
		Sweden	2		66.97		61.72	-5.25	0.11	-5.36
	Sum 70		4	771594	**66.04**	584515	**61.19**	**-4.85**	0.19	**-5.04**
E6 Hedmark	90	Oslo	2		89.06		84.28	-4.78	1.10	-5.88
		Hamar	1		90.18		85.66	-4.52	1.76	-6.28
Sum			3	2049627	**89.35**	1927571	**84.62**	**-4.73**	1.43	**-6.16**

Measured and calculated changes
Changes on the experiment sites and the comparison sites

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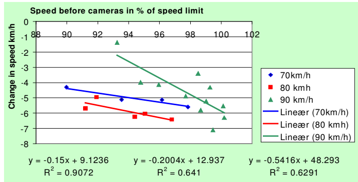
Speed cameras in Norway



Relationship between the speed in the before situation and the net effect of the speed
(Each speed camera represents one data point)

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Speed cameras in Norway

Speed cameras reduces speed:

- at the measurement sites
- between measurement sites
- after measurement sites

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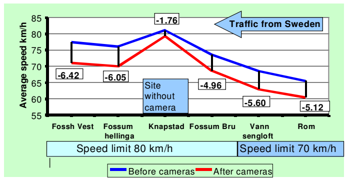
Speed cameras in Norway



- at and between measurement sites

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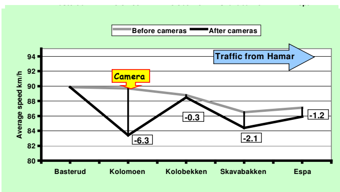
Speed cameras in Norway



- after measurement sites

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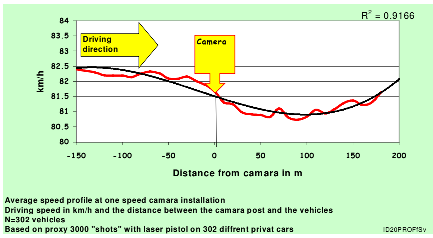
Speed cameras in Norway

- road users do adjust their speed in the direct vicinity of the speed camera



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Changes of speed limits
Effects on speed and accidents

Results from a project carried out at
Institute of Transport Economics, Oslo

TØI-report 529/2004
Arild Ragnøy

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Changes of speed limits

In autumn 2001 speed limits were lowered in Norway

- 274 sections, 741 km, lowered from 80 km/h to 70 km/h
- 47 sections, 393 km, lowered from 90 km/h to 80 km/h

Road sections had been identified as having a high expected injury severity density :

- More fatal or serious acc per km than similar roads (acc costs)
- Regression to the mean

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Changes of speed limits

County NO	Name	80 km/h - 70 km/h No. of sections	80 km/h - 70 km/h Length km	90 km/h - 80 km/h No. of sections	90 km/h - 80 km/h Length km	TOTAL No. of sections	TOTAL Length km
1	Østfold	6	20.980	1	17.100	7	38.080
2	Akershus	7	57.469	2	37.319	9	94.788
3	Oslo	0		0		0	
4	Hedmark	13	31.867	2	27.750	15	59.617
5	Oppland	18	56.195	9	53.199	27	109.394
6	Buskerud	16	63.297	2	15.923	18	79.220
7	Vestfold	13	31.927	0		13	31.927
8	Telemark	18	68.285	2	43.581	20	111.866
9	Aust-Agder	11	54.689	3	7.486	14	62.175
10	Vest-Agder	10	41.900	1	10.745	11	52.645
11	Rogaland	17	34.375	1	9.051	18	43.426
12	Hordaland	18	56.081	0		18	56.081
14	Sogn & Fjordane	10	21.036	0		10	21.036
15	Møre & Romsdal	17	47.362	1	6.570	18	53.932
16	Sør-Trøndelag	49	105.661	5	29.954	54	135.615
17	Nord-Trøndelag	15	30.602	6	21.422	21	52.024
18	Nordland	2	4.235	0		2	4.235
19	Troms	1	2.269	2	6.945	3	9.214
20	Finnmark	6	13.143	10	106.015	16	119.158
	Totalt	247	741.373	47	393.060	294	1134.433

Sections with lowered speed limit

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Changes of speed limits

Study design:

Effect on speed
- Before and after study on treated roads
- Comparison sites

Effect on accidents
- Before and after study (Empirical Bays design)
- Controlling for long-term trends in acc occurrence by comparison groups
- Two different groups:
  Comp group 1 consisted of roads that retained the original speed limit of 80 km/h (alt 90 km/h)
  Comp group 2 consisted of all public roads in Norway (minus those that had the speed limit lowered)

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Changes of speed limits

	Treated Before	Treated After	Comparison Before	Comparison After	Total Before	Total After
80 km/h - 70 km/h	12528963	12821282	5816427	6053589	18345390	18874871
90 km/h - 80 km/h	7162606	7536759	2858459	2955170	10021065	10491929
Total	19691569	20358041	8674886	9008759	28366455	29366800

Data after quality assurance

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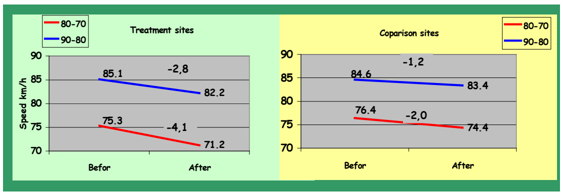
Changes of speed limits



Results Driving speed

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Changes of speed limits

Group	Item of data	Before	After
80 km/h to 70 km/h	Total days covered	589,496	148,403
	Injury accidents	2307	455
	Fatalities	211	30
	Critically injured road users	133	4
	Seriously injured road users	404	66
	Slightly injured road users	2949	680
90 km/h to 80 km/h	Total days covered	99,280	27,230
	Injury accidents	718	257
	Fatalities	108	32
	Critically injured road users	43	10
	Seriously injured road users	188	64
	Slightly injured road users	954	373

Accident data for treated road sections summarized

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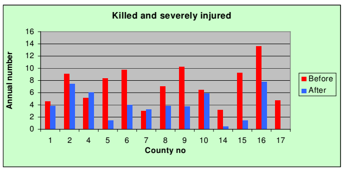
Changes of speed limits



Killed and severely injured 80 km/h to 70 km/h
Reduction in all but 2 counties

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Changes of speed limits

	Recorded Number	Expected number	Regression to the mean %
80 km/h - 70 km/h			
Accidents	2307	2151.6	-6.7
FA	211	161.2	-23.6
VSI	133	86.6	-34.9
SI	404	362.2	-10.3
LI	2949	2886	-2.1
90 km/h - 80 km/h			
Accidents	337	320.0	-5.0
FA	56	47.4	-15.4
VSI	16	15.2	-5.2
SI	91	77.1	-15.3
LI	449	441.6	-1.7

"Regression to the mean effect"

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Changes of speed limits

Speed limit change 80 km/h - 70 km/h	Sections with lowered speed Changes % Gross	Regression to the mean	Gross without regression	Comparison section Changes % Comp I	Comp II	Net effect Changes % Based on Comp I	Comp II
Accidents	-21.2	-6.7	-15.5	0.0	-1.8	-15.5	-13.9
FA	-43.2	-23.6	-25.6	27.3	-0.9	-41.6	-25.0
VSI	-88.0	-34.9	-81.5	-15.9	-20.8	-78.0	-76.7
SI	-34.7	-10.3	-27.2	-4.9	-17.2	-23.4	-12.1
LI	-7.9	-2.1	-5.8	4.7	0.5	-10.1	-6.3
Speed limit change 90 km/h - 80 km/h							
Accidents	31.1	-5.0	38.0	-7.8	-1.8	49.8	40.6
FA	8.5	-15.4	28.2	63.9	-0.9	-21.8	29.4
VSI	-14.8	-5.2	-10.1	25.7	-20.8	-28.5	13.4
SI	24.7	-15.3	47.1	7.9	-17.2	36.3	77.6
LI	43.2	-1.7	45.6	-11.5	0.5	64.4	44.9

Results Accidents

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Workshop 12

Speed management

Leitung

David Lynam (TRL) und Fred Wegman (SWOV)

Vorträge

Heinrich, Jaroslav, Skládany, Pavel (CDV)

“Speed management in urban areas“

Hels, Tove (DTF)

“The effect of roundabout design features on cyclist accident rate”

Lynam, David (TRL)

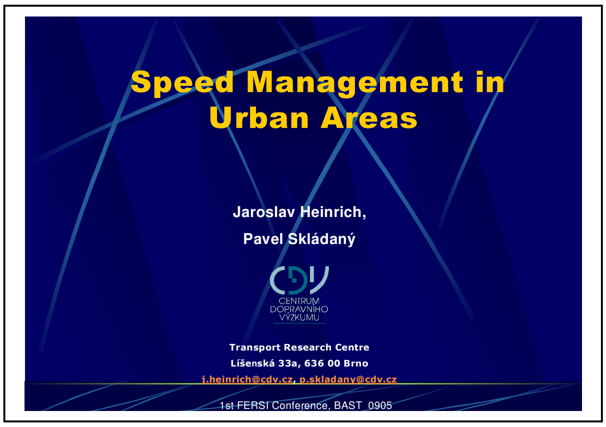
“Setting speed limits consistent with road quality“

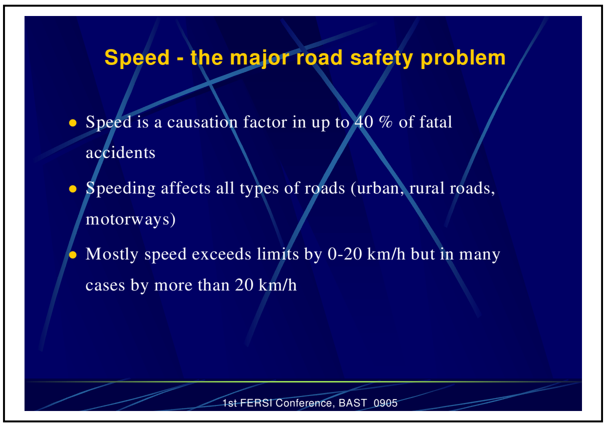
Heinrich, Jaroslav, Skládany, Pavel
CDV,
Czech Republic

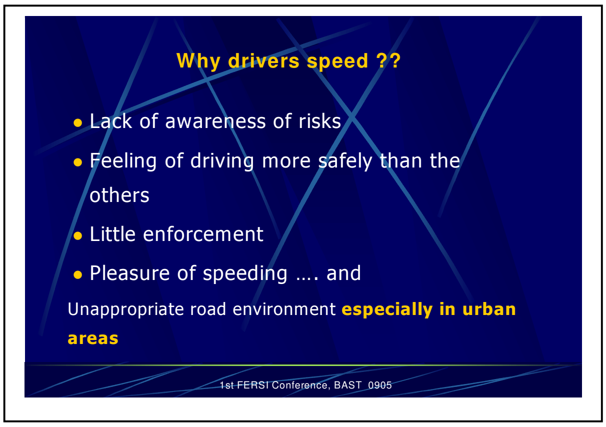
Speed management in urban areas

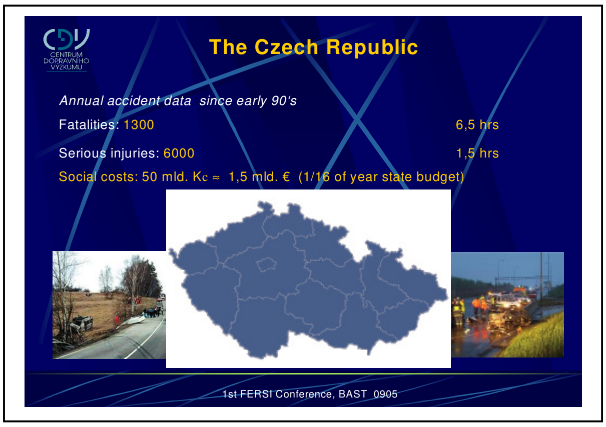
Speed management in urban areas is a key issue for a still increasing amount of decision makers. We may see more and more new roundabouts, new pedestrian facilities to cross the road, re-constructed stops of public transport all around the Europe. They are very different according the shape, design parameters, lighting etc. Which of them is safer? Why some of them haven't brought expected increasing road safety? Does the design parameters influence accidents and their personal consequences? And what about the speed? Does the design parameter, especially wideness of the line influence a choice of speed on approaching vehicle?

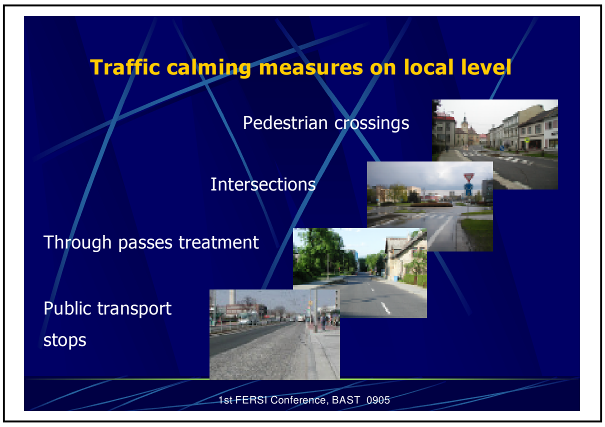
Those questions have to be answered for the Czech Republic by the integrated team of researchers-engineers from CDV, doctors from the Czech National Trauma Centre in Brno, professors from the Czech Technical University in Prague and court accident expert. They have been working on the in depth analysis of 160 such measures around the Czech republic to collect best practises and to show most frequent mistakes in speed management and traffic calming.

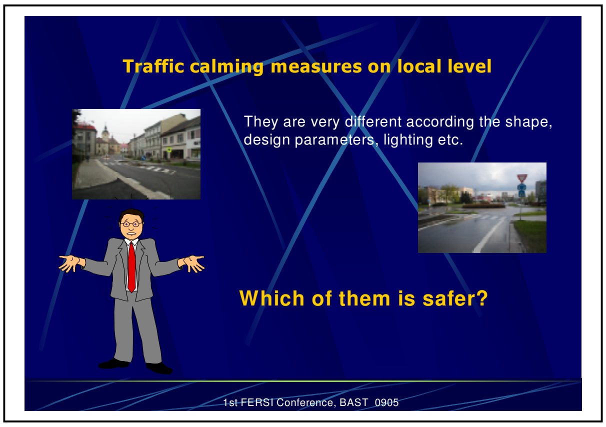


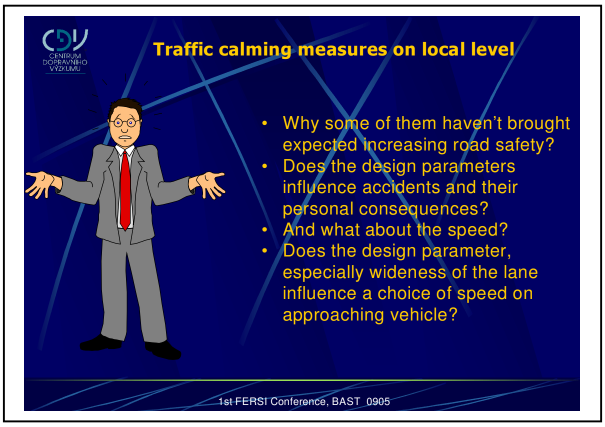




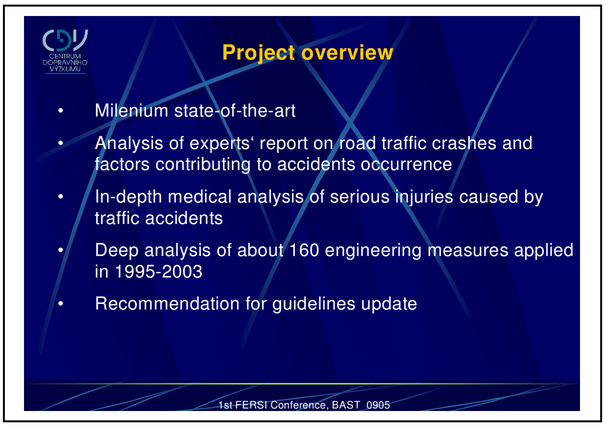


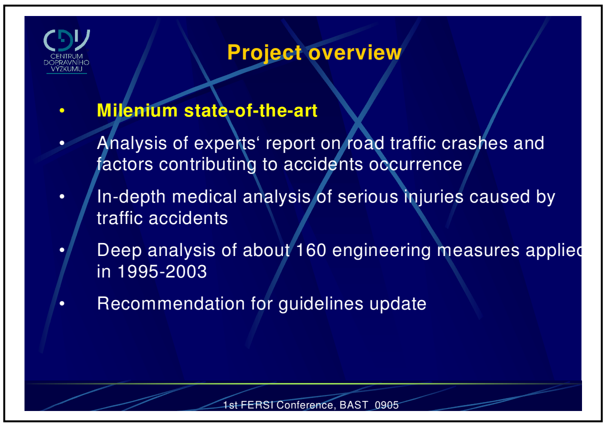

Traffic calming measures on local level
Pedestrian crossings
Intersections
Through passes treatment
Public transport
stops
1st FERSI Conference, BAST 0905


Traffic calming measures on local level
They are very different according the shape, design parameters, lighting etc.
Which of them is safer?
1st FERSI Conference, BAST 0905


Traffic calming measures on local level
Why some of them haven't brought expected increasing road safety?
Does the design parameters influence accidents and their personal consequences?
And what about the speed?
Does the design parameter, especially wideness of the lane influence a choice of speed on approaching vehicle?
1st FERSI Conference, BAST 0905


BESIDIDO
Those questions have to be answered by the Czech national R+D project BESIDIDO, sponzored by Ministry of Transport and co-ordinated by CDV (Centrum dopravniho výzkumu, Transport Research Centre).
Partners:
Czech Technical University in Prague,
Trauma Centre in Brno
ADN Consult led by Ing. Sachl (an accident court expert).
1st FERSI Conference, BAST 0905


Project overview
Milenium state-of-the-art
Analysis of experts' report on road traffic crashes and factors contributing to accidents occurrence
In-depth medical analysis of serious injuries caused by traffic accidents
Deep analysis of about 160 engineering measures applied in 1995-2003
Recommendation for guidelines update
1st FERSI Conference, BAST 0905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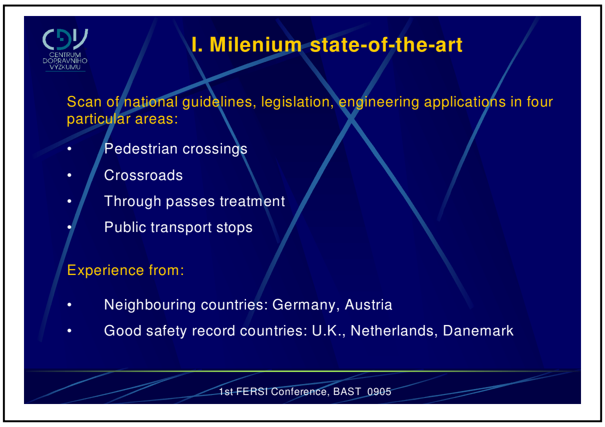
I. Milenium state-of-the-art
Scan of national guidelines, legislation, engineering applications in four particular areas:
Pedestrian crossings
Crossroads
Through passes treatment
Public transport stops
Experience from:
Neighbouring countries: Germany, Austria
Good safety record countries: U.K., Netherlands, Danemark
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I. Milenium state-of-the-art
Goal: To present up date best-practices to professionals
May serve for national guidelines up-dating
Shows many practical examples of efective engineering measures to improve road safety
Gather together wide range of technical information
BESIDIDO
1st FERSI Conference, BAST 0905

Project overview

- Milenium state-of-the-art
- **Analysis of experts' report on road traffic crashes and factors contributing to accidents occurrence**
- In-depth medical analysis of serious injuries caused by traffic accidents
- Deep analysis of about 160 engineering measures applied in 1995-2003
- Recommendation for guidelines update

II. Analysis of experts' report on road traffic crashes and factors contributing to accidents occurrence

- **Goldmining** of the database made by ADN Consult

Purpose:

- Gather data on accident, location, circumstances
- Searching for a common features
- Searching for possible counter-measures

II. Analysis of experts' report on road traffic crashes and factors contributing to accidents occurrence

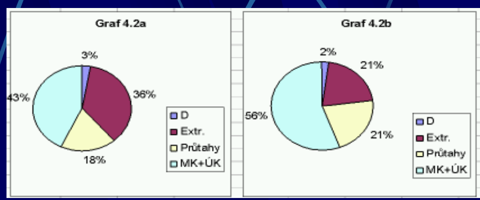
The database comprise information on:

- Accident condition (visibility condition, weather)
- Expert calculation, time estimates
- Road location
- Vehicles, drivers condition
- Behavior of all participants

II. Analysis of experts' report on road traffic crashes and factors contributing to accidents occurrence

Comparison on pedestrian accident road type location

All accidents / Pedestrian accidents



II. Analysis of experts' report on road traffic crashes and factors contributing to accidents occurrence

Pedestrians accidents

- Based on about 200 expert's reports on road traffic accident involving pedestrians

Major findings:

- Inappropriate pedestrian behaviour (crossing outside zebras, impetuous reactions)
- Inappropriate drivers' behaviour (speeding, reactions, evaluation of the situation)
- Wrong lay-out (too long walking distances, obstacles)
- Low visibility (lighting poles presence)

Project overview

- Milenium state-of-the-art
- Analysis of experts' report on road traffic crashes and factors contributing to accidents occurrence
- **In-depth medical analysis of serious injuries caused by traffic accidents**
- Deep analysis of about 1
  in 1995-2003
- Recommendation for guic

III. In-depth medical analysis on traffic accidents serious injuries

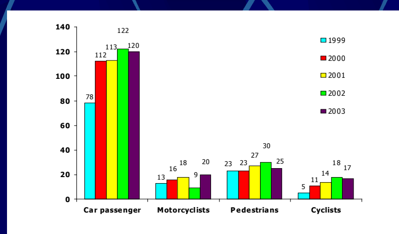
- Regional Centre of EMS of Brno – trauma treatment centre
- Altogether 1331 in-patients in the period 1992-2003
- Criterion ISS>16

Aim of the study:

- Survey of the situation
- Trends description
- Vulnerable and high-risk groups identification
- Typical injuries description pertaining particular road users

III. In-depth medical analysis on traffic accidents serious injuries

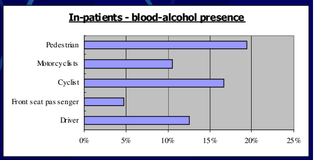
Set of serious injuries investigated:



III. In-depth medical analysis on traffic accidents serious injuries

Major findings:

- Elderly pedestrians – high risk group
- Road design –need for vulnerable users separation
- Cyclists – without helmets!
- Alcohol – often!!
- Vehicles – sharp edges
- Low seat belts use



Project overview

- Milenium state-of-the-art
- Analysis of experts' report on road traffic crashes and factors contributing to accidents occurrence
- In-depth medical analysis of serious injuries caused by traffic accidents
- **Deep analysis of about 160 engineering measures applied in 1995-2003**
- Recommendation for guidelines update

IV. Analysis of about 180 engineering measures

- Measures applied in 1995-2002

Four areas:

- Pedestrian crossings (zebra crossings)
- Road intersections treatment (roundabouts)
- Public transport stops
- Through-passes treatment

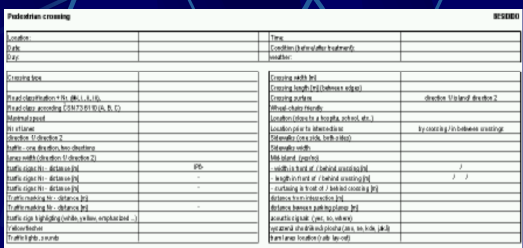
IV. Analysis of about 180 engineering measures

Used methodology:

- Site history, site categorization, accident analyses, site observations
- In-site recognition, Accidents report scanning
- Accidents analyses, speed reduction
  - Accidents reports scanning
  - Collision diagram
  - Accident summary table
  - Search for contributing factors
  - Treatment detailed description
  - Treatment evaluation
  - Social costs of accidents, CBA or CEA

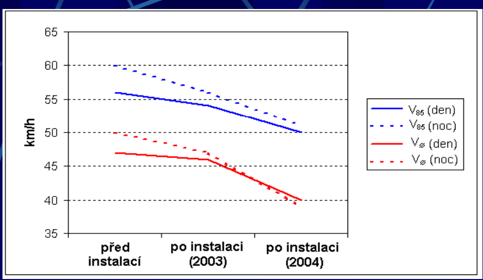
IV. Analysis of about 180 engineering measures

Form for gathering data on zebra crossings



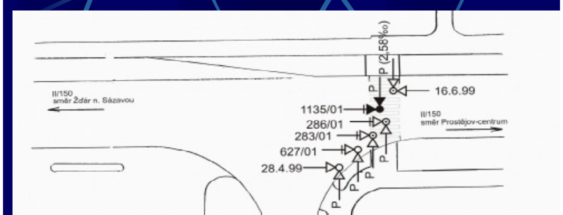
Psychologicaly „raised" pedestrian crossing – Brno

Psychologicaly „raised" pedestrian crossing – Brno
Comparison of speed before / after / 1 year after



Pedestrian crossing with protective island - Prostějov
Collision diagram

3 years before: 6 accidents with personal damage




Pedestrian crossing with protective island - Prostějov
3 years before: 6 accidents with personal damage
1 year after: no accidents
Estimated reduction of V85: 5 km/h
1st FERSI Conference, BAST 0905


Redesign of crossing to roundabout – Lázně Bohdaneč
Before:
High speed, seriously accidents
After:
Low speed, slightly accidents
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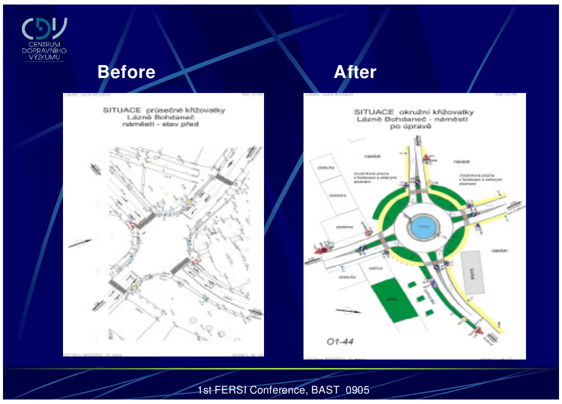
Before
After
SITUACE průsečné křižovatky Lázně Bohdaneč náměstí - stav před
SITUACE okružní křižovatky Lázně Bohdaneč - náměstí po úpravě
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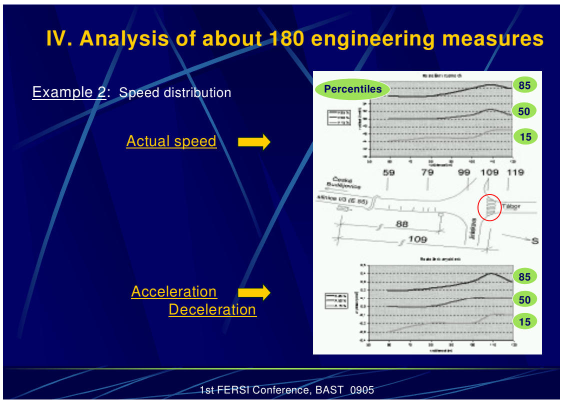
IV. Analysis of about 180 engineering measures
Example 2: Speed distribution
Actual speed
Acceleration
Deceleration
Percentiles
85
50
15
59 79 99 109 119
88
109
85
50
15
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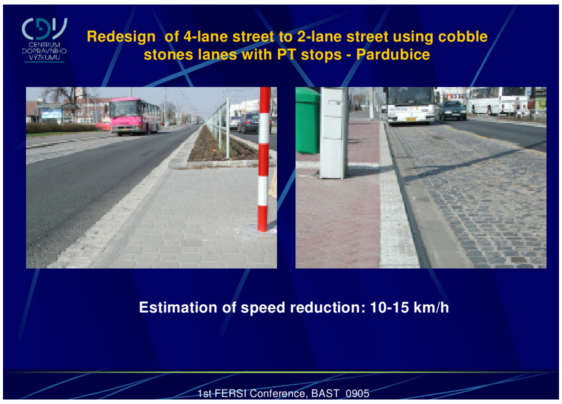
Redesign of 4-lane street to 2-lane street using cobble stones lanes with PT stops - Pardubice
Estimation of speed reduction: 10-15 km/h
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Redesign of crossing to roundabout – Blansko
Bad example:
In spite of minimal diameter (26 m) stil high speeds (50 km/h) because of narrow cobble ring and unsufficient islands
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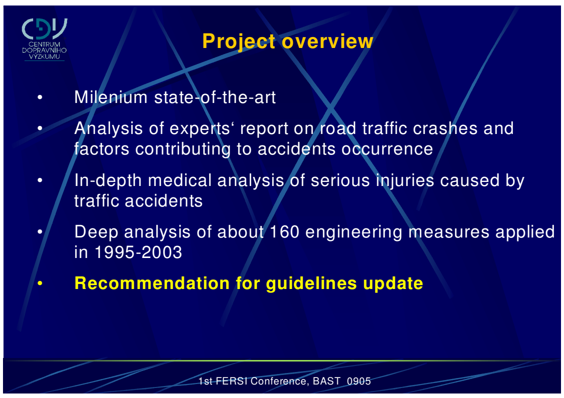
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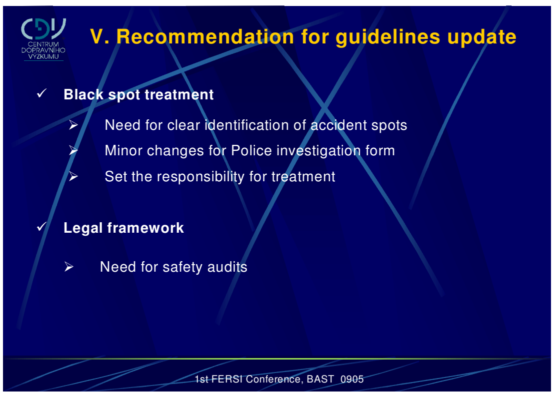
V. Recommendation for guidelines update
Black spot treatment
Need for clear identification of accident spots
Minor changes for Police investigation form
Set the responsibility for treatment
Legal framework
Need for safety audits
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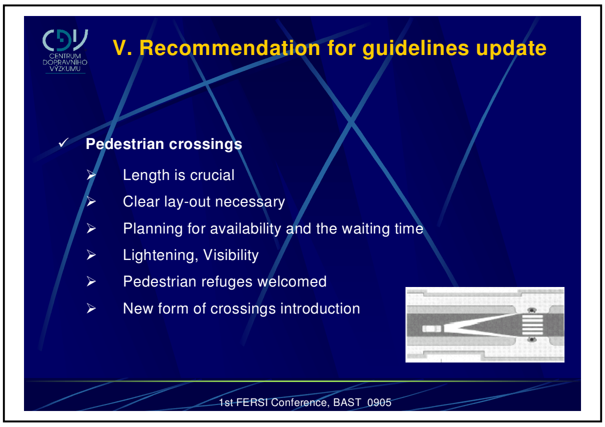
V. Recommendation for guidelines update
Pedestrian crossings
Length is crucial
Clear lay-out necessary
Planning for availability and the waiting time
Lightening, Visibility
Pedestrian refuges welcomed
New form of crossings introduction
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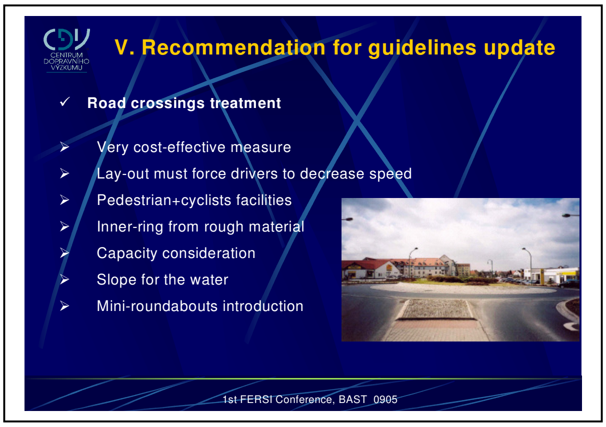
V. Recommendation for guidelines update
Road crossings treatment
Very cost-effective measure
Lay-out must force drivers to decrease speed
Pedestrian+cyclists facilities
Inner-ring from rough material
Capacity consideration
Slope for the water
Mini-roundabouts introduction
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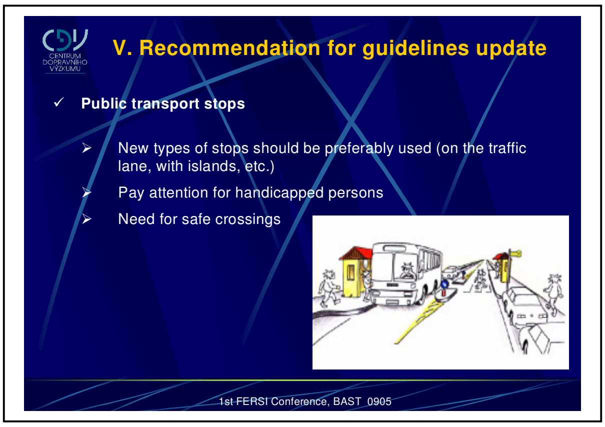
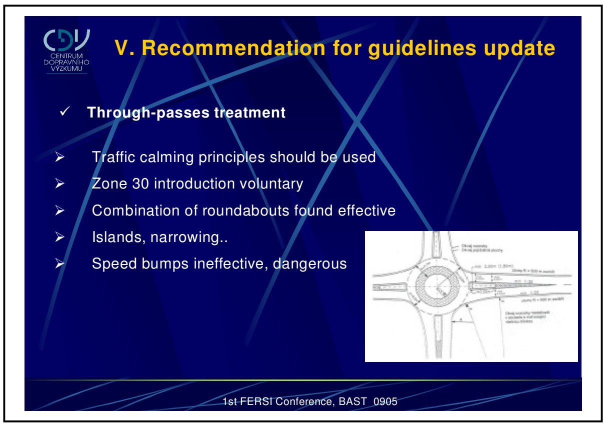

V. Recommendation for guidelines update
Public transport stops
New types of stops should be preferably used (on the traffic lane, with islands, etc.)
Pay attention for handicapped persons
Need for safe crossings
1st FERSI Conference, BAST 0905


V. Recommendation for guidelines update
Through-passes treatment
Traffic calming principles should be used
Zone 30 introduction voluntary
Combination of roundabouts found effective
Islands, narrowing..
Speed bumps ineffective, dangerous
1st FERSI Conference, BAST 0905


BESIDIDO
final remarks
Project:
Identified many problems with black spots treatment
Launched discussion on technical standards quality
Presented best practices
Encouraged designers to apply new approaches
Brought numerous recommendations in different fields
1st FERSI Conference, BAST 0905


Thank you for your attention!
j.heinrich@cdv.cz & e.simonova@cdv.cz
1st FERSI Conference, BAST 0905


Further information
Presented paper is based on CDV own research sponzored by Ministry of Transport, mostly in frame of BESIDIDO project (2001-2005)
jaroslav.heinrich@cdv.cz; zdenek.hruby@cdv.cz;
eva.simonova@cdv.cz; pavel.skladany@cdv.cz
1st FERSI Conference, BAST 0905

Hels, Tove
DTF,
Denmark

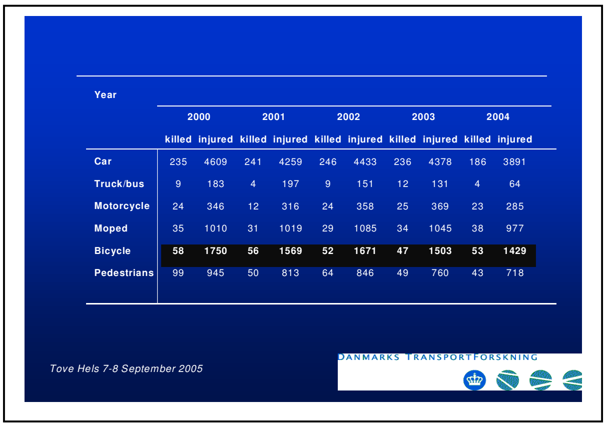
The effect of roundabout design features on cyclist accident rate

For the moment, roundabouts are popular. During the latest twenty years, more and more intersections have been converted to roundabouts, both in Europe and in the US. The advantages of roundabouts are obvious: Enhanced safety and mobility. However, roundabouts do not have the same positive effect on cyclist accidents as they do on motor vehicle accidents. The aim of this study was to clarify the proportions of various types of cyclist accidents and to find relations between the number of cyclist accidents in roundabouts and their geometric features, age and traffic load.

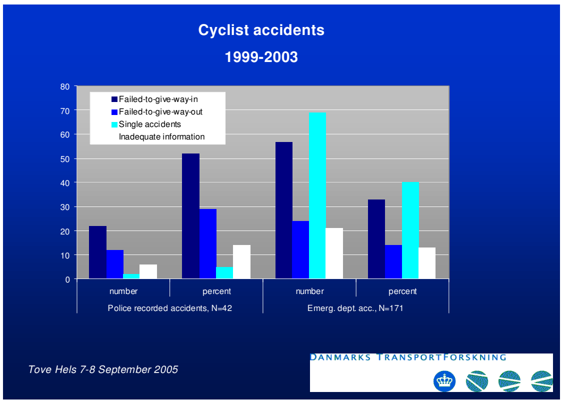
Geometric features of each of the roundabouts at the Danish island of Funen (88 roundabouts) were recorded together with the age and position of the roundabouts. Moreover, the number of vehicles and cyclists entering the roundabouts per 24 hours were recorded. Cyclist accidents were recorded by the police and by the casualty department. Accidents between 1999 and 2003 involving cyclists were recorded.

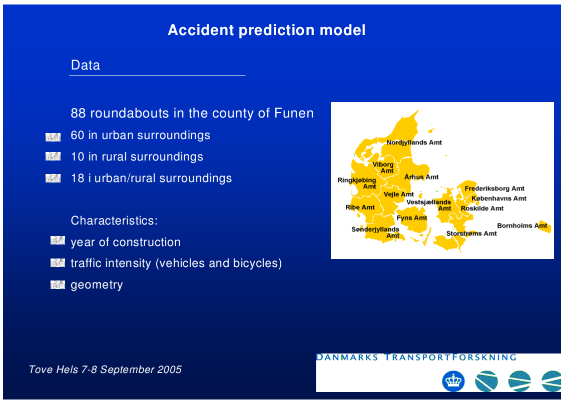
Most of the cyclist accidents were motor vehicle-failed-to-give-way-accidents and single-cyclist accidents. The degree of underreporting by the police compared to the casualty department was 75 %. Important features for cyclist accident occurrence seem to be traffic load, with the number of cyclists being the most significant variable: The more cyclists, the more accidents and the higher the accident probability (the accident risk was found to increase by a factor 7.5 for traffic volumes in roundabouts above 1000 cyclists per 24h compared to traffic volumes below 1000 cyclists per 24h). There is a controversy in the literature concerning the number of cyclists – one view is that with few cyclists, drivers do not perceive them and thus accidents occur. My results support the opposite view: The more cyclists, the more accidents. Potential speed of motor vehicle through the roundabouts seems to be important as well – the higher you can physically drive through the roundabout in a vehicle, the more cyclist accidents are predicted. Finally there is a tendency for older roundabouts to have more cyclist accidents, probably due to older roundabouts following older standards, e.g. smaller central islands.

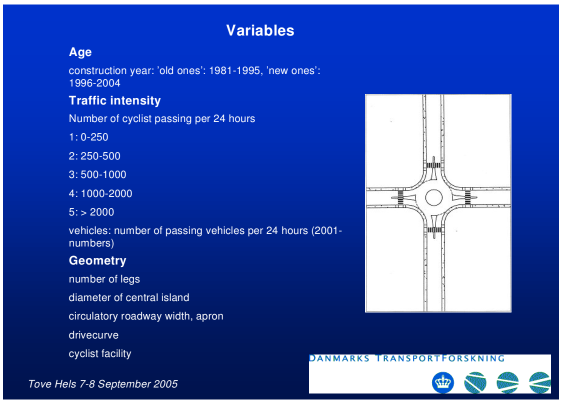
The models developed here must be regarded as preliminary due to the relatively low number of roundabouts. Firmer relationships will be established in later models with more data.

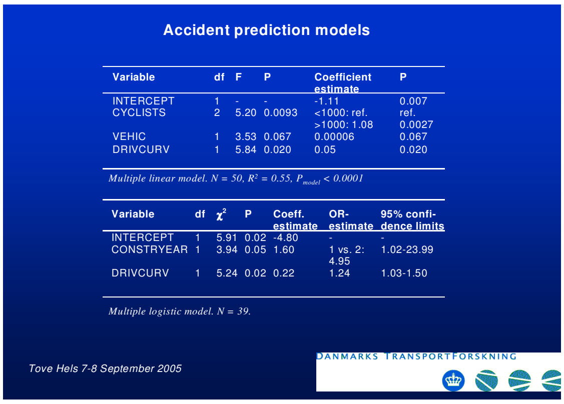


Year	2000		2001		2002		2003		2004	
	killed	injured	killed	injured	killed	injured	killed	injured	killed	injured
Car	235	4609	241	4259	246	4433	236	4378	186	3891
Truck/bus	9	183	4	197	9	151	12	131	4	64
Motorcycle	24	346	12	316	24	358	25	369	23	285
Moped	35	1010	31	1019	29	1085	34	1045	38	977
Bicycle	58	1750	56	1569	52	1671	47	1503	53	1429
Pedestrians	99	945	50	813	64	846	49	760	43	718


Cyclist accidents
1999-2003
Failed-to-give-way-in
Failed-to-give-way-out
Single accidents
Inadequate information
80
70
60
50
40
30
20
10
0
number
percent
number
percent
Police recorded accidents, N=42
Emerg. dept. acc., N=171
Tove Hels 7-8 September 2005
DANMARKS TRANSPORTFORSKNING


Accident prediction model
Data
88 roundabouts in the county of Funen
60 in urban surroundings
10 in rural surroundings
18 i urban/rural surroundings
Characteristics:
year of construction
traffic intensity (vehicles and bicycles)
geometry
Nordjyllands Amt
Viborg Amt
Århus Amt
Ringkjøbing Amt
Vejle Amt
Frederiksborg Amt
Københavns Amt
Vestsjællands Amt
Roskilde Amt
Ribe Amt
Fyns Amt
Sønderjyllands Amt
Storstrøms Amt
Bornholms Amt
Tove Hels 7-8 September 2005
DANMARKS TRANSPORTFORSKNING

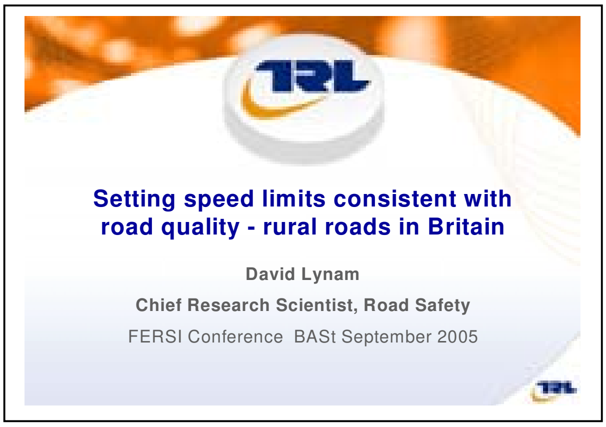

Variables
Age
construction year: 'old ones': 1981-1995, 'new ones': 1996-2004
Traffic intensity
Number of cyclist passing per 24 hours
1: 0-250
2: 250-500
3: 500-1000
4: 1000-2000
5: > 2000
vehicles: number of passing vehicles per 24 hours (2001-numbers)
Geometry
number of legs
diameter of central island
circulatory roadway width, apron
drivecurve
cyclist facility
Tove Hels 7-8 September 2005
DANMARKS TRANSPORTFORSKNING

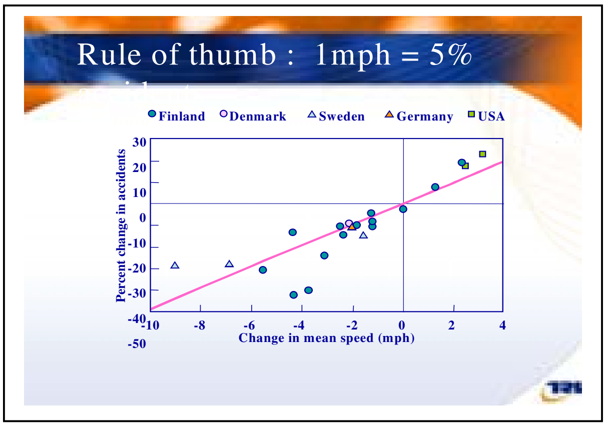

Accident prediction models
Variable | df | F | P | Coefficient estimate | P
INTERCEPT | 1 | - | - | -1.11 | 0.007
CYCLISTS | 2 | 5.20 | 0.0093 | <1000: ref. | ref.
>1000: 1.08 | 0.0027
VEHIC | 1 | 3.53 | 0.067 | 0.00006 | 0.067
DRIVCURV | 1 | 5.84 | 0.020 | 0.05 | 0.020
Multiple linear model. N = 50, R² = 0.55, P model < 0.0001
Variable | df | χ² | P | Coeff. estimate | OR-estimate | 95% confidence limits
INTERCEPT | 1 | 5.91 | 0.02 | -4.80 | - | -
CONSTRYEAR | 1 | 3.94 | 0.05 | 1.60 | 1 vs. 2: 4.95 | 1.02-23.99
DRIVCURV | 1 | 5.24 | 0.02 | 0.22 | 1.24 | 1.03-1.50
Multiple logistic model. N = 39.
Tove Hels 7-8 September 2005
DANMARKS TRANSPORTFORSKNING

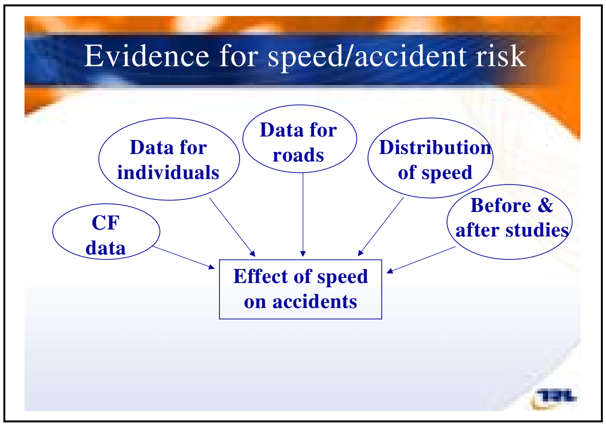
Lynam, David
TRL,
United Kingdom

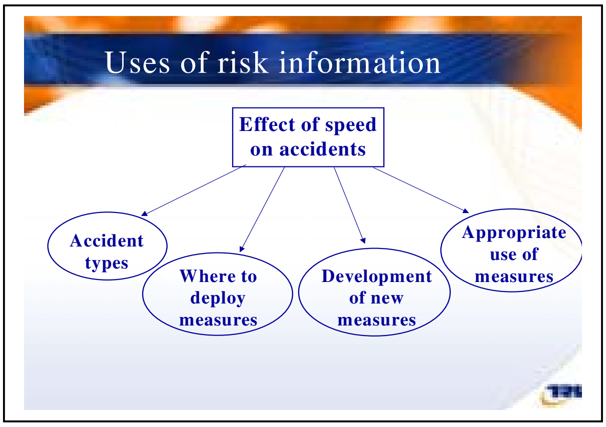
Setting speed limits consistent with road quality

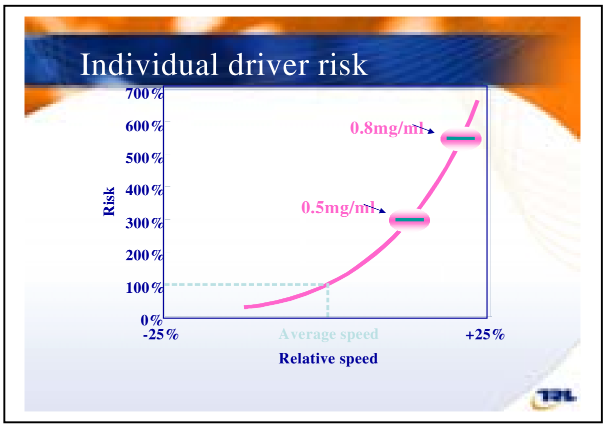
The presentation would describe methodology developed in Great Britain for setting speed limits on rural roads which balance safety, mobility, and environmental needs, demonstrating how improving the standard of these roads would justify higher speeds. This approach would be compared with current speed management policy in Sweden and the Netherlands.

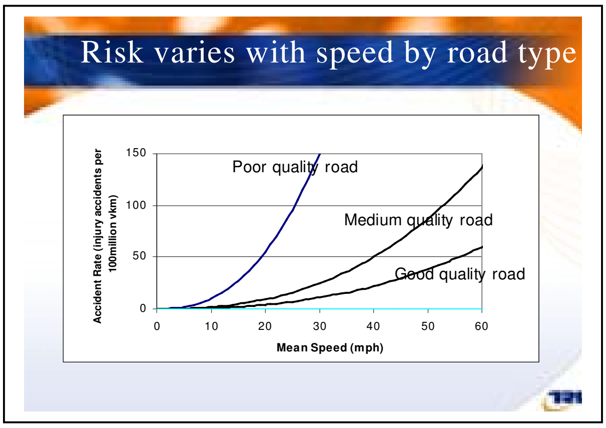








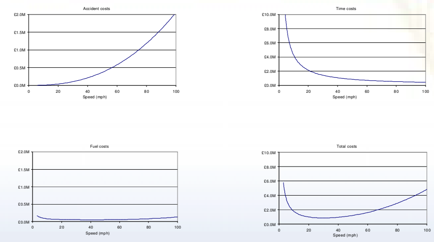




Assessment balancing safety and mobility

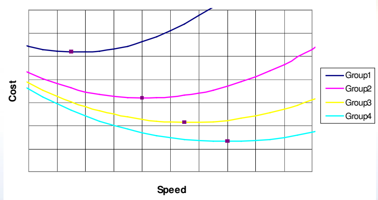
- Set of curves showing how cost of safety, mobility, environment factors vary with speed
- Assess speed range giving "minimum" total cost for conditions relevant to each road type
- Include factors that cannot be costed

Cost curves - total

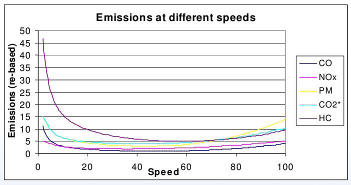


Speed management – by minimum costs

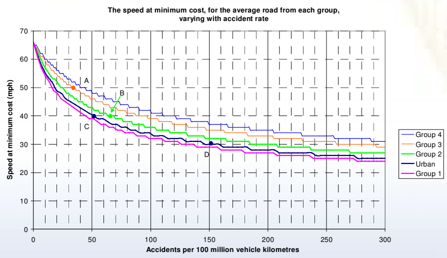
Speeds associated with minimum costs for different road groups



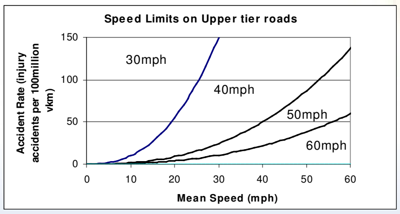
Effect of speed on emissions



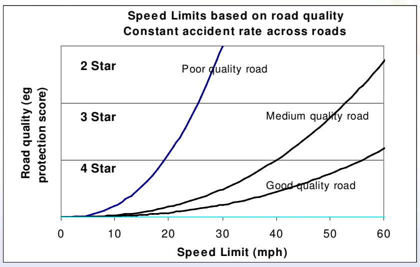
Accident thresholds for limits



Variation of speed limit by accident rate and speed



Ethical speed limit to meet accident rate thresholds



Ethical or equitable basis for speed limits?

- Both closely associated with quality of road in terms of accident rate
- Need more work to compare outcomes for different road types
- What weight to be given to fatalities and other injuries in ethical approach?

Schriftenreihe

Berichte der Bundesanstalt für Straßenwesen

Unterreihe „Mensch und Sicherheit“

2001

M 124: **Fahrerverhaltensbeobachtungen auf Landstraßen am Beispiel von Baumalleen**
Zwielich, Reker, Flach € 13,00

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M 130: **Informations- und Steuerungssystem für die Verkehrssicherheitsarbeit für Senioren**
Meka, Bayer € 12,00

M 131: **Perspektiven d. Verkehrssicherheitsarbeit für Senioren Teil A: Erster Bericht der Projektgruppe zur Optimierung der Zielgruppenprogramme für die Verkehrsaufklärung von Senioren Teil B: Modellprojekt zur Erprobung von Maßnahmen der Verkehrssicherheitsarbeit mit Senioren**
Becker, Berger, Dumbs, Emsbach, Erlemeier, Kaiser, Six unter Mitwirkung von Bergmeier, Ernst, Mohrhardt, Pech, Schafhausen, Schmidt, Zehnpfennig € 17,00

M 132: **Fahrten unter Drogeneinfluss – Einflussfaktoren und Gefährdungspotenzial**
Vollrath, Löbmann, Krüger, Schöch, Widera, Mettke € 19,50

M 133: **Kongressbericht 2001 der Deutschen Gesellschaft für Verkehrsmedizin e. V.** € 26,00

M 134: **Ältere Menschen im künftigen Sicherheitssystem Straße/Fahrzeug/Mensch**
Jansen, Holte, Jung, Kahmann, Moritz, Rietz, Rudinger, Weidemann € 27,00

2002

M 135: **Nutzung von Inline-Skates im Straßenverkehr**
Alrutz, Gündel, Müller unter Mitwirkung von Brückner, Gnielka, Lerner, Meyhöfer € 16,00

M 136: **Verkehrssicherheit von ausländischen Arbeitnehmern und ihren Familien**
Funk, Wiedemann, Rehm, Wasilewski, Faßmann, Kabakci, Dorsch, Klapproth, Ringleb, Schmidtpott € 20,00

M 137: **Schwerpunkte des Unfallgeschehens von Motorradfahrern**
Assing € 15,00

M 138: **Beteiligung, Verhalten und Sicherheit von Kindern und Jugendlichen im Straßenverkehr**
Funk, Faßmann, Büschges, Wasilewski, Dorsch, Ehret, Klapproth, May, Ringleb, Schießl, Wiedemann, Zimmermann € 25,50

M 139: **Verkehrssicherheitsmaßnahmen für Kinder – Eine Sichtung der Maßnahmenlandschaft**
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Schmiedel, Moecke, Behrendt € 33,50

M 141: **Die Bedeutung des Rettungsdienstes bei Verkehrsunfällen mit schädel-hirn-traumatisierten Kindern – Eine retrospektive Auswertung von Notarzteinsatzprotokollen in Bayern**
Brandt, Sefrin € 12,50

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2003

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M 153: **Grundlagen streckenbezogener Unfallanalysen auf Bundesautobahnen**
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M 154: **Begleitetes Fahren ab 17 – Vorschlag zu einem fahrpraxisbezogenen Maßnahmenansatz zur Verringerung des Unfallrisikos junger Fahranfängerinnen und Fahranfänger in Deutschland Projektgruppe „Begleitetes Fahren“** € 12,50

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2004

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Verlag für neue Wissenschaft GmbH
Postfach 10 11 10
D-27511 Bremerhaven
Telefon: (04 71) 9 45 44 - 0
Telefax: (04 71) 9 45 44 77
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