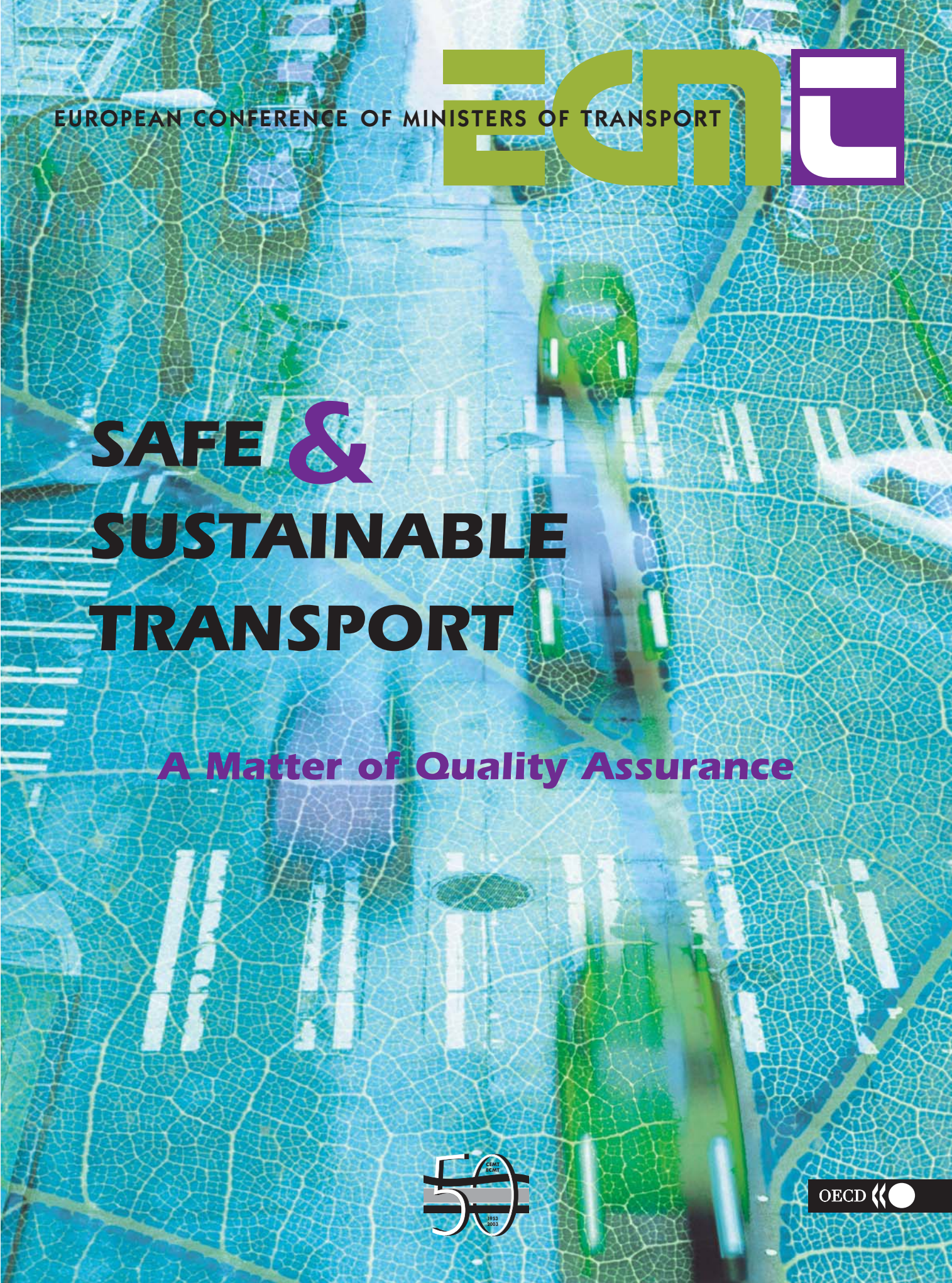
EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT
ECMT
SAFE & SUSTAINABLE TRANSPORT
A Matter of Quality Assurance
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SAFE & SUSTAINABLE TRANSPORT

A Matter of Quality Assurance

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EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT (ECMT)

The European Conference of Ministers of Transport (ECMT) is an inter-governmental organisation established by a Protocol signed in Brussels on 17 October 1953. It is a forum in which Ministers responsible for transport, and more specifically the inland transport sector, can co-operate on policy. Within this forum, Ministers can openly discuss current problems and agree upon joint approaches aimed at improving the utilisation and at ensuring the rational development of European transport systems of international importance.

At present, the ECMT's role primarily consists of:

- helping to create an integrated transport system throughout the enlarged Europe that is economically and technically efficient, meets the highest possible safety and environmental standards and takes full account of the social dimension;
- helping also to build a bridge between the European Union and the rest of the continent at a political level.

The Council of the Conference comprises the Ministers of Transport of 42 full member countries: Albania, Austria, Azerbaijan, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, FYR Macedonia, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Moldova, Netherlands, Norway, Poland, Portugal, Romania, the Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, the United Kingdom and Federal Republic of Yugoslavia. There are six Associate member countries (Australia, Canada, Japan, Korea, New Zealand and the United States) and two Observer countries (Armenia and Morocco).

A Committee of Deputies, composed of senior civil servants representing Ministers, prepares proposals for consideration by the Council of Ministers. The Committee is assisted by working groups, each of which has a specific mandate.

The issues currently being studied – on which policy decisions by Ministers will be required – include the development and implementation of a pan-European transport policy; the integration of Central and Eastern European Countries into the European transport market; specific issues relating to transport by rail, road and waterway; combined transport; transport and the environment; sustainable urban travel; the social costs of transport; trends in international transport and infrastructure needs; transport for people with mobility handicaps; road safety; traffic management; road traffic information and new communications technologies.

Statistical analyses of trends in traffic and investment are published regularly by the ECMT and provide a clear indication of the situation, on a trimestrial or annual basis, in the transport sector in different European countries.

As part of its research activities, the ECMT holds regular Symposia, Seminars and Round Tables on transport economics issues. Their conclusions serve as a basis for formulating proposals for policy decisions to be submitted to Ministers.

The ECMT's Documentation Service has extensive information available concerning the transport sector. This information is accessible on the ECMT Internet site.

For administrative purposes the ECMT's Secretariat is attached to the Organisation for Economic Co-operation and Development (OECD).

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UNE GARANTIE DE QUALITÉ

Further information about the ECMT *is available on Internet at the following address:*
www.oecd.org/cem

TABLE OF CONTENTS

CONCLUSIONS

This document was submitted for information to the Council of Ministers at their Session in Bucharest on 29-30 May 2002 [CEMT/CM(2002)15].

It is based on a draft prepared by Mr. Josef Mikulik, General Rapporteur of the Seminar.

There is a huge need and enormous potential across ECMT to improve road safety policies and practices. Differences in social and political development in ECMT Member countries result in varying levels of traffic safety -- there are countries with a very high level of road traffic safety, countries with some achievements in improving safety and countries with very high accident rates. One of the tasks of ECMT is to help countries with the poorest levels of road safety to improve them, and bring them up to the level of countries with the strongest performance. In other words to create a high level of road traffic safety in all Member countries.

In order to meet this objective and as a follow-up to the Seminar, participants request ECMT Transport Ministers to take note of the outcome of the meeting and of the recommendations as formulated hereafter:

The Seminar noted that:

- Safety should be a prerequisite for mobility. Every citizen has the right to life and health in the context of using the road transport system.

- Road traffic accidents are still a major cause of deaths, injuries and economic loss in ECMT countries.

- In some ECMT countries, even though road traffic safety is seen as important to sustainable transport policy, politicians and general public still do not consider road traffic safety as a major priority.

- Road traffic fatalities are still too often considered as the normal price to pay for mobility.

- Too much responsibility for safety currently lies with the road user. To reduce fatalities and serious injuries, road designers, vehicle engineers and legislators all also have responsibilities. They must plan traffic systems taking full account of the fact that human beings are not perfect and that therefore the traffic system has to be adapted to road user's limits.

- Transport companies together with companies and public authorities that use the road transport system must take responsibility to see that the transport services they purchase or perform with their own vehicles are safe and sustainable.

- Governments should integrate into policy the following factors:

- Use of clear safety indicators that ensure transparency and quality.
- Incentives to achieve safety results.
- A better understanding of the underlying causes of accidents.
- Cultivation of road safety culture in transport companies.

The Seminar made the following Recommendations:

- To promote sustainable mobility, the highest possible priority should be given to road traffic safety issues by responsible Authorities at all levels concerned.

- "A culture of Quality Assurance" must be developed for public and commercial transport services. By culture of quality assurance it is understood that individuals should play an active part in placing demands on society and manufacturers for safe road traffic.

- Comprehensive road safety policies must be developed and implemented; the key components of a strategic, comprehensive approach are as follows:

  - A strong political commitment based on an increased acceptance of road safety as a problem.
  - The development of a safety culture in society, which clearly recognises that road safety is the responsibility of each of us individually.
  - Co-ordination between all of the actors involved, at whatever level.
  - The setting of road death and injury reduction targets.

- To verify the effectiveness of measures taken, high priority should be given to evaluation, which should be added to the three already existing road safety principles. This means that a road safety plan should consist of:

  - Engineering measures for roads and vehicles.
  - Education and training.
  - Enforcement of traffic law and regulations.
  - Evaluation of the measures taken.

- Dynamic safety standards should be applied to all components of the transport system to stimulate continuous development. In particular this applies to:

  - *Vehicles*, to develop awareness and demand from consumers-buyers, with a view to making safety a major purchase criterion, for the benefit of all road users.
  - *Roads*, to introduce compulsory road safety audits of roads at the construction stage and develop safety assessment methods for existing roads.
  - *Drivers*, to continuously develop and implement improvements of driver licensing systems and further driving education and testing of professional drivers.

- Governments should encourage companies to create better road safety culture and take their own steps to improve road traffic safety for their employees.

- Means for governments and non-governmental bodies to implement ECMT resolutions on road traffic safety and sustainable development need to be strengthened with special attention given to promoting environmentally friendly modes of transport and to the protection of vulnerable road users.

- Although and because there are limits to influencing road user behaviour, incentive programs, enforcement, empowerment and participation processes are all important parts of the overall package of safety measures.

- The possibilities of public/private partnership in developing the quality of safety programs should be explored.

- Closer links among existing road traffic accident databases need to be established with joint use for in-depth analysis to inform development of efficient measures.

- All serious road injuries and fatalities should be investigated in-depth as an essential ingredient of a feed back loop for continuous improvement of the system.

- Road traffic safety research must be continued in ECMT Member countries so that governments have the possibility to use up to date and efficient measures to fight against road traffic accidents. In this context, any piece of work aiming at an improvement of active and passive safety on board vehicles should be promoted at national and international level, without neglecting the negative effects some of those systems may generate.

- Exchange and dissemination of information among Member countries must be enhanced both on best practices and on research results — full account must also be taken of relevant results and recommendations related to road traffic safety and sustainable development elaborated by international non-governmental bodies.

- Broader involvement of NGOs and civil society must be solicited in helping to make road safety a common cause and an issue of public debate.

- Continual dissemination of information on new policies, on road traffic research results, new technologies and expertise is vital to help developing and transition countries in improving road traffic safety:

    - In respect of dissemination of information and exchange of best practices, the work carried out in various International Organisations, governmental and non-governmental, must be taken into full account, and the implication of the most recent ECMT Member countries in this work is highly recommended.
    - In respect of communication, the role of the media is of vital importance. It is therefore important to improve the relations of all actors with the media in order to give a coherent message on road safety.

Introduction

A ZERO VISION AND QUALITY ASSURANCE - TWO CONCEPTS WITH THE SAME TARGET

"What is "Vision Zero"?

Contribution by Claes TINGVALL
Director of Road Safety
Swedish National Road Administration (SNRA)
Borlange - Sweden

On October 9, 1997 the Road Traffic Safety Bill founded on "Vision Zero" was passed by a large majority in the Swedish Parliament. This represents an entirely new way of thinking with respect to road traffic safety.

What is Vision Zero?

Vision Zero is conceived from the ethical base that it can never be acceptable that people are killed or seriously injured when moving within the road transport system. It centres around an explicit goal, and develops into a highly pragmatic and scientifically-based strategy which challenges the traditional approach to road safety.

Vision Zero: goal

- The long term goal is that no-one will be killed or seriously injured within the Swedish road transport system.

A new approach to road safety

For many years, the emphasis in traffic safety work has been in trying to encourage the road users to respond, in an appropriate way, typically through licensing, testing, education, training and publicity to the many demands of a man-made and, increasingly, complex traffic system. Traditionally, the main responsibility for safety has been placed on the user to achieve this end rather than on the designers of the system.

The Vision Zero approach involves an entirely new way of looking at road safety and of the design and functioning of the road transport system. It involves altering the emphasis away from enhancing the ability of the individual road user to negotiate the system to concentrating on how the whole system can operate safely. Also, Vision Zero means moving the emphasis away from trying to reduce the number of accidents to eliminating the risk of chronic health impairment caused by road accident.

Vision Zero: strategic principles

- The traffic system has to adapt to take better account of the needs, mistakes and vulnerabilities of road users.

- The level of violence that the human body can tolerate without being killed or seriously injured forms the basic parameter in the design of the road transport system.

- Vehicle speed is the most important regulating factor for a safe road traffic. It should be determined by the technical standard of both roads and vehicle so as not to exceed the level of violence that the human body can tolerate.

Vision Zero accepts that preventing all accidents is unrealistic. The aim is to manage them so they do not cause serious health impairments. The long term objective is to achieve a road transport system which allows for human error but without it leading to serious injury.

While the concept envisages responsibility for safety amongst the designers and users of the system, the designer has the final responsibility for fail- safe measures.

Vision Zero: system designer has primary responsibility

- System designers are responsible for the design, operation and the use of the road transport system and are thereby responsible for the level of safety within the entire system.

- Road users are responsible for following the rules for using the road transport system set by the system designers.

- If the users fail to comply with these rules due to lack of knowledge, acceptance or ability, the system designers are required to take the necessary further steps to counteract people being killed or injured.

Vision Zero sets out the operational principles which would need to be taken up by citizens, decision-makers, public authorities, the market and mass media if the strategy is to be effective.

Vision Zero: operational principles

- At political level not allowing road traffic to produce more health risks than other means of transportation or other major technological systems.

- At professional level seeing serious health loss due to traffic accidents as an unacceptable quality problem of products and services connected with road transportation.

- At individual level viewing serious health loss as unacceptable, being aware of what it takes to create a safe system, and playing an active part in placing demands on society and manufacturers for safe road traffic.

Action in a variety of fields is needed to produce a safe road system.

Vision Zero: action strategy

- To prevent accidents leading to serious injury.

- To reduce the severity of injury in the event of an accident.

- To ensure that the severity of injuries received is minimised through efficient rescue service, health care and rehabilitation.

A result-based action programme for safe road traffic within the principles outlined above will be defined by the Swedish agencies for future road safety work which should lead to the realisation of Vision Zero in the long run.

In the next ten years, it is estimated that it should be possible to reduce the number of fatalities by a quarter to one third.

The similarities between modern quality and environmental management and the use of a "Zero Vision" concept in the road transport system

Contribution by Kate McMAHON
Head of Road Safety Division
Department for Transport, Local Government and the Regions
London - United Kingdom

This is a summary of the full Powerpoint presentation made at the Conference.

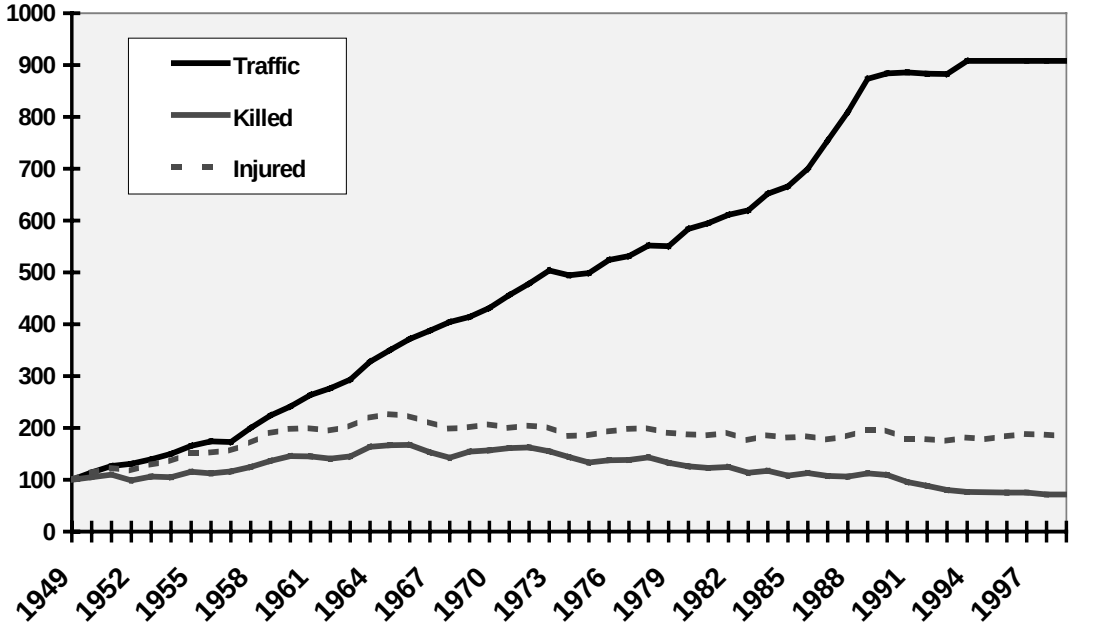
I would like to thank the Conference Organisers for inviting me to take part in this Conference. Road Safety has always been taken seriously in the UK, but it has been given even greater priority since our first road casualty reduction target was set in 1987.

We have had some real success in reducing casualties, and I hope that this presentation will be useful in explaining how we intend to make even more progress in the next 10 years.

I will first set the scene by showing trends in casualties and then explain broadly how the targets for 2010 were derived. I will then outline the strategy and how it is being implemented.

Despite our relatively good record, there are still a quarter of a million road accidents each year in which someone is injured. Probably 10 times as many damage only accidents, which are not systematically recorded in our police accident reporting system.

Figure 1. **Motor traffic and casualties 1949-1999**
1949 = 100

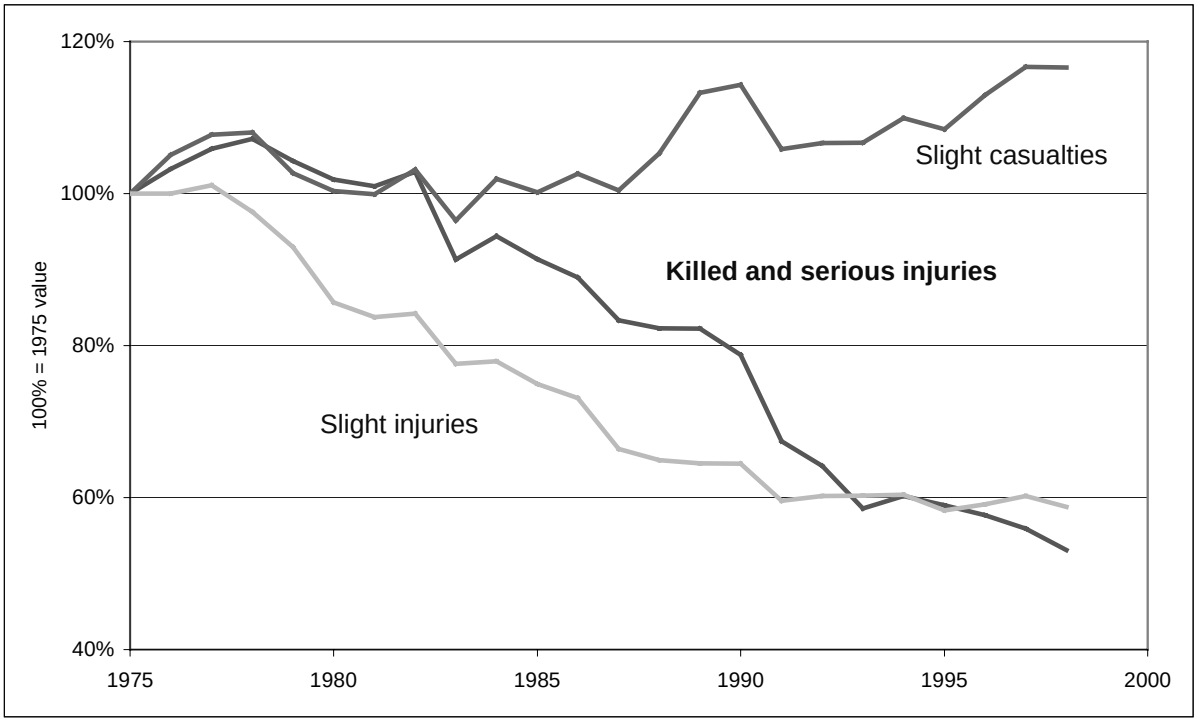


We estimate that in cost-benefit terms the value of prevention of all these accidents is £17 billion, of which £8 billion is direct economic cost. Injury accidents account for £12 billion, including £3.5 billion direct economic cost.

Whilst road deaths have declined since the early 1970s, and injuries have remained fairly constant, traffic has grown fairly steadily and is now nearly 10 times the level in 1949.

Figure 2 sets out the very different trends for killed and seriously injured which have declined significantly since about 1980, and slight injuries which have by contrast continued to grow. But the slight casualty rate, which takes account of the traffic growth shown in the previous slide, has declined steadily.

Figure 2. **Casualties since 1975**



In 1987, the first casualty reduction target was set, which was to reduce all casualties by one third by 2000, compared with the average for 1981-85. Although this target was more than met for fatal and serious casualties, the growth in slight casualties meant that there was little improvement in the total.

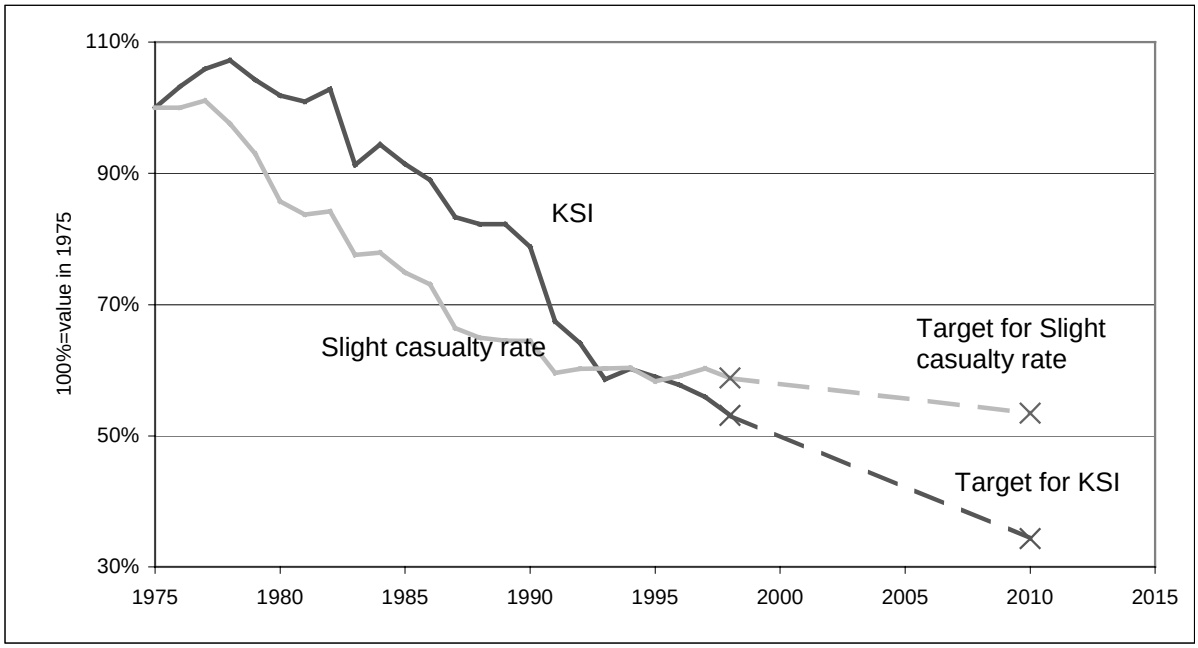
Table 1. **The target for 2000**

Severity	1981-1985 average	2000	Change
Fatal	5 598	3 409	- 39%
Serious	74 534	38 155	- 49%
All	321 919	320 283	- 0.5 %
Casualty rate	108	68	- 37 %

The 1987 target was however very successful in raising the profile of road safety. It was therefore decided, as the target date of 2000 approached, that a new target should be set for 2010. Given the very different trends for KSI (Killed and Serious Injuries) and slight casualties, different targets were set for each. For KSI it is a simple numerical target of 40% reduction, 50% for children, but for slight casualties the target is 10% reduction in the casualty rate.

Figure 3 shows graphically the necessary trends to meet the targets compared with the actual trends since 1975.

Figure 3. **Illustration of the new targets**



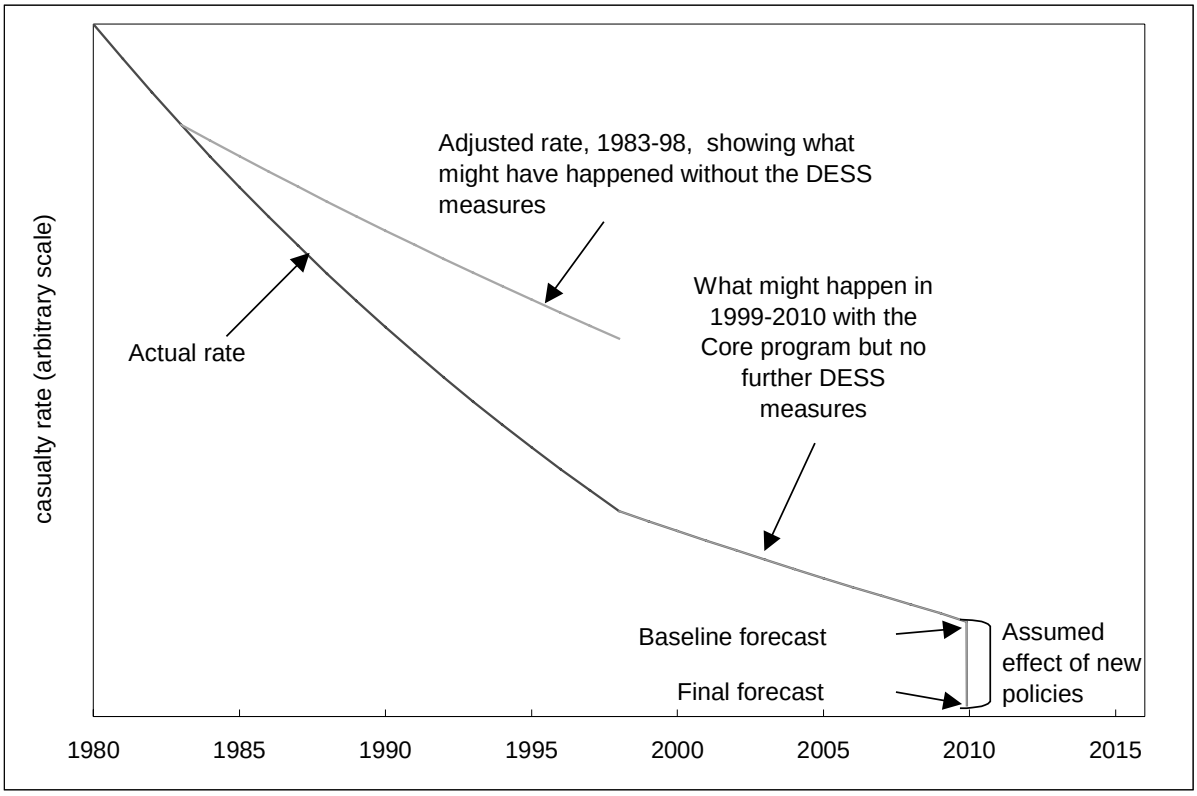
Road Safety and casualty reduction must involve the whole community. Therefore a lengthy process of consultation, advice, and analysis was gone through. This involved a wide range of interests and experts both within government, but importantly also outside government. We consulted on the target date, the type of target, discussed policy options with a consultative advisory group, and TRL did detailed statistical analysis.

Broadly, the methodology for deriving casualty forecasts which was developed by TRL was based on analysis of trends in casualty rates by main road user group, using data mainly for 1983 onwards. The effects of three key policy areas could be identified, and the underlying rates due to the "core" road safety programme were then analysed. The final stage was to build in estimates of the effects of new policies.

The TRL trend analysis showed that it was possible to identify the effects of three policy areas, drink drive, local safety engineering, and secondary safety in cars, termed the DESS measures. The effects of these measures could be isolated, and the underlying trends in casualty rates could be estimated. Thus the first step in the forecasting methodology was to identify what the trends in casualty rates would have been without the effects of all other aspects of road safety policies, the "core" road safety programme. All the underlying trends were downward except for the slight casualty rate for car users.

The next stage was to extrapolate the underlying casualty rates forward to 2010 for each road user group separately. These casualty rate forecasts were then converted into forecasts of casualty numbers by applying them to a range of scenarios for traffic growth. There is considerable uncertainty about future trends in traffic growth. It was therefore decided to include for each road user group a broad spectrum of possible traffic scenarios.

Figure 4. **Illustration of forecasting method**



Obviously it would be an unmanageable task to consider all possible combinations of traffic growth scenarios. It is unlikely that certain combinations e.g. high traffic growth with high growth in both walking and cycling, would occur. Therefore, in order to contain the final number of scenarios, the twelve most likely combinations of motor vehicle, pedestrian and cyclist traffic were combined with the three motorcycle scenarios to produce 36 scenarios in all. For each of these scenarios baseline forecasts of casualties in 2010 were produced for each road user group using separate models of casualty rates for each group.

The baseline forecasts set out in Table 2 assumed no new policy measures. And no further initiatives in the DESS measures. The next step was to consider, in the light of current knowledge, the contribution of possible new policy measures.

Policies were considered under the following headings:

- Road safety engineering.
- Car secondary safety.
- Other vehicle safety.
- Cycle and motorcycle helmets.
- Rural roads.
- Novice driver safety.
- Pedestrian and cyclist protection.
- Speed reduction.
- Child protection.
- Driver behaviour.
- Drink-drive.
- Work related driving.

For some measures in the upper half of the list, reasonably good numerical estimates of the likely effects of particular policies were available. For other policy areas, it was more difficult to provide clear numerical estimates. For these, goals were set for what, on the basis of available analysis, was considered to be realistic estimates of what could be achieved with new policy measures.

The assumptions on the percentage reductions in casualties by road user group were applied to the baseline forecasts for 2010 to produce for each scenario new casualty forecasts by road user group for KSI and slight casualties separately. These forecasts therefore represent what could be achieved by 2010 if all policies under consideration were pursued effectively and with reasonable success between now and 2010.

The results of this modelling work were used to inform further work on policy development and the final choice of the new targets for 2010.

Table 2. **Assumed effects of new policies (in %)**

	KSI	Slight
New road safety engineering programme	7.7	6.9
Improved secondary safety in cars	8.6	
Other vehicle safety improvements	4.6	3.6
Motorcycle and pedal cycle helmets	1.4	
Safety on rural single carriageways	3.4	1.2
Reducing accident involvement of novice drivers	1.9	2.6
Additional measures for pedestrian and cyclist protection	1.2	0.8
Speed reduction	5	5
Child protection	1.7	1.1
Improved driver behaviour	1	1
Reducing casualties in drink / drive accidents	1.2	0.8
Reducing accidents during high-mileage work driving	1.9	2.3
Combined effect	**35**	**23**

In March 2000, “Tomorrow's Roads - Safer for Everyone” was published which set out the new targets and the strategy that is being adopted to achieve them.

Key policies in the Strategy are:

- Priority for child safety.
- Improvements to road safety education and training.
- Local authorities to have specific child safety measures in their local transport plans.
- Improvements to driver training and testing.
- Add hazard perception to theory test.
- Develop a framework to help local authorities to set appropriate speed limits.
- More effective enforcement of speed limits including financing speed cameras.
- Change attitudes to inappropriate speed through education and publicity.
- Encourage walking and cycling by improving safety.
- Wider access to rehabilitation schemes for drink-drive offenders.
- Improvements to vehicle design for protection of occupants and pedestrians.
- Review road traffic penalties (to consider, for example raising the max penalty for careless driving from a £2500 to a £5000 fine; a new offence of driving far in excess of the speed limit; penalties for unlicensed and uninsured driving).

We are now in the process of implementing the Strategy. The key tools are engineering measures for roads and vehicles; education and training; and enforcement of traffic law and regulations.

Different policies will require a different mix of these tools:

- Drink drive policy, for instance, requires both enforcement and education, using both together with publicity, to change drivers' behaviour.

- Speed is another key policy area. Enforcement, particularly speed cameras, is very important, but engineering, (traffic calming etc), and education and publicity to change attitudes and behaviour are also necessary.

- Child safety requires education and practical training for both children and drivers, together with engineering measures, particularly in residential areas, and some enforcement e.g. Of speed limits.

A strategic approach has been adopted to both developing and implementing the GB Road Safety Strategy and targets. The key elements are:

- Commitment from all.
- Partnership with key players.
- Consultation throughout.
- Continuing evaluation.

The development and implementation of the Strategy required strong commitment from within Government. The actual Strategy was a result of several years of hard work and co-ordinated planning between Government Departments. It was important to obtain agreement on key policy areas. This carefully co-ordinated approach ensured that the main elements of the Strategy had inter-departmental support, and also the planning process opened up new opportunities for working together which have been sustained in the implementation. All relevant government departments take account of road safety targets where applicable to their own policies.

The Strategy was launched by Prime Minister Tony Blair, which ensured it had a high profile, and with wide involvement, including the devolved administrations in Scotland and Wales.

Implementation of road safety measures requires commitment and action from a wide range of people in partnership. Within central government the key Departments outside DTLR are health, particularly on issues concerning alcohol and drugs; the Health and Safety Commission on work related accidents; and Education concerning road safety education in schools. Local government, through local highway authorities, is an important deliverer of road safety since most accidents occur on local roads, not on the main motorway network. Local authorities must set their own targets, and work to new public service agreements. In many areas formal partnerships have been set up, for example involving local authorities and the police in combating crime. The new system for funding speed cameras, which involves partnership of police, local authorities and courts, is another good example. Health authorities are also increasingly eager to work with local highway authorities in accident prevention. There is continued need for "joined up" government where policies overlap, particularly in the areas of health, accident prevention, education and enforcement.

An important part of the process of developing the strategy was consultation with a wide variety of stakeholders. This has continued with the setting up of the Road Safety Advisory Panel and its sub-groups, who are part of the process of implementing the Strategy. It is through such consultation that continuing commitment is sustained. There are many road safety interest groups, and groups representing particular road users or transport and industry concerns, e.g. motor manufacturers and freight associations. All stakeholders must be involved in the political process. Local authorities must

set their own targets, and work to new public service agreements. It is also vital that individual road users - drivers, motorcyclists, cyclists and pedestrians, are involved through publicity campaigns and through training and education. The media have a role to play as often media reports highlighting road safety issues can have more impact than paid advertising. The European context is very important, particularly in areas such as vehicle standards, drivers licensing, driver's hours. The Government cannot achieve such a major improvement in road safety on its own and support and action from all is vital.

As well as implementation of policy, it is also crucial to carry out policy monitoring and evaluation. We monitor policy implementation and try to estimate the effects of particular measures, and we are tracking trends in casualties. We also track the effects of publicity campaigns. Much of this forms part of our research programme.

We will also, next year, carry out the first detailed three year review of the strategy and progress so far towards the targets.

Finally, to sum up, the process of developing the strategy and targets was not quick and easy. It took several years of detailed analysis, research and consultation. The most important thing is that all the players sign up to it and are committed to implement it.

The Approach to Road Safety in the Czech Republic

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Ministry of Transport and Communications
Prague - Czech Republic

Introduction

As in most European Countries, the development of sustainable transport systems has become one of the priorities of the Transport Policy approved by the Government of the Czech Republic. The requirements of the EU association process as well as the ECE UN and ECMT/CEMT membership provided the framework for Czech Transport Policy in the field of road traffic. The Ministry of Transport and Communications has made and continues to make great efforts to implement EC legislation, the EU Action Programme on Road Traffic Safety recommendations, the White Book on Implementation of the EU Transport Policy recommendations, and other internationally recognised policies and documents into national Acts and regulations as well as governmental recommendations and materials of the Czech Republic.

Transport network development policies, as well as other important related decisions, are carefully evaluated in terms of their effect on the environment, transport safety and possible socio – economic factors. Systems of public mass transport are expressly supported in order to increase the interest in public transportation and to decrease the use of private means of transport. Serious attention from all levels of state authorities is given to non-motorised transport, especially cyclist and pedestrian.

Road Traffic Safety

The endeavour to improve road traffic safety, one of the main priorities of the Ministry of Transport and Communications, is an international concern as well. The idea of creating a uniform European transport environment, in which safety and ecological issues are priorities, is not unique to the European Union. This idea is also based on fundamental ECE UN international documents and ECMT/CEMT recommendations, bodies in which the Czech Republic has been an active member for many years. More and more attention is being given to safety issues in road construction, the use of safe and environmentally friendly vehicles, as well as the training and education of road users. All these areas were intensively supported by the recent adoption and amendment of a large dossier of Acts and regulations.

The above mentioned steps began in the first half of the 1990's, when Yearly Police Accident Statistics showed a very unsatisfactory trend in the consequences of accidents, demonstrating a need to take resolute steps to improve road traffic safety. It was clear that not all accident consequences should be taken into consideration in this trend, because of the dramatic increase of motor vehicles by 5% per year.

Due to the heightened interest of the Ministry of Interior, the Police Force of the Czech Republic, the Ministry of Transport and Communications and all other actors on road traffic safety, this trend

was changed during the second half of the 1990's. It showed a decrease in accident consequences per vehicle kilometres travelled.

Road Accidents and their consequences – where we are?

While thinking about suggested measures to improve road traffic safety, it is useful to compare the situation in the Czech Republic with that in other countries, especially those in the EU, and in other member countries of ECMT/CEMT. It is necessary to stress that in the EU countries road traffic safety is a political and transport priority with special attention given to the long term. This is the reason why road traffic safety is an important evaluation criterion of the Czech Republic during the EU accession meetings.

One of the basic criteria for consideration of the Czech Republic's position among other European Countries and other OECD countries is the number of fatalities per 100 000 inhabitants. In countries where basic European concepts of road traffic safety improvements have been carried out, a comparison can be made between the Netherlands, Sweden and the United Kingdom on one hand, and selected countries of Central and Eastern Europe on the other. In the case of the Czech Republic the comparison of fatalities per 100 000 inhabitants is almost two times higher than in the above mentioned EU countries, but comparable with some other countries, especially from the Mediterranean Region.

Overall long term development of fatalities in road traffic can be shown by comparing the Czech Republic with Sweden. This comparison is very relevant not only because Sweden is among those countries with the lowest number of fatalities, but especially because the difference in the number of inhabitants is small. Looking at this comparison it is clear that the achievement of desired results is possible only through long term, systematic road safety work accompanied by long term stabilised social development of the society as a whole.

During the decade of the 1990's, the number of fatalities ranged from 1300 to 1600 per year. On the basis of an in depth analysis, the following most problematic areas were selected.

Speeding

As in many countries, speeding is one of the most often cited, long term causes of very serious road traffic accidents.

Speed was substantially reduced by a very important legislative change in 1997: the speed limits of 50 km/h in urban areas and of 130 km/h on motorways and dual carriageways were introduced.

During the first year of its existence, this measure contributed in a substantial way to a decrease in the number of persons killed in traffic, but in the long term this effect has diminished. It was shown that for the enforcement of the speed limit it is necessary to introduce more frequent police intervention, accompanied by suitable public education provided by the media. Also important is relevant road layout in urban areas to prevent drivers from travelling over the speed limit.

Use of Passive Safety Devices

Among other important factors in plans to decrease road traffic accident consequences is the use of seat belts by drivers and all passengers. Seat belt use has been at a very low level for a very long period, especially in urban areas. The last survey on this topic in the Czech Republic was executed in autumn 2000.

The survey brought to light the following important information:

- Although the legislation of 1997 obliged road users to wear seat belts in cars, most drivers and passengers in particular, ignore this obligation.

- The highest rate of use was observed on motorways (app. 80% of drivers and passengers); on lower class roads the number of people wearing seat belts decreased. In urban areas the rate is about 45% of drivers and passengers in front seats.

- Persons in rear seats do not wear seat belts in most cases.

Vulnerable Road Users

A particularly alarming feature is the very high percentage of fatalities from road traffic accidents of vulnerable road users – cyclists and pedestrians - especially in urban areas. On the other hand it should be stated that due the efforts of all actors involved the situation is getting slowly better.

Other Important Aspects

As can be seen from other in depth analyses of road traffic accidents, it is necessary to stress some other factors to be considered during the introduction of new measures for road traffic safety improvement. They are as follows:

- New drivers licence holders (up to 2 years) are involved in road traffic accidents by app. 25%.
- Accidents caused under the influence of alcohol represent about 10 – 15% of fatalities, which is, compared to EU figures, a relatively low percentage.
- Fatigue of professional drivers.
- Differences in the ages of cars within the vehicle fleet.
- Continual lack of finance for road maintenance and development.

Economic Losses due Road Traffic Accidents

Financial loss associated with the consequences of road traffic accidents is another very important factor to evaluate. In 1999, overall losses caused by road traffic accidents reached the level of 2.2% GDP of the Czech Republic and the direct costs of road traffic accidents were 4.1% of the national budget. Because this data does not mention peripheral costs e.g. damage to the environment, loss of compensation, etc. it can be stated that the real costs to society are much higher.

Steps on the Way Towards Sustainable Mobility

The Czech Republic gives continuous attention to solving problems related to road traffic safety and to the protection of the environment. All these activities are supported by changes in national legislation concerning problem areas to bring it closer to EC legislation. From the point of view of road traffic safety the following key steps for better co-ordination have been taken:

- Introduction of the 50 km/h speed limit in urban areas, introduction of variable message signs, etc. (1997).

- Transfer of the Governmental Co-ordinating Body for Road Traffic Safety from the Ministry of Interior to the responsibility of the Ministry of Transport and Communications. This transfer was executed from 1.1.1999.

- Adoption of the Action Programme on Road Traffic Safety by the Government's Decision of 19th October 1998. One of the key features of this Programme was to assure the preparation of a nation wide System Programme on Road Traffic Safety.

- Adoption of a large dossier of Acts and regulations, concerning the areas of human factor as well as vehicles and roads:

  - Act No 247/2000 on Obtaining and Improving of Professional Competence for Driving a Vehicle an on Changes of Some Acts (in force since 1st January 2001).
  - Act No 361/2000 on Traffic on Road and on Changes of Some Acts, as amended (in force since 1st January 2001).
  - Act No 56/2001 on Conditions of Vehicles on Roads and on Change of the Act No 168/1999 on Third Part of Insurance and on Changes of Some Other Related Acts, as amended by Act No 307/1999 (in force since 1st July 2001).

The above mentioned legislation gives authority to state officials and Police on issues of road traffic. Compared to previous legislation the responsibility of the Ministry of Transport and Communications has been reinforced.

Among the key measures that have come into force since 1st January 2001 are the following:

- Priority for pedestrians on pedestrian crossings.
- Daytime running lights during the period of wintertime.
- Priority of vehicles on roundabouts.
- Obligatory use of child restraint devices.
- Obligatory use of cycle helmets for children up to 15 years.

And other measures:

- Education and training of professional drivers.
- Common system for the training and testing of drivers licence applicants.
- Protection of vulnerable road users.
- Black spots solution.

Through adoption of the above mentioned legislation the Czech Republic has come closer to legislation in the EU countries, in terms of administrative structures as well as adoption of measures, and in some cases terms are stricter than those in EU countries (day time running lights, obligatory cycle helmet use).

Programme on Decrease of Accidents and Their Consequences in Road Traffic for the Period 2002 – 2005, with Prognosis up to YEAR 2010 adopted through the Czech Government's Decision of 18 July 2001

The basic approach in the evaluation of road traffic safety is to keep in mind this principal question:

- What level of safety is "enough", or in other words:
- How many people killed on Czech roads can society tolerate?

The Goal of the Proposed Programme

The goal of the proposed Programme is to decrease road accidents and their personal and social consequences to a level compatible with that in EU Countries.

Principles

The main principles to achieve this goal are:

- Co-ordination of the measures to be taken in the spheres of legislation and organisation, human factor, vehicle and road.
- Process of incremental steps during the realisation of the Programme and its measures.
- Timely implementation of the main measures of the Programme into the Yearly Implementation Programme.
- Adoption of measures with clearly defined quantitative and qualitative coefficients for all organisations and institutions involved.
- Regular evaluation of the efficiency of adopted measures and their actualisation.
- Public involvement in the process of both preparation and realisation of the Programme.

Assumption of Effective Realisation

Basic conditions to achieve these goals are:

- The adoption of the Programme by national state authorities.
- Assuring the co-ordination of all activities and actors involved in the process of road traffic safety.
- Giving all adequate measures to regional and local levels.

- Assuring all necessary competencies and personal responsibility on all levels.
- Assuring necessary financial sources.

Targeting the Programme

The proposed Programme is divided into measures in the following areas:

- Organisation, legislation.
- Human factor.
- Vehicle.
- Road.

The above mentioned list of areas should not be considered as a hierarchy of priorities. Only the complex and co-ordinated approach of all actors can bring about a decrease in the accident rate. Nevertheless, in some cases we should indicate some preferences. A comparison of road accident statistics for the last ten years in the Czech Republic with the EU Countries shows that in some measures, especially in terms of vehicles, the Czech Republic is not far behind EU demands, but in other areas we have some reservations.

Another aspect of road traffic safety improvement is its integration into a sustainable development strategy. Road traffic safety must be an integral part of environmental protection. This means that measures included in the Programme should be in line with environmental protection principles because road traffic safety is one of the necessary conditions of a high quality environment.

The proposal is based on analysis of all available databases, research results and international best practices.

The proposed measures have a systematically based character and their concrete results, including quantitative and qualitative goals will be specified in the Year Implementation Plans. The achievement of positive results in terms of a decrease in the accident trend assumes an increase in Police enforcement and punishment of offenders.

Organisation and Legislation

Improvement in the organisation of road traffic safety programs can be expected after some of the responsibilities have transferred from the Ministry of Interior and the Police Force respectively, to the Ministry of Transport and Communications and Regional Authorities, which is based on Acts No 247/2000, No 361/2000 and No 56/2000.

One of the basic assumptions for the successful implementation of the whole Programme is the co-ordination of all activities in the field of road traffic safety. This function will be assured by the Co-ordination Council of the Minister of Transport and Communications on Road Traffic Safety (BESIP), approved by the Czech Government Decision No 505 of 21st May, 2001.

Within this co-ordination it is necessary:

- To set unambiguous, defined, quantified and yearly targets for the co-ordination bodies of all state authority levels in the Implementation Plan.

- To implement Road Safety Plans at all state authority levels. Within this framework, to motivate lower bodies of state authorities to adopt efficient measures to increase road traffic safety.

- To stabilise or create co-ordination bodies in regions and towns with the priority task being the decrease of road traffic accidents in their respective region or town. The members of these bodies should consist of representatives of regional, county or local authorities, Police, road administrators, and representatives of other organisations and institutions that influence road traffic safety, as well as other experts such as pedagogues, transport psychologists, or judges.

- To implement rules of road traffic safety into all phases of the process of land planning (reduction of unnecessary transport).

- To continuously improve the rescue system and post trauma treatment of road traffic accidents victims.

- To create conditions for the harmonisation, linkage and efficient use of the databases related to road traffic safety within various bodies of the government.

- To efficiently involve non-governmental bodies, professional associations, etc. in the road traffic safety improvement process, including co-operation with representatives of international projects that have direct links to transport safety.

- To finish amendments of relevant legislation and to finish changes of organisational structures related to road traffic safety. Within this, to assign personal responsibility for assuring road traffic safety improvements based on an established plan of tasks that are described in quantitative terms.

Human Factor

Human factor is a wide area for the implementation of road traffic safety measures which can make an impact on individuals, social groups and the public as whole. Human factor can be influenced by education on legislation and behaviour in road traffic and by providing actual information on the traffic environment, as well as the use of police surveillance and restrictive measures.

Training and Education:

- To inform the public thoroughly and develop their support for road traffic safety measures by convincing them that road traffic safety is a very serious problem of society. To do this by informing them about the consequences of accidents, measures taken, and the expected results these measures will achieve.

- To create a system of reliable and topical information on the transport environment, the traffic situation and on acceptable behaviour in road traffic.

- To create a uniform and methodological background for road traffic safety campaigns in the Czech Republic. To develop these campaigns on both regional and local levels, aimed at concrete target groups and concrete problems; to co-ordinate with other measures, especially traffic law enforcement.

- To observe the rules established by state authorities to operate driving schools and to execute the tests.

- To assure the adequate and systematic traffic education of children in school from kindergarten and up, based on the implementation of our own experiences and on best practices from abroad. Direct greater attention to the support of traffic education in families.

- To establish specialised workplaces for the expert state supervision of AETR and ADR agreements and related Czech legislation, the weighing of vehicles and the observation of relevant articles of legislation related to the storage of vehicle loads.

Vehicles

The Czech Republic achieved the highest progress in this area from the point of view of EU standards implementation. It will be necessary to implement consistently ECE-UN and EU technical standards and regulations during the next period.

Roads

High quality road maintenance has a direct impact on road traffic safety and is thus a necessary condition for the successful operation of suggested safety measures.

- To create conditions which assure a high level of road maintenance.
- To give attention to solving black spots.
- To improve the level of roads in a manner that provides a more precise localisation of accidents, including the preparation of road signage.
- To implement road engineering measures to protect vulnerable road users.
- To prepare drafts on how to use road safety audits on newly constructed roads and then on existing roads.
- To modify incrementally the road signage system and bring it into line with valid principles for road signage and marking.
- To implement the telematics.

Road Safety Research

Road safety research plays an important role in road traffic safety by searching for efficient measures for its improvement. Research is an integral part of the entire process of road accident databases evaluation, the drafting of measures and their implementation and the evaluation of the whole system as well as its particular parts. The inclusion of research in the process of road traffic safety improvement is a matter of course in all countries with high levels of road traffic safety.

It is necessary to focus research on the following areas:

- The theoretical background of road traffic safety and its practical implementation, including links with EU research activities.

- Systematic analytical work on road traffic accident trends and on particular factors influencing them, including clinical analyses of accidents.

- Social and psychological aspects of road users' behaviour and possible methods to influence them.

- Implementation of new measures in prevention.

- Systematic evaluation of the efficiency of particular measures adopted abroad and the verification of best practices, especially in the form of pilot projects.

- Evaluation of the efficiency of telematics systems in road traffic.

Conclusion

The long-term vision of the proposed Programme is an endeavour which aims to continuously decrease road traffic accidents and their consequences. This task can be achieved only if the measures adopted in the areas of organisation, legislation, human factor, vehicle and road are closely linked together. The entire concept is organised around these areas and is based on the assumption that road traffic safety is a cyclical and on going process.

The efficient implementation of the drafted Programme on Road Traffic Safety Improvement assumes a regular evaluation of the efficiency of particular measures applied, their innovation and last but not least, the involvement of the public in the process of its preparation and implementation. It will be necessary to fulfil basic conditions: complete co-ordination of all activities and actors involved in the process of road traffic safety, adoption of the Programme on a national level by the central state authorities in the form of a binding decision, provision of adequate support measures to regional and local levels, the assurance of all necessary competencies and personal responsibility on all levels and the assurance of all necessary financial sources.

We hope the ECMT will be an important partner of the Czech Republic in its endeavour to improve the transport system in the future.

Safe and Sustainable Traffic in the Republic of Serbia

Contribution by Marija Roseta VUKOSAVLJEVIC
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Present Status in the Republic of Serbia

The overall volume of traffic streams was in continuous growth until the beginning of the 1990's, while the volume of transported goods has shown a decreasing trend since the beginning of the 1980's, reflecting the deep, but hidden, economic crisis. The twenty year crisis, exacerbated by the isolation caused by wars and extremely strict economic sanctions, has had a disastrous effect on economic potential, has cut the local traffic in half and has prevented the address of issues concerning transit. Changes in state borders have brought about a re-allocation of traffic in the network. Over the past ten years changes are noticeable in the characteristics of the vehicles in use, whose impact on the costs of transportation is not negligible.

The general status of traffic in Serbia is estimated as very bad and worrying. This estimate is valid for all elements of the traffic system. The number of employees in road traffic in the year 2000 was 45 600, which represents 3.4% of the total number of employees in the Serbian economy.

Road infrastructure

The total length of all roads in the territory of Serbia is 50 497 km, of which highways account for 6 222 km, regional roads for 12 650 km, and the rest is accounted for by local roads. 59.8% of all roads are asphalt-paved. The road network density is 0.49 km/km^2, while in Romania it is 0.66, in Hungary 1.71 and in Greece 3.56 km/km^2.

Several decades of insufficient capital and irregular maintenance of the road network (all funds available had been used for new construction) have reduced all road performance to a very low level.

The status of the highway and regional road network is generally very bad (53%), or bad to medium (45%), while the sections of the road network that could be categorised as good, very good or excellent account for not more than 2.5% of the highway and regional road network.

It is important to note that since the disintegration of ex-Yugoslavia, there has been a re-allocation of traffic streams, so that at present the major traffic arteries are: the Hungarian border-Belgrade, Belgrade-towards Montenegro, Belgrade-Niš, Niš-Bulgarian border, and Niš-Macedonian border. One of the significant characteristics of the road network in Serbia is that capacity is not expected to be exhausted in the near future, with the exception of access roads to Belgrade. However capacity will be exhausted in this same future time frame on most other arteries.

Vehicles

According to data for the year 2001, the total number of motor and towed vehicles in the Republic of Serbia was 1 666 347, while the number of passenger vehicles was 1 443 057. The average age of passenger vehicles in private ownership is over 10 years, while the average age of

freight vehicles and buses is 13 years. There is an extremely low level of technical adequacy of vehicles in traffic, approaching even 50%.

The condition of vehicles in traffic in Serbia is consequently a factor in the increased danger in traffic, increased fuel consumption and increased negative environmental impact.

Safety in traffic and legal regulations

For the purpose of improving traffic safety, the fining policy for traffic violations has been changed. As of the beginning of this year the number of fines for traffic violations increased 7 to 10 times, and the number of traffic violations has been reduced.

A new modern law of road traffic dealing with safety in traffic, in line with trends in traffic and harmonised with European regulations is presently in preparation.

A new law on public transport is also in preparation to introduce licensing for public line passenger transport, whereby an open market of transport services will be established. This will significantly influence the quality of services provided, environmental protection measures and the more efficient use of resources. At the end of 2001, changes and amendments were made in this law, so that at present public inter-city transport is within legal frameworks.

A new law on roads is also in preparation, which will provide for more efficient management and control in the field of road infrastructure.

A contract has been signed with the US Company 3M, which specialises in traffic signalization, so that the status of horizontal and vertical signalization will improve.

A program for the renewal of bus fleets has been drawn up, providing also for the engagement of local manufacturers, which is expected to contribute to a significant improvement in the age structure of the bus fleets in Serbia.

Several public campaigns have been launched with the aim of improving safety in traffic for specific groups of participants in traffic, primarily children.

The measures to be intensified in the future concern the fields of manufacture and the import of vehicles. Check-ups and controls in the areas of vehicle quality, servicing, maintenance and technical adequacy, fuel and lubricant quality, road maintenance (signalization, stops, help services), traffic management in cities and on roads outside cities, training of drivers and other participants in traffic, enforcement of a quality traffic safety system, and other measures will contribute to traffic safety.

Works on the roads infrastructure

The degree of utilisation of roads is relatively low, so that fluidity, accessibility and the protection of pre-existing infrastructure facilities are the primary criteria for new investment.

A study of priority investments in the road infrastructure in FR Yugoslavia has been made for the main traffic corridors, based on which reconstruction works and construction of new roads will be undertaken.

Since very little had been invested in the maintenance of the road infrastructure, one of the priorities now is to bring road quality to a satisfactory level. The financing provided for maintenance, rehabilitation, reconstruction and new construction for the year 2002 will be 2.5 times higher than in the previous year, i.e. about 5 times higher than in the year 2000.

During the year 2001, about 82 million Euros were invested in road maintenance, rehabilitation, reconstruction and new construction.

Funds are utilised by respecting the priorities set according to traffic load, the actual condition of the road, and financial justification of the investment.

Safety

The ratio of motorization in the Republic of Serbia compared with European countries is very low (184 vehicles per 1 000 inhabitants), and due to the low standard of living, mobility is still very low. Despite these facts, the level of danger in traffic is very high. In terms of number of traffic accidents, the Republic of Serbia is unfortunately one of the highest risk countries in Europe.

The total number of traffic accidents in the year 2000, was 48 650, with 1 048 people killed, and 16 547 people injured.

The most frequent cause of traffic accidents is speeding and driving at speeds not appropriate to the existing conditions. Most accidents occur on city and town streets and on sections of highways and regional roads that pass through settlements.

One of the indicators of the state of traffic safety in Serbia is the number of people killed per 10 000 passenger vehicles, which is 7.3. For the European Union countries and USA this indicator is about 2, for Central Europe it is about 5, for Eastern Europe it is about 20/25, while in Asia it is about 40. Table 1 presents a comparison between the situation in traffic safety in Serbia, Poland and Hungary.

Most parties responsible for traffic accidents are characterised by insufficient training, lack of discipline and non-compliance with traffic regulations.

Signalization on all roads is very bad, for both horizontal and vertical traffic.

It is also a fact that the public lacks awareness about the negative effects of traffic and its consequences, in terms of traffic safety and environmental protection.

Most citizens are not familiar with concepts of sustainable development or sustainable mobility, and those who are find them difficult to comply with. To a certain degree this is a consequence of the desire for an increased standard of living and the satisfaction of basic needs. In this context, the negative effects of general development, including traffic development, have been marginalized.

Table 1. **Road Safety in Serbia, Poland and Hungary**

	Serbia	Poland	Hungary
Population	7 822 795	38 644 000	9 000 000
Number of motor vehicles*	1 666 347	13 616 000	2 840 187
Number of private vehicles	1 445 057	9 673 000	2 302 000
Degree of motorization	185	220	268
Number of accidents	48 650	57 331	17 493
Number of killed	1 648	6 294	1 064
Number of injured	16 547	71 638	16 429
Number of killed per million population	134	168	118
Killed / 100 accidents	22	11	6.1
Killed / 10 000 private vehicles	7.3	6.5	4.5
Accidents per million population	6 219	1 484	1 944
Accidents / 1 000 motor vehicles	29.2	4.2	6.2

Activities that have been undertaken

Intensive activities are being undertaken to improve safety, but due to lack of financing and due to the grave, pre-existing situation, the effects of such measures are still not very noticeable. Activities have been undertaken in all fields relevant to traffic, with emphasis on the objective of harmonisation with the concept of sustainable development.

The sustainable development concept, defined as development which covers all its expenditures during its exploitation period, and is not undertaken at a cost to future generations, is the only logical and right development concept.

Within the sustainable development concept, appraising development alternatives is of utmost significance. The process of social development that was initiated after the democratic changes in Serbia also includes traffic development. Traffic is a complex system and its planning and development is carried out in stages involving all system elements. It is understood that throughout this process, the direction of the overall development of the traffic system and its possible negative effects must be kept in mind.

Special attention is paid to developing the traffic system in Serbia with respect to its surroundings and Europe. Here the exchange of knowledge and experience is of great importance, in terms of legal regulations and with regard to Serbia joining the work of international organisations.

However, the financing available is not nearly sufficient to improve the road infrastructure to a satisfactory level in a short period of time, and therefore the assistance of international financial institutions is necessary.

During the year 2001, apart from regular road maintenance, most works were carried out on the highway and regional road network, primarily rehabilitation and reconstruction of the most critical sections.

Major investments planned for the future period include the construction of a highway Belgrade-Novi Sad-Hungarian border, Niš-Dimitrovgrad-Bulgarian border, and completion of works on the highway section Niš-Macedonian border, whereby the Corridors will be operating as part of the traffic network.

One of the major investments planned for the future period, in line with the concept of sustainable growth, is the completion of works on the construction of a bypass around Belgrade.

Studies concerning traffic accidents point out 26 black spots on the road network, whose improvement is planned for the year 2002.

Sustainable development - increasing public awareness

Implementation of the sustainable development concept depends primarily on the degree of public awareness about the necessity of adopting this concept in all fields of human activity.

The sustainable development concept in the field of traffic means the optimal utilisation of resources. It is implemented through traffic planning in line with environmental planning and sustainable mobility. This would require the optimal use of individual passenger vehicles, priority to public transportation, reduction of fuel consumption, a change to alternative means of transportation and protection of all resources, including human resources.

By signing the Declaration of Ministers and high representatives of countries participating in the "Day without automobiles", Serbia has joined the European initiative "To the City without an automobile". This is based on the concept of sustainable mobility in cities by increasing public awareness of the negative effects of automobile use and encouraging the change to alternative means of transportation. 18 towns in Serbia participated in this initiative in the year 2001, and according to results we expect a positive educational effect.

One of the principal tasks is to garner intensive participation of professional organisations, and non-governmental organisations, in all activities related to the field of road traffic, in terms of safety and the reduction of negative effects of traffic on the environment.

Part I.

SAFE AND SUSTAINABLE TRANSPORT FOSTERS NEW RESPONSIBILITIES

ROLE OF THE CONSUMER / BUYER / FORWARDER IN THE TRANSPORT MARKET TO CHANGE MENTALITY

How can one express a demand for safe and sustainable transport in order to get a proper supply?

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1. QUALITY ASSURANCE ON ROAD TRANSPORTS – AN INTRODUCTION

1.1 What do we mean by "a proper supply"?

To me a proper supply is when road transports, to which I am directly or indirectly responsible, corresponds with the goals set out for road safety, environmental protection, a good working environment and other goals vital for the activity concerned.

The traditional way of dealing with road safety and the environmental problems is to implement new and more restrictive laws and regulations, to increase police enforcement and to give more education, training and penalties. All these measures are important, but they normally only address one of the persons involved; the driver. The driver himself is of course responsible for his own behaviour in road traffic. But if he fails or disobeys traffic rules then it is, in a last resort, a problem for those ordering the transport, isn't it? Because the driver is only the last link in a long chain from the company or authority that orders the transport (the consumer) to the performer of the road transports and as mentioned in the last place the driver.

If a road transport is of high quality it means that people and goods shall arrive at the right place, at the right time, to the right cost and in the right way. In this context, *the right way* means that there is no danger of serious human injury damage to goods or the environment in connection with the transport. To put almost all this responsibility on the road user is not an efficient way to solve neither the safety nor the pollution problems. The driver him self can in fact not do that much to road safety or the environmental impact of the transport.

1.2 Consumer-demand - an efficient way to secure safe and environmental sound products

Besides demands on the driver and the transport, a demand on the vehicle and its performance is essential. Within the framework of the standardisation work being carried out in the European Union,

requirements are becoming more stringent. This is a time-consuming process and once the requirements have ultimately been established, manufacturers must be given a reasonable amount of time to adapt their products accordingly. Quite naturally, manufacturers do not push developments further than that provided for in the regulations, unless there is an obvious consumer demand.

The standardisation of different products means that they shall fulfil a minimum of safety or environmental requirements. However, in many cases, there are huge differences between, for example, the best and worst car-models. The best possible performance concerning safety and environmental protection is judged in many cases to be much higher than available in the present products on the market. This is obvious when looking at the results of the crash tests of current car models within the Euro NCAP´s programme. The programme is supported by the European Commission in order to give consumers reliable, objective and comparable information about the passive safety performance of individual models.

One of the prime reasons that products are not improved to the extent possible can often be because there is no obvious clear demand for enhanced safety and environmental protection.

Enlightened consumers are those that can put pressure on manufacturers to develop their products above the standards and norms required. Raising the minimum safety or environmental requirement level on products, when defining demands on road transports, is an efficient way to reach the safety and environmental goals in the long term.

1.3 The Vision Zero first enlightened Quality Assurance on road transports

The Swedish Vision Zero presumes a new division of responsibility for road safety within the road transport system. The Vision Zero means, among other things, that companies and public authorities should take considerably greater responsibility for the quality assurance of their road transports, official business trips and so-called work-related trips from a road safety and environmental point of view. If this is done in an organised way throughout the whole society, there will be a significant improvement concerning road safety and environmental issues.

According to the context in the Governmental Bill of 1997 about the Vision Zero, it should be possible to accelerate this process by putting suitable pressure on government agencies, administrations and state-owned companies to initiate action in this field where their operations generate a certain amount of road traffic. The reason for the increasing extent of quality assured transports and official business trips partially stems from greater consumer demands and the fact that traffic accidents cause work-related employee injuries and entail costs through sick leave and material damages. About every third death within the work force in Sweden occurs in road traffic.

1.4 Who is responsible for Quality Assurance on road transports?

The responsibility for a system through which road transports are quality assured rests instead with the top management of the company or public authority. As for all other types of quality assurance, road transport quality assurance must be integrated into all facets of the operations. In this connection, top management should be responsible for setting up goals and establishing policy on the quality assurance of transports. It must also provide organisational and financial backing for the work, and take an unequivocal, ethical stand on the subject. Management should also ensure a follow-up of the goals and policy established. This can be done, for example, through using road informatics.

In Sweden the Swedish National Road Administration (SNRA) has an overall responsibility to support and co-ordinate the development of quality assurance on road transports, both on national and regional level. If the ECMT Member states want to promote this process, it is crucial that some public authority is given a similar responsibility within each nation. On a local level in Sweden this responsibility lays on the municipalities, but they get valuable support from the SNRA existing of the latest know how, good examples and in some cases even financially support.

2. HOW TO EXPRESS AND IMPLEMENT DEMANDS FOR SAFE AND SUSTAINABLE ROAD TRANSPORTS

Before going into any details, please find the whole Process schematically described in Appendix 1.

2.1 Step 1: Define what goals the Quality Assurance should address

Demands on road transports ought to address problems within the road transport sector that are important from a road safety and environmental point of view. First the problems and needs must be analysed. The result of this analysis can vary somewhat between different countries and different modes of transport. But to all countries these minimum of goals should be at focus in order to get safe and environmentally sound transports.

- Decrease vehicle emissions harmful to human health.
- Decrease vehicle emissions of carbon dioxide.
- Increase the use of seatbelts.
- Increase the use of vehicles with high passive safety.
- Right speed in all situations.
- No drink-drivers.

2.2 Step 2: Define what type of transports the demands should address

On the basis of the goals that have been set up, all types of transports, of which a company or public authority is directly or indirectly responsible, ought to be quality assured. The demands can be more or less precise, depending on what type of transport the demands addresses; purchased road transports or transports under personal management.

- Work-related trips (to and from work). The demands cannot be obligatory. However, the demands can be formulated so that if the employee freely corresponds with the “demands”, the employer will give some (symbolic?) award.

- Official business trips. In principle the employer can put forward any demands he likes. Nevertheless, it is important that the demands easily can be understood and remembered, and that they address the most important issues.

– Transports under personal management. Many public authorities, both local and regional, answer for different types of transports under personal management. There are same principles for quality assurance of these transports as for official business trips, given above.

– Purchased road transports. According to the legislation that regulates purchasing of services within the public sector in the European Union, the demands on purchased transports cannot be so explicit that certain companies have advantage of it. Having fulfilled that criterion, the demands can be quite precise, if wanted.

– Purchased services that includes road transports. According to the legislation mentioned above, the demands cannot be too explicit because it is not the transport itself, but a service that includes road transports, that one orders. However, a minimum of demands, such as the transport should be carried out according to the legislation, can at least be defined.

2.3 Step 3: Formulate a Policy that defines the employers approach when it comes to Quality Assurance on road transports

Before one starts to formulate different demands, it is important that the whole company or authority agrees on a common Policy. The Policy should in a structural way describe, how to in principle handle issues concerning safety and environmentally sound road transports. It can be efficient to formulate one Policy for work-related and official business trips, one Policy for road transports under personal management, and one Policy for purchased services and road transports.

The Policy should focus on how to reach high quality assurance on road transports, both from a road safety and environmental point of view. This can involve:

– Influencing the need for road transports.

– Influencing the need for travelling by car.

– Influencing how the road transports are carried out.

– Influencing the choice of vehicle, equipment and fuel etc.

The Policy should for example consist of the following parts.

– Aim. Define what you want to achieve by the Policy.
Example: Every official business trip should be safe and environmentally sound.

– Approach. Define a common way of handle and look upon different issues.
Example: First of all we shall check if the transport really is necessary, secondly we shall use the transport mode that is most environmental friendly – given that it is acceptable from an economic point of view, thirdly we shall always comply with the traffic rules when driving.

– Responsibility. Define whom or what unit are responsible within the organisation and what they are responsible for?
Example: Every head of section has the responsibility to see that all employees are familiar with the Policy. Every head of Department has the responsibility to see that a revision of the compliance with the Policy is made once a year.

2.4 Step 4: Define clear and distinct demands

Basically a broad analysis must be done to define such demands that will make it possible to reach the goals adopted. As in all systems of quality assurance, the results from the follow-up of earlier activities are an important input when defining new demands. Inversely the quality of the follow-up studies depends on how clear and distinct the demands are formulated in the first place. Besides own experiences a dialog with other companies and authorities as well as with the performers, will create opportunities of making right priorities and good results.

When defining the demands it is crucial that one gives priority to the most important demands and that the demands are formulated in a way that makes them possible to measure or in some other way possible to follow-up. It is important that all involved easily understand all the demands. The demands can neither be expressed as unconditional demands nor expressed as desirable demands. For example all demands that address the company's responsibility to comply with certain traffic rules and other adequate legislation, should be expressed as unconditional demands (please, see Appendix 2 at the end of this document for examples of possible demands).

In order to facilitate the follow-up studies of some demands mentioned in the Appendix, a Ledger of Transports ought to be made at the road carrier or the like. This ledger should be open for revision at any time and include data of all vehicles and drivers connected to the contract or agreement. Following data could be registered within the Ledger of Transports.

- Type of vehicle, model-year and how the vehicle complies with the demands concerning passive safety and fuel consumption.
- The drivers' education, including education connected to the agreement in force.
- Point of time and results with respect to change of tyres, air pressure in tyres, vehicle tests and special brake-inspections.
- Real fuel consumption per km, driving time, traffic offences, serious conflicts etc.

2.5 Step 5: Define how to implement the demands

The way to implement the demands can vary depending on what type of transport the demands addresses. It is a question of management philosophy within each company or authority when it comes to how to implement demands on Work-related trips, Official business trips and transports under personal management. Independently of how the demands are implemented, the key factor of success is to make those affected by the demands within the organisation, to understand the meaning and purpose of the demands adopted. Otherwise it will be a problem to motivate the employees to comply with the demands.

Demands on purchased road transports and purchased services that include road transports, must be integrated with the purchasing in all of the following three steps.

1. Integrate the demands in the context when inviting tenders for offer.

2. Integrate the demands as important criteria when evaluating and approving the offers. Those offers which do not comply with the unconditional demands should be rejected as a whole.

3. Integrate the demands with the finally contract or agreement.

2.6 Step 6: Revision and follow-up of the demands

It is rather easy to put forward a lot of demands concerning quality assurance on road transports. But the most important – and the most difficult part – is to make the revision and follow-up study of all activities. But this is crucial because the revision is a condition for good results and most importantly; to maintain the motivation and respect of complying with the demands at the highest possible level.

The revision and follow-up of the demands in force should at least take place once yearly. The aim is to investigate how the performer has been able to comply with the demands according to the contract or agreement. But the revision also aims, and this is important, to support the performer taking further steps in order to improve methods and routines.

To support the follow-up studies a Plan for Quality Audit should be developed on the basis of the contract or agreement, in order to define how, when and from whom the revision should be carried out. In this plan the revision of the Ledger of Transports should be included. The result of the revision can be put together in an annual Audit Report. As a suggestion the discrepancies found should be registered in two levels: grave or minor discrepancies. Within the report the performer ought to have a possibility to make comments on the result of the revision and to give suggestions on how to improve the activities.

Most demands registered in the Ledger of Transports can be relatively easy to follow-up, given that the ledger is correctly filled in. But some demands will be very difficult to follow-up, even for the performer him self. One example is speeding which most likely is the most important issue of all because of its impact on both safety and the environment. Today there is, however, a technical device to this problem, consisting of a vehicle-based system for Intelligent Speed Adaptation (ISA). Hereby one can get a technical control and follow-up system through the use of road informatics in for example publicly procured road transports. Further more there are other areas where technical devices, already tested in Sweden, that can be used in a similar way when it comes to quality assurance on road transports, as for example intelligent seatbelt reminders and so called alcohol ignition interlocks.

3. PROGRESSIVE ACTIVITIES WITH QUALITY ASSURANCE ON ROAD TRANSPORTS IN SWEDEN

3.1 Activities among public authorities, organisations and companies in Sweden

In recent years, since the Riksdag (the Swedish Parliament) approved the Bill on the Vision Zero, many public authorities, organisations and companies in Sweden have been working on the quality assurance on road transports. The SNRA, for example, has since 1996 a travel policy that specifies the employer's policy on official business trips and work-related trips with respect to the environment and road safety.

At the moment more than 18 county councils, 120 municipalities and 100 companies and organisations in Sweden are committed to different activities with quality assurance on road transports. All together this means that approximately 20 % of all employees in Sweden, in one way or another are affected by this approach. The main demands address alcohol and drugs in road traffic, use of seatbelts, vehicle performance concerning passive safety and fuel consumption, education in safe and environmental friendly driving, logistics and finally maintenance of vehicles such as special brake-inspections and checking of air pressure in tyres.

The total effect of these measures are difficult to foresee, but there is no doubt about that quality assurance on road transports will have a significant long-term influence on the performers logistic-planning, vehicles performances, offences within road traffic and the drivers qualifications. The SNRA, that have supported and co-ordinated many of these activities, estimate that quality assurance on road traffic has a potential to affect about 25 % of all organised road transports in Sweden.

3.2 Activities in the City of Västerås, Sweden

The City of Västerås is Sweden's sixth largest city with almost 130 000 inhabitants. The city is situated in the valley of Lake Mälaren, some 100 km west of Stockholm.

Besides the responsibility of urban road infrastructure and its maintenance, the City of Västerås generates a great deal of road transports through its own operations. Some examples are school transports, transportation services for the elderly and disabled people, maintenance of urban roads and cycle ways, distribution of goods to schools and day care centres, refuse-collection etc. The municipality is also ultimately responsible for local public transport in co-operation with the county council.

So far the City of Västerås has in some cases expressed demands for safe and sustainable road transports. Please, notice the following three examples.

- In the year 2000, demands were implemented for *transports under personal management* generated by refuse-collection and building and maintenance of urban roads, cycle ways and parks. The demands are followed-up once yearly. Since the year 2001 a Ledger of Transports has been implemented so that, for example, the real fuel consumption of all heavy vehicles and family cars is registered. In the end of 2001 all employees affected by the demands, in all 110 persons, where educated in safe and environmental friendly driving (so called EcoDriving). Thanks to the Ledger of Transport it will be possible to measure the difference in fuel consumption before and after the education. The education will be repeated every third year.

- In the year 2001, demands where implemented for *purchased transportation services* for the elderly and disabled people. As a result of the demands adopted in the contract, the municipality and the performers are, at present, investigating the possibilities to introduce an ISA-system in all vehicles affected in order to secure the obedience of the speed limits in force.

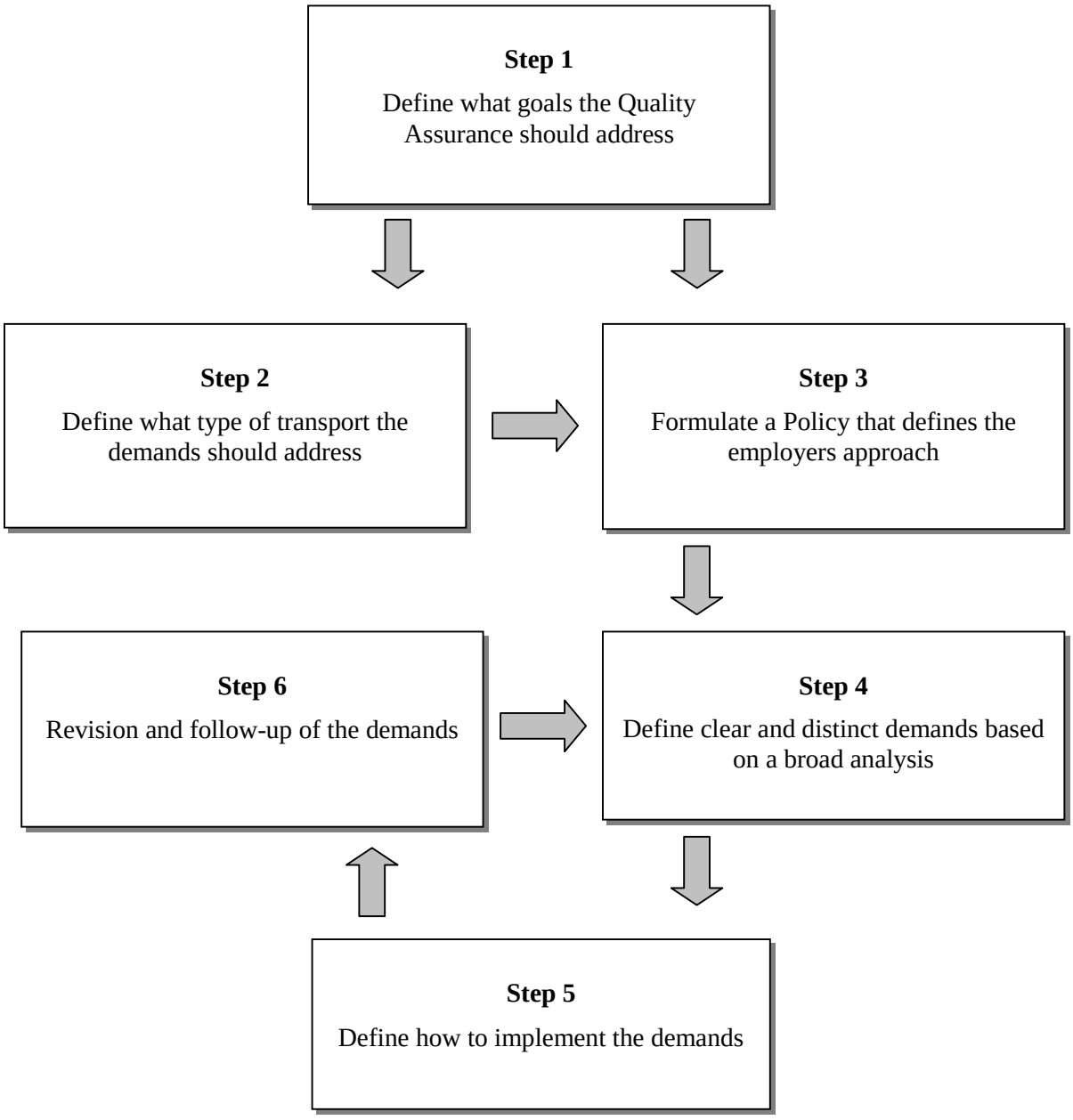
- In the year of 2001, demands where implemented for *official business trips* by cycle. The municipality places official business cycles with high quality at the employee's disposal. The Policy says that official business trips shorter than 3 km ought to be carried out on bicycle if possible and that helmet shall be used when cycling.

According to a newly developed Plan of Local Transports in Västerås, the municipality probably will introduce an Office of Mobility Management. This office should, among other things, support both the municipality it self and local authorities and companies to express demands for safe and sustainable transports, including demands for technical devices.

Appendix 1.

HOW TO IMPLEMENT DEMANDS FOR SAFE AND SUSTAINABLE ROAD TRANSPORTS – THE PROCESS

Below, the whole Process of Quality Assurance on road transports is schematically described.



Appendix 2.

DEMANDS FOR SAFE AND SUSTAINABLE ROAD TRANSPORTS – SOME EXAMPLES

Below there are some examples of possible demands on road transports. How to express each demand and its order of priority can vary a great deal depending on the aim of the quality assurance, the problems in focus, the type of transport modes involved and the on-going development of the vehicles concerning passive safety and environmental protection.

The performer

- Should have a policy for work-related trips, official business trips and other road transports under personal management.
- Should have a policy for purchased transports aimed at all subcontractors.
- Shall have internal routines for management, implementing of the demands, documentation (including a transport ledger), training, information on how to handle critical issues and deviation from the contract, revision and follow-up studies.
- Shall have an internal reporting-system for accidents and road traffic conflicts.

The driver

- Employees driving a vehicle for more than 1 hour a day on average shall have an education in safe and environmental friendly driving (so called EcoDriving). This can lower the fuel consumption by about 5 to 15 %.
- All car drivers shall be sober and drug-free during all working–time. If alcohol level is positive in blood levels when testing, it must not be more than 0.02 %.

The vehicle

- New family cars shall have no less than 4 stars according to the crash tests within the Euro NCAP- programme. Family cars not tested within the programme shall weigh no less than 1 000 kg.
- Family cars should weigh no more than 1 400 kg. This is because a heavy vehicle does not necessarily have a higher passive safety but has higher fuel consumption.
- New family cars shall have a fuel consumption of no more than 7.7 dm^3 (petrol) and 5.4 dm^3 (diesel) per 100 km.

- From the year 2005 all new vehicles shall have a seatbelt reminder system in function.

- Heavy vehicles shall at least fulfil the demands of EURO 1.

The vehicle service and maintenance

- Used motor oil and lubricants shall be managed as hazardous waste.

- All maintenance should be carried out in places adapted for the activity concerned, so that all liquids and other waste are properly taken care of.

- All tyres shall have the right air pressure (controlled twice a month), shall have a tread depth no less than 3 mm and should not be older than 5 years. The correct air pressure can lower fuel consumption by about 3 to 5 %.

- All heavy vehicles shall have a brake-inspection every half-year.

The road transport

- All trips and road transport shall be carried out in full compliance with the traffic rules in force, especially:

  - Speed limits. If the average speed decreases by 10 %, the number of fatalities will decrease by 40 %.
  - Seatbelt use. Wearing a seatbelt will halve the risk of being killed or injured if an accident occurs.
  - Stipulated maximum driving-time.

- The car driver should be very careful at all pedestrian crossings.

- Transport routes should be drawn up in such a way that journeys respect the environment and people's health as much as possible.

- The driver shall always calculate what time the trip takes so that the journey can be carried out in compliance with the demands adopted.

How can one secure that the delivered transport fulfils the demanded sustainability and safety requirements?

Contribution by Paul WHITE
International Road Transport Union (IRU)
Geneva - Switzerland

1. Introduction

The IRU is the only international organisation representing the interests of the road transport industry - the operators of coaches, taxis and lorries. It is represented in 68 countries on the five continents and, more particularly, it has Member Associations in all European countries - the Member States of the EU, the CIS and, of course, the Countries of Central and Eastern Europe, including the Czech Republic, where it is proud to have the Association CESMAD Bohemia as its Member.

The IRU was founded in 1948 and immediately found its place as the private sector partner of the United Nations Economic Commission for Europe, the main intergovernmental forum and source of international instruments in the field of transport at that time, and, subsequently, with the European Conference of Ministers of Transport, the European Union and, most recently, the Commonwealth of Independent States.

2. The IRU and Sustainable Development

The social responsibility of the IRU is set out in the opening paragraph of Article 2 of its Constitution, which indicates that the IRU must work "in the interest of society as a whole" with the main objective of promoting sustainable development.

Over the years, with the tremendous growth in road traffic, the IRU has increasingly assumed its responsibilities in combating the downside of the industry's activity, while never letting it be forgotten that the economic benefits it provides are also largely social in nature: road transport alone is capable of providing a door-to-door service, of adapting rapidly to the needs of the economy and of society, and of providing a transport service which is not a burden on the tax-payer.

A milestone in this work was the signature, by all the IRU Member Associations, at the Organisation's Congress in Budapest in 1996, of its Charter for Sustainable Development, as called for by Agenda 21, adopted at the United Nations Earth Summit.

The road transport industry, alone amongst the transport modes, thus made a commitment to:

- Work together towards the common goal of sustainable development.
- Implement road transport operations which respect the environment and other road users.

3. Sustainable Development and Road Safety

Road safety was perceived as a very important element in this Charter for, indeed, no activity of such proportions can be sustainable if it does not maintain an acceptable level of safety.

Indeed, the three IRU priorities in relation to sustainable development are:

- Road safety.
- Energy savings.
- Environmental protection.

These form a "Magic Triangle", each supporting and reinforcing the other.

Measures that improve one of the three factors almost always improve the two others. For instance, defensive and anticipatory driving to avoid accidents is also energy-efficient driving, avoiding consumption peaks in accelerating, decelerating, stopping and sta65

ting, is also driving producing less exhaust, simply because less fuel is burned.

4. IRU Guide to Sustainable Development

The innovative programmes for national road transport associations and transport companies contained in the IRU's Guide to Sustainable Development therefore highlight measures to improve road safety amongst the most significant means of promoting sustainable development which also implies the promotion of sustainable transport.

The Guide is a reference work of existing action programmes conducted by IRU Member Associations in six European countries. It contains the modules providing practical support for the application of tailor-made measures and programmes at national level. Its objective is to encourage as many transport operators as possible to implement Sustainable Development practices.

A critical success factor for accelerating implementation will be effective incentive schemes, set up by Governmental partners of the road transport industry, to further encourage the use of the latest available technology and best industry practices. These measures should include preferential taxation for environmentally friendly vehicles or cleaner fuels, or advantages for those operators who have implemented sustainable development practices as set out in the IRU Guide.

The modules contained in the Guide are as follows:

- Signing the *IRU Charter for Sustainable Development* is a means of raising awareness and commitment by actors in the road transport industry to drive towards the goal of sustainable development.

- The *Well-Driven Campaign* commits transport operators to improving road safety according to a certain code of practice elaborated by National Road Transport Associations and opens them up to stimulating positive and negative appreciation by the general public.

- The *Environmental Management System* encourages transport operators to implement and possibly obtain certification for the integration of sustainable development practices into a company's everyday activities.

- *Environmental Controlling* relates to the development and application of environmental controlling tools and techniques

- *Promoting Best Industry Practices* includes industry awards for environmental excellence and industry reports on best practices.

- Finally, *driver training* is targeted as an important means of improving road safety, fuel efficiency and load security.

5. Road safety is a priority

Road safety is increasingly becoming a top priority for society.

The World Bank has estimated that, worldwide, road traffic crashes now result annually in 700 000 deaths and over 10 million injuries annually.

In its Consultative Paper on a 3rd Road Safety Action Plan for 2002-2010, the European Union referred to more than 40 000 persons killed in road accidents in the 15 Member States each year.

The trend is, however, generally encouraging. In the European Union, the number of accidents resulting in bodily injury has fallen by 15% since 1970, and the number of persons killed, by more than 40%, despite the constant increase in road traffic.

Although the trend is not yet so positive in some of the Central and East European countries, there is every reason to be confident that similar results can be achieved there too, providing all those concerned work to that end.

6. Accidents involving commercial vehicles

Accidents involving commercial vehicles also followed the general positive trend. Indeed, the accident rate of commercial vehicles in Germany has fallen by an impressive 63% in Germany since 1970.

Out of every 100-vehicle accidents with bodily injury in Germany, France, the Netherlands, Austria and Denmark, an average of only 1 to 2 buses and coaches and 6 to 8 trucks are involved. This means that commercial vehicles are underrepresented in accidents.

And this does **not** mean, of course, that commercial vehicles are the cause of all the accidents in which they are involved. It is, unfortunately, a natural human reaction to suppose that the big guy is the bad guy and the little guy is the good one. Transposed to road traffic, this means that, if an accident occurs between a truck and another vehicle, the public presupposes that the truck was the cause.

Unfortunately, no statistical series is available at the European level or even at the European Union level to corroborate the findings, favourable to commercial traffic, available for certain countries.

In the statistical series on road traffic accidents published by the UN/ECE, the number of fatalities and injuries is given for each type of vehicle, but not the number of accidents respectively involving such different types of vehicles, still less the vehicle causing accidents involving more than one party.

7. Accident prevention requires causation statistics

Indeed, the IRU is of the firm opinion that further improvement in safety concerning commercial vehicles can only be achieved by a scientific analysis of the causes of accidents where such vehicles are involved, through the further development of the CARE and CAREPLUS databases and their extension to countries outside the EU.

Pending the collection of such official statistics, which is not likely to be achieved in the near future, it is imperative to at least start, without delay, with a scientific analysis of 1000 cases in various countries /environments. Only by doing so will it be possible to identify the major causes of accidents requiring priority attention, and to focus limited funds where they can give most benefit. Moreover, only by concentrating on the main causes of such accidents, as identified by such analyses, can we expect to further motivate an industry that is already doing all in its power to improve its safety record. Experience shows that encouragement and incentives are far better tools to improve road safety than any restrictive measures.

It is essential, in the context of an integrated Europe, that such an analysis should include cases in all parts of Europe, including the CEEC.

8. Human behaviour and the regulatory framework

Nevertheless, human behaviour is generally recognised as being the number one factor in traffic accidents. However perfect the road infrastructure, however perfect the vehicle, if the driver is incompetent, an accident is likely to occur.

Accident-prone behaviour can be averted or remedied by three types of action:

- Training.
- Education.
- Incentives.

Such action can be voluntary but must, in all cases, correspond with the applicable regulations, in relation to which, it is extremely important that further progress be made, following prior consultation with the interested parties, - and notably the road transport industry - in the harmonising the rules and their application with regard, notably, to:

- More stringent criteria for access to the road transport industry.
- Speed limits, road signs and the highway code in general.

- Rules relating to the transport of specific kinds of goods, such as perishable foodstuffs or hazardous cargoes.
- Driving hours and rest periods, where it is essential to secure harmonised enforcement simultaneously with a technically perfected digital tachograph.

9. Training commercial vehicle drivers

Training of all road users is the first prerequisite for road safety.

The IRU welcomes the initiative by the European Commission to introduce compulsory training for all commercial vehicle drivers, additional to the driving licence, as a contribution to improved road safety. Confusion and duplication with existing legislation on the training of young drivers must, however, be avoided.

The IRU also considers that synergies between the training for the (upgraded) driving licence and the training for professional competence must be found and that, rather than minimum hours of training, successful examination should be the criterion for establishing the professional competence of a candidate driver.

Finally, the IRU considers that revision courses for drivers on the job, are of great importance to update drivers on new technical or legislative features and eliminate bad habits. However, the European Commission's proposal in this respect is not adequate and not practicable. The road safety objective will be achieved best if the training is in accordance with specific needs, and not simply a 35-hour requirement every 5 years.

10. IRU Academy

The **IRU Academy** has been set up to contribute to the international harmonisation of training and testing road transport professionals and, indirectly, to improving the quality and safety of services offered by the industry. Its Advisory Committee includes a representative of the ECMT, as well as of the World Bank, the European Commission, the European Training Foundation and the European Transport Workers' Federation.

In 2002, the fourteen Accredited Training Institutes in Eastern and Western Europe issued almost 400 IRU Academy Diplomas to individual students graduating with a certificate of Professional Competence in Road Transport Management which relates, *inter alia*, to ensuring that road safety rules are respected. Three new standards (professional driver, dangerous goods driver and dangerous goods safety adviser) have been developed and will be launched this year, both innovating and using materials already created by the IRU.

11. Motivating managers and transport company staff

The IRU and its national Associations have a special responsibility to motivate their transport operator members, currently on the market, to integrate road safety into their firms' overall policy in the general public interest of sustainable development and road safety, but also in their own direct self-interest. Fewer accidents mean reduced costs of repairs, a reduction in insurance premiums, a saving in time, satisfied customers and an improved image for the company.

This was the logic that led the IRU to launch its "Road Safety Management Manual" for road transport companies with the financial support of the European Union, which is now being implemented by IRU Member Associations in all the European Union countries, as well as in Hungary and Romania.

The Manual describes the measures that can be taken in relation to:

- Company management.
- Staff.
- Equipment.

It provides a plan for the 5-step integration of road safety into company policy and practice and gives a method to analyse the accident data collected and how to use such analysis.

The IRU also provides, through its National Associations, direct incentives through its annual award of "Diplomas of Honour" to exemplary drivers.

12. Partnership on the road

The main difference between the safe activity of the road transport industry and any other economic sector is that this safety directly affects - but is also directly affected by - the behaviour of other **road users**.

It is therefore particularly important that the different categories of road users understand the physical and other constraints particular to other road users. Following the inclusion of the IRU's corresponding proposals for the training of the various categories of road users in the UNECE Consolidated Resolution on Road Traffic, it issued, with the financial support of the European Commission, attractive leaflets through its national Associations and the organisations representing other road users, addressing advice to young motorists and to the young riders of motorcycles, scooters and mopeds. The "Well Driven" campaign already referred to and which is currently in force in Sweden and the United Kingdom is also aimed at improving relations between road users.

Transport users are an essential partner for the industry in promoting road safety, particularly at present, where increasing competition in the industry is making transport operators ever more eager to secure business.

13. Road infrastructure

Road infrastructure is clearly an important factor in securing road safety. It is one to which the IRU and its Members can make no direct contribution but for which they can and must lobby at the national and international levels.

Since the emergence of the consumer society and the extension of human habitat to the periphery of the major conurbations, political opposition to road construction has ironically strengthened.

And yet the statistics show that there is an inescapable logical correlation between the construction of motorways and the reduction in road accident fatalities.

In this context, the IRU is following, with close interest, the work piloted by the Swedish government to make all road infrastructure as "forgiving" as possible.

14. Safety in tunnels

In connection with the catastrophes which occurred in the major Alpine Tunnels, the IRU has been involved in the work of the UN-ECE Multidisciplinary Group of Experts on Safety in Tunnels, seeking to ensure that such incidents never again have such terrible consequences. The IRU has argued that the responsible authorities should:

- Take all necessary measures to equip all tunnels with the best possible safety devices available in terms of modern construction and monitoring techniques, in order to eliminate risks for all road users.

- Whenever possible, but in any case where major traffic flows are involved, provide tunnels with separate tubes for traffic in each direction, for reasons of safety and for strategic reasons.

The current policy of governments to introduce timetables for commercial traffic in alternate directions is of no proven efficacy. Indeed, head-on accidents between commercial vehicles in tunnels are extremely rare and this measure is creating congestion on approach and alternative routes, itself detrimental to road safety.

15. The vehicle

The third variable in road safety relates to the vehicle, its design, but also its maintenance.

Over the last 20 years, the vehicle manufacturers have made great strides forward in improving the safety of commercial vehicles, both in the interest of their drivers (according to statistics from Volvo truck corporation, 50% of all accidents involving trucks are single vehicle accidents) and of other road users.

16. Conclusions

Having briefly considered some of the main aspects of the IRU vision of its role in promoting safe and sustainable transport, allow me to conclude by summing up as follows.

In line with the watchword of the UN Secretary General, the IRU is seeking to promote public-private partnership both in developing and in implementing policies to improve road safety. In this context, it should be mentioned that the IRU is a founder member of the World-Bank-initiated Global Road Safety Partnership, which is seeking to promote such partnerships in demonstration projects in selected countries, including eastern Europe

Under the watchwords of Incentives, Innovation and Investment, we are seeking, with the co-operation of our Member Associations, our associate member vehicle manufacturers and our partners in the road-building and maintenance sector, to improve human behaviour, infrastructure and vehicles.

We are pressing governments to improve the breakdown and harmonisation of accident statistics in order to identify the major causes of accidents involving commercial vehicles. This will allow better targeting of areas for remedial action and counteracting the smear campaigns launched by the gutter press whenever a major accident involves a commercial vehicle.

We are pressing governments to improve the content and application of legislation aimed at improving transport safety.

We are urging governments to reinforce the criteria for access to the profession of road transport operator in the interest of road safety.

We are seeking to obtain government rewards for best practice, in the context of the projects contained in the IRU Guide to Sustainable Development.

But, in all of these activities, the IRU cannot act alone. It counts on the constructive co-operation and goodwill of its partners in industry and trade, in government and in the media. For it is only by working together that we can hope to achieve a better future.

How to organise the responsibilities to ensure coherence?

Contribution by Chris BOLAND
Distribution Safety Manager
Dupont UK Ltd
Stevenage - United Kingdom

This is a summary of a full powerpoint presentation made at the Conference.

Introduction

If you do not have a committed management, you cannot be efficient; a safety culture can provide an economic return as well as helping to protect people and preserve the wider environment.

DuPont Distribution Safety Policy

It is DuPont policy to consider distribution as an extension of the manufacturing process, so that distribution will receive the same attention to safety, health, and the environment as manufacturing receives.

Responsible Care

Responsible Care is a voluntary public commitment by the chemical industry to demonstrate continuous improvement in Safety, Health & Environmental performance, for maintaining a dialogue with the public, and for publication of the results of the continuous improvement efforts.

DuPont's Responsible Care initiative is based on 6 codes of management practices:

1. Community Awareness and Emergency Response
2. Pollution Prevention
3. Distribution
4. Process Safety
5. Employee Health and Safety
6. Product Stewardship

DuPont Company Standards states that: the Distribution Code of Management Practices shall be applied world-wide.

The DuPont Commitment

We will conduct our business with respect and care for safety, health and the environment, without compromising the ability of future generations to meet their needs. We are committed to:

- The highest standards of performance and business excellence.
- The goal of zero injuries, illnesses and incidents.
- The goal of zero waste and emissions.
- The conservation of energy and natural resources, and habitat enhancement.
- Continuously improving our processes, practices and products.
- Open and public discussion, and influence on public policy.
- Full management and employee commitment and accountability.

Core Values

DuPont core values centre around four areas:

1. Safety & Health

- All occupational injuries and illnesses are preventable.
- Safety, process, distribution and environmental incidents are preventable.
- DuPont's goal for all injuries/illnesses, waste emissions and incidents is zero.

2. Respect for People

- Operating globally in a way that recognises the four fundamental needs of employees:
  - Recognise & value individual differences and needs.
  - Respect, dignity, fairness, caring & self-esteem.
  - Encourages maximum individual development.
  - Creating a work environment that addresses those needs.
- Operating a similar environment with respect to our community and business and be recognised as a great global company.
- Promoting open dialogue with our stakeholders.

3. Ethics

- Conducting its business with respect to the highest ethical standards.
- Creating an environment in which employees will conduct the company business with integrity, in compliance with applicable laws and in a manner that excludes consideration of personal advantage.

– Creating an environment of respect for the individual and fair treatment for employees.

– Thereby be recognised as a respected "corporate citizen" and enhancing our standing in the communities in which we operate.

4. Environment

Reduce the footprint of our product along the whole value chain by:

– Driving towards “0” incident (Process, Environmental, Distribution) and reduce to “0” our global waste and emissions.

– Promoting the use of renewable resources.

– Requiring DuPont businesses to be more inventive and "knowledge intensive" and consuming less "raw material and energy".

– Product stewardship is part of Responsible Care and an essential tool to achieve DuPont’s goals of "sustainable growth", playing a fundamental role in how products are made, under what conditions they are produced and how they are handled and marketed.

An Introduction to *RHYTHM*

RHYTHM®: **R**emember **H**ow **Y**ou **T**reat **H**azardous **M**aterials.

RHYTHM® is DuPont's program for managing the safety aspects of physical distribution, and nowadays covers both dangerous and non-dangerous goods.

The RHYTHM® program was first introduced in September 1975. After all these years, the principles of the RHYTHM® program are well-proven, but changing regulations, changing products and changing personnel require constant attention and emphasis.

RHYTHM® has been responsible for a year-on-year decline in the number of major releases of dangerous goods. The cornerstone of RHYTHM® is the belief that a totally safe system is not beyond our reach.

Every DuPont site throughout the world has a RHYTHM® (or Distribution Safety) Co-ordinator, trained by the Company to be knowledgeable about regulations and DuPont standards and procedures. The Co-ordinator is charged with implementing the program at site level.

The Distribution Safety Co-ordinators from around the world form a global network. The network is encouraged to pool and share knowledge, experiences, expertise, best practices, etc. This is achieved by various means including; teleconferences, face-to-face meetings and sharing information on Intranet Web Sites. This networking is the very important for effective communications, and is the overall lifeblood to the management system. Networking helps to both accelerate and spread the overall rate of progress.

The RHYTHM® program was trade-marked in 1981 and since that time, many elements of the program have been adopted by hundreds of companies and organisations, to the extent that

RHYTHM® in DuPont is now part of the wider program of Responsible Care® in distribution to which chemical companies around the World are committed.

The RHYTHM program assigns specific roles & responsibilities for distribution safety to various individuals and groups in the organisation. There are four different categories of RHYTHM Co-ordinator: Regional, Business, National and Shipping Point. The responsibilities of the latter two are nowadays mirrored in the Dangerous Goods Safety Adviser Directive and legislations.

RHYTHM® - Principles and Practices

Principles

1. All incidents can be prevented, and the goal is zero.
2. Relevant training in safety and regulatory compliance, for all who need it (S12U).
3. Self-auditing and second-party auditing, as per Company SHE Guideline S16U.
4. We will learn from our own mistakes, and the mistakes (incidents) of others, and take preventive measures.
5. 100 % regulatory compliance.
6. Progress monitoring and reporting, to/from/within all organisational levels.
7. Continuous improvement in Safety, Quality, Health and Environmental performance.
8. Safety partnerships with Logistics Service Providers are key.
9. Right first time, every time.
10. We will maintain an efficient and effective emergency response capability.

Practices

- A RHYTHM® or Distribution Safety Co-ordinator at every DuPont Site world-wide, to provide guidance and oversight on implementing of distribution-related DuPont Standards, Guidelines and (industry) Best Practices.

- Regular in-house training courses are held, and self-teach training packages have been developed and are available.

- Regular in-house training courses are held, and self-teach training packages have been developed and are available.

- Self-audit program covering distribution activities at every site/shipping point, and periodic SHE second-party audits.

- Incident investigation to determine root cause and preventive measures, central-reporting, report sharing with other sites and Businesses, for lesson-learned value.

- Checklist procedures for unloading, handling and loading.

- All incidents reported in a global Incident Database, quarterly Distribution Incident Summary Reports, RHYTHM & DUCHEM HELP Web pages, RHYTHM Networks.
- Effective usage of the CEFIC Safety & Quality Assessment System (SQAS).
- Regular Carrier Safety Seminars.
- DUCHEM HELP Incident/Emergency response system.

Emergency Response System SCOPE and PURPOSE

DUCHEM HELP is the name of DuPont's incident and emergency response system in Europe. Its purpose is to provide a simple and effective procedure for handling distribution and after-sales incidents and emergencies occurring in Europe, the Middle East and Africa, in a way that:

- 24-hour Level 1 response is comprehensive, prompt and reliable.
- Level 1 response covers all DuPont products -- regulated and non-regulated.
- A uniformly competent Level 2 and 3 response capability is maintained.
- Incident reporting maximises lesson-learned value, and introduces measures to prevent any recurrence.
- Regular test-calls are carried out to ensure that Emergency Responders are well-rehearsed in the Procedure at all times.

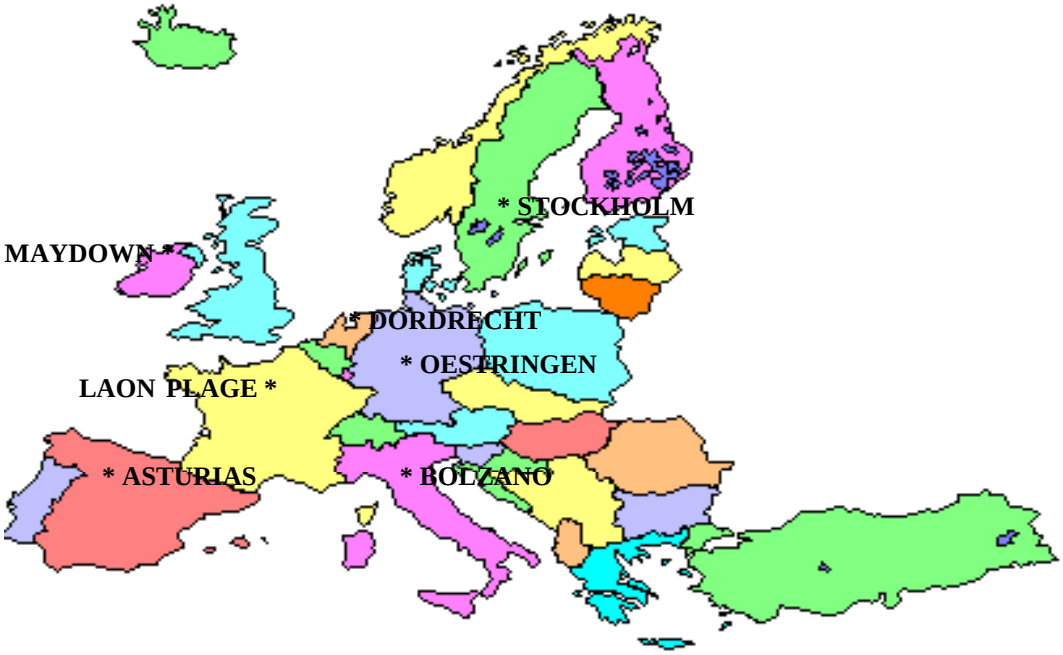
In this way we can continue to drive towards our goal of zero incidents; to safeguard those who use or handle our products (the general public and the environment); and to protect DuPont's image as a responsible company and a leader in safety.

DGQuest™

DuPont has developed unique software for producing a compliance checklist specific to an individual load. It covers the Dangerous Goods transport regulations for three major modes of transport (road, sea and air).

DGQuest produces a load-specific checklist, as an aid to ensuring compliance with transport regulations and operational safety standards. By way of a series of tickboxes and pulldown windows, it takes just a couple of minutes to enter the key details about the particular load, and produce a checklist, which is specific to that load. From a databank, the software then selects the relevant checkpoints, and produces a checklist, which is specific to that load, and quotes the corresponding regulatory references.

24-hour DUCHEM HELP Emergency Response Centres



Compared with the conventional method of checklist production, DGQuest™ offers the following advantages:

- Covers all the major international transport regulations: ADR, IMDG Code and IATA, as applicable.
- Rather than being "static", the checklist content varies according to the particular load.
- Addresses only those regulatory requirements that affect the load, and ignores the rest.
- Always up-to-date with current regulatory requirements.
- Handles all major load types, and modes of transport.
- Also gives guidance on operational safety (safe loading/unloading).
- Takes account of the consignor concessions (e.g. limited quantity provisions) as applicable.
- Checklist can be completed as a hardcopy, or on-screen.

Excellence in Safety

DuPont's Safety Philosophy:

- All incidents are preventable.
- Management is responsible and accountable for safety.
- All operating exposures can be controlled.

- Employees must receive safety training.
- Working safely is a condition of employment.
- Management audits are a “must”.
- Deficiencies must be corrected.
- Good safety is good business.
- Off-the-job safety is as important as on-the-job safety.
- Employees are the key.

Safety must be integrated as a core business and personal value.

Safety Programme - Major tools

- Responsible Care.
- Safety Guidelines.
- Process Safety.
- Performance Tracking.
- Audits.

Auditing

Four types of audits:

1. 1st party audits: site self-audits.
2. 2nd party audits: DuPont audits DuPont.
3. 3rd party audits: ISO/EMAS certification.
4. 4th party audits: governmental inspections.

1st party audits

- Pro-active.
- Structured.
- Regular.
- Results-Oriented.
- Focused.
- Management driven.

DuPont's Second party Audit Standard S2Y

Following competency areas are audited:

- Process safety management.
- General safety.
- Occupational health.
- Fire Protection.
- Pollution Prevention.
- Distribution/Transportation.
- Product Stewardship.

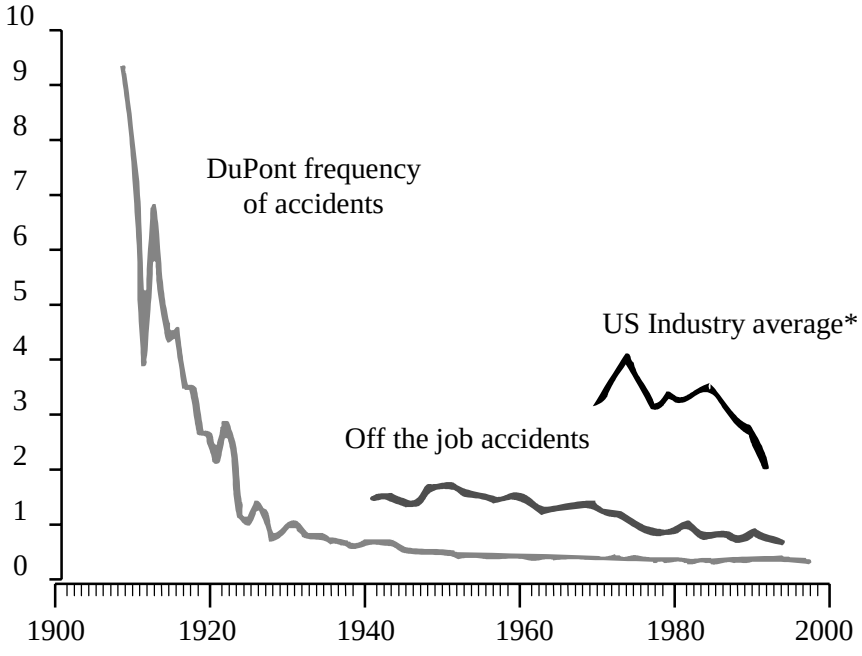
The audit process:

Audit frequency is 2-4 years per site/ or unit and competency.

Auditing includes:

- Pre-audit preparation.
- Audit.
- Audit report/recommendations.
- Tracking of recommendations till closure.
- Overall quality assurance process.

Figure 1. **Excellence in safety**



* Bureau of Labor Statistics

How to avoid obstacles? - Act on supply as well as demand

Contribution by Stanislav HANZL
Cesmad Bohemia
Czech Republic

CESMAD BOHEMIA Association, the essential professional organisation of hauliers operating international road transport, perceives the assurance of road traffic safety as an integral part of the enterprise. The association represents more than 2200 international Czech hauliers, with a capacity of more than 18 000 vehicles. For this reason the quality of their services is directly implicated in road traffic safety.

The association would like to help reverse the unfavourable trend in road accident occurrence. In 1986 the accident rate was comparable to that of most developed countries. Although statistics do not mention the number of accidents caused by international transport drivers, it can be expected that due to the selection of drivers and to a high technical standard of vehicles, the accident rate in this area will be comparable to European countries. One indicator shows the percentage of road accidents caused by goods vehicle drivers in general is 14%.

Influencing hauliers in a positive way can be assured by the continuous improvement of quality in the human factor area and by enhancing the technical level of vehicles. To this end the CESMAD BOHEMIA Association adopted an extensive programme of education which has been offered to drivers and to middle and top management of transport enterprises. We think it is more efficient to influence the human factor through education concerning legislation and behaviour in the traffic environment and through the dissemination of actual information about this environment, than through police enforcement and sanctions.

Top management training of transport enterprises is executed in accordance with EU standards, divided into passenger and goods transport. Training covers not only professional competence but includes actual issues of concern to the Czech and European transport market, which is especially important at the present time as the Czech Republic moves closer to concluding transport legislation to harmonise with EC legislation. From the content of the top management training some topics with direct impact on road traffic safety can be pointed out. First; the implementation of selected EC and Czech Republic legislation; specifically, the Act on Road Transport which gives hauliers a set of tasks related directly to road traffic safety, especially the practical implementation of international agreements which are binding for the Czech Republic. The most important training program covers the AETR Agreement and European Agreement on Transportation of Dangerous Goods by Road (ADR). The training is concluded by a final test provided by an examining board named by the minister of transport and communications. Analogous content includes the training of operational management on the higher implementation of concrete conditions of certain enterprises. In terms of influencing the human factor, the highest importance is given to the training of drivers, of course. This training is covered by Act No. 247/2000 on Training and Testing of Professional Competence for Driving of Motor Vehicles which came into force 1.1. 2001. The background for training and testing requires a knowledge of the Highway Code. This training is assured in regions by the Driving School of Road Transport Institute of CESMAD BOHEMIA.

Training curriculum of all types assured by the association has been completed on two road safety topics: the training of road safety advisors and the establishment of digital tachographs. Since

1.7. 2001 new amended wording of ADR has come to force which contains an institute vs. Dangerous Goods Safety Advisors (DGSA) clause that states that a safety advisor should be nominated by all enterprises involved in the transport, distribution and handling of dangerous goods. This is an area in which the association sees a great opportunity for influencing transport customers on road traffic safety. The transitional period for new ADR implementation by all subjects is 18 months, which means that all subjects should be trained by 31.12.2002.

Another practical measure for influencing the human factor will be the implementation, correct usage and analysis of digital tachographs, which according to the European Commission, will be established in 2003. Both management and drivers should be trained on data control, data management and outputs for checking institutions because during the transition period both analogue and digital tachographs will be used.

It is clear that a safe transport system and its sustainable development is possible only when the most up to date vehicles with high levels of active and passive safety devices and environmentally friendly designs are included in the transportation development process. In this regard, the Czech international road transport system is not behind that of developed countries. The fleet of Czech hauliers consists of mostly eco-friendly vehicles: about 84%, including 71% EURO 2 vehicles. In accordance with the law vehicles fulfilling EURO 3 are approved for Czech roads since 1.10.2001. The rapid replacement of the vehicle fleet is the result of the Czech hauliers' endeavour to offer customers relevant modern vehicles in terms of capacity and load. The other important factors that encourage the use of environmentally-friendly vehicles are tax incentives (reductions of the road tax tariff) and preferential treatment of these vehicles in the awarding of international entrance permits.

The above mentioned endeavour of the association to support and enforce road traffic safety and sustainable safety development can achieve its results only within the framework of a favourable legislative environment. For this reason the association was involved in work on amendments of transport legislation, not only during the preparation of governmental drafts of Acts but also during discussions in Parliament and the Senate. Three examples related directly to road traffic safety can be mentioned. Act No. 247/2000 on Training and Testing of Professional Competence for Driving of Motor Vehicles obliges 16 hours of training to insure the professional competence of drivers (those driving a vehicle over 7.5t etc.) and a yearly test. Because this is unascertainable in practice, the association initiated a proposal before members of Parliament to prolong the testing period. The minister of transport and communications suggested the test be taken once every three years.

Act No 16/1993 on Road Tax. In the past the association was successful in its proposal to reduce taxes for environmentally friendly vehicles (compared with those not meeting these requirements). This helped hauliers replace fleets relatively quickly. Tax relief for EURO 2 vehicles (up to 25%) and for EURO 3 vehicles (up to 50%) should have ended in 2001. The association succeeded in extending this tax relief to the end of 2003.

The Act on working hours and rest periods for shift employees in transport is of vital importance for road traffic safety. The association co-operated on this Act as well.

A new communication on human behaviour - How do "ideas propagators" work to achieve this task?

Contribution by Rüdiger TRIMPOP
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Changing mentalities in the transport market is a complex task since many interests clash. With consumers wanting to buy the cheapest products, the producers and shops that need to produce and sell at a profit have very small margins in which to operate. This downward pressure on prices is passed on to transport companies which, in turn, have to calculate travel times, wages, repairs and safety measures in such a way that they have an advantage over competing companies. As a result, they pass the pressure on to drivers and expect them to do everything possible to bring the product in on time at a low cost. The problem is exacerbated if international competition is taken into account, since other countries have much lower price and wage schedules, examples being Greece, Russia, Poland, Romania and Spain. Also, safety standards and inspections are much higher and costlier in some countries than in others, e.g. Sweden, Germany and the Netherlands. Governmental regulations, subsidies, obstacles etc. further distort the notion of a free market or a regulated approach to driving behaviour. Mental change can therefore never be achieved via one agent or agency alone, but has to be a complex multi-faceted approach with a clearly targeted common purpose (Kiegeland 2001).

In the following, I shall utilise psychological information on organisations and data from occupational traffic safety, on which transport draws very largely. I shall argue that there are measures for drivers, for transport organisations, for buyers and producers, for customers and the representatives of society, namely governments, both national and Europe-wide. I shall indicate approaches that have proven successful in scientific studies and practice alike, especially at the organisational and individual level. I shall point out areas where further improvement is needed and also where no research has been done. The approach will range from the behaviour of the community as a whole to that of the individual. For each level different ideas, different propagators and different methods will be specified. First, however, I want to raise the question of the broader "organisational culture", namely society's system of values, since this is what sets the standard and value of safety measures.

The value of safe transport

Society as such seems to enjoy mobility, prefers to pay lower prices for goods, wants to decide about modes of transportation, enjoys new cars and other vehicles, wants reasonable salaries, prompt supplies for their companies and yet no accidents, no traffic jams, a clean environment and no regulations. It is immediately obvious that these are conflicting goals and that some can only be reached by sacrificing others. For example, freedom of choice as regards speed or mode of transportation, or travel time is liable to be environmentally much more damaging than using public transport. To pay little money for goods or services implies that the people supplying these demands reduce their income or drive/produce at other standards of safety or with different time management (Hamelin, 1999). To insist on having products just in time implies that drivers have to take extra risks to compensate for a traffic jam or a sick fellow worker. Thus, depending on the societal/individual

value system, mood or preference, the accident rate is the dependent factor. Indeed, research could clearly show the dependency between fatal accidents and macroeconomic factors.

Partyka (1984) took the number of people unemployed, employed and not available for the labour force as economic indicators and compared this index to the fatality rate in the USA from 1960-1982. Applying her model to these economic variables revealed that she could predict accidents with a coefficient of determination of 0.89 for the general population, and 0.98 for young people (age 15-19). Adams (1985) used Partyka's approach on British accident and employment statistics and reported determination coefficients of 0.88-0.95. Economic fluctuations, such as unemployment, financial gains or bankruptcy can thus produce lower target levels of risk, as they increase the relative costs of accidents and the costs of dangerous "joy-driving". This in turn further reduces the target level of risk and hence the motivation for engaging in risk-taking behaviour. Accidents increase and diminish in line with the level of economic activity. This has to do with increased mobility and the relative value of an accident. When money is scarce, even a small accident can be a financial burden, while in times of economic growth the same accident is considered much less damaging (Trimpop, 2001).

The first way for a society to reduce accidents and to increase health, safety and the quality of the environment would be to value these factors more highly than individual and societal mobility or low prices. At present this does not seems to be the case. People tolerate thousands of fatalities and millions of injuries just to keep their mobility. Also, people with highly influential roles and high mass media profiles seem to promote the value of risk-taking and risk-seeking behaviour, such as race-car drivers, financial investors or politicians. In general, taking risks is necessary not only to make profits but also to have fun. To change behaviour on the roads, society would have to develop other options for enjoying challenges and testing driving skills (Wilde, 1994). Ideas propagators would have to come from those parts of society that are linked to status and opportunity seekers, rather than from subgroups of society that seem to have other priorities than the average member of society. Rather than taking the people factor into account right from the planning stage, most regulatory bodies rely largely on technical and economic factors, sometimes augmented by health and safety concerns. The advocates of the different arguments again use a predominantly technical or economic scale of appraisal and are then surprised when the average person does not comply with the ideally engineered design principles. One perfect example is the building of wide, straight roads in the 70's all over Europe. While the idea behind the engineering was to allow drivers to see a long way ahead and so prevent accidents, the actual result was, and still is, that people increase speed and pay less attention. Similar examples of changes in behaviour are numerous (Trimpop and Wilde, 1993). The conclusion therefore is that the knowledge of traffic psychologists and other behavioural experts has to be built in at the planning stage of regulatory action or construction work. Herein lies the opportunity for governments to increase acceptance as the basis for changing mentalities.

Governmental agents and actions

It can safely be predicted that any German party that made speed limits a priority item on its next election platform would lose substantial support among the general public, despite there being some 10 000 fatal accidents and 500 000 injured every year in Germany alone. Similarly, any government seeking to make speed subject to automatic control systems, for example through computer links to every speed limit sign, with a highly supervised, satellite controlled surveillance system, would be considered "Orwellian" and also voted out. Individual freedom is the key value at present. Garo (2001) shows in an international study of truck and transport drivers from several European countries that the key problems of time-pressure, fatigue, distraction and poor working conditions are virtually identical across nations. Possible solutions differ widely, however, ranging from working fewer hours to more freedom in designing working and driving procedures. Widespread deregulation, privatisation and the

reduction of socio-economic welfare systems in the industrialised world all lean in the direction of individual responsibility and withdrawal from governmental influence and control.

At the same time, however, the European Union is introducing far-reaching guidelines and stipulations through national deregulation approaches. This also offers the opportunity for substantial change in the closely intertwoven European road and transport system. Only through common guidelines, approaches and strategies can problems be tackled that national governments are unable to solve. Thus, European legislation in 2000 (93/104/EG), aimed at changing the length of driving times and redefining working time, is a positive step towards a unified strategy. At present, however, we have to focus on different levels of governmental action. Regions, provinces and counties have many degrees of independence as to the specific design of their traffic and transport systems. Here it is vitally important that the ideas of the broader European Community and its bodies are communicated effectively to lower levels of government. There are, however, very few measures for advertising and selling rules and regulations to recipients. Even the information is either scarce or indigestible, as it often focuses on small details in long reports. So, ideas propagators in all governments have to learn to sell ideas, rather than dictate them. Information and motivation are needed.

As we know from 100 years of learning theory, old habits die hard and when there are conflicting goals one tends to choose the solution more advantageous to oneself. Also, support systems aimed at changing habits, such as better and mandatory education for truck drivers and for companies utilising transportation devices, as well as for companies providing such services, would have to be quality guaranteed, standardised and, of course, strictly enforced. From the area of work safety, there is clear evidence that people only adhere to safety standards if they are enforced, regardless of the extent of the possible consequences (Hoyos & Wenninger, 1995). It follows that another measure for ideas people in government would be to set quality standards, enforce compliance with them, educate people and monitor actual behaviour. Ideas should come not only from and through government, but also from other bodies, such as public insurance companies, accident prevention agencies, marketing institutions, research institutes, quality control organisations, transport companies, to name but a few. Apart from this interdisciplinary body of organisations, it is essential to include those people who actually have to live with the consequences of regulations on a day-to-day basis and those who can predict the behaviour of average drivers and organisational decision-makers. To change mentalities, it is necessary to enforce linkages between seemingly separate bodies, agencies and financial resources. For example, before permission for a production plant or a shopping centre is granted, information about possible usage, conflicts with other citizens, likely traffic behaviour, environmental issues, as well as issues to do with easy commuting for workers, customers and visitors, has to be gained and utilised at the planning stage. Can trucks turn round, pass each other on the roads, change their trailers etc.? These are questions that obviously need to be checked beforehand, but are in fact often overlooked (Kalveram, Trimpop & Lau, 2000). Also, planned or already installed road usage charges could be linked directly to compliance with established safety standards and procedures. Thus, a variety of actors and interdisciplinary competencies are required to enhance awareness of all the linkages involved in the goal of changing mentalities.

Consumers

The role of the consumer is a key factor in modern societies. Millions of euros are spent on motivating the consumer to buy products, vote for political candidates or take up entertainment offers. The price of the product is the main deciding factor for the customer (Kroeber-Riel, 10xx). These ideas are planted through direct advertising, product placement in movies, indirect advertising, for example at sports events, tests, and via all the possibilities that today's media offer. Compared to the amount of money, time and creativity invested in buying products or services, investment in any kind

of health and safety is negligible (Trimpop, 2000). Consumers are often not even aware of the dangers and chances taken when buying one product rather than another. For example, during the recent focus on meat products contaminated by BSE, very few consumers knew the actual procedures involved in how their meat gets from the cow in the field to the point of purchase in the supermarket. While environmental and animal protection agencies had already pointed out many of the dangerous and illegal procedures involved, e.g. in transporting live animals for hundreds of kilometres in extremely confined spaces just so as to reduce the cost of slaughtering them, since workers in foreign slaughterhouses have lower wages, people only reacted when the media caused a mass panic over the eating of meat. As a positive but unwanted side-effect, the amount of livestock transportation declined significantly and clean and closely monitored slaughterhouses in the immediate proximity got an increase in customers, thus reducing the volume of traffic and the number of accidents suffered by consumers in their role as road users. At this stage, a well designed media campaign could have linked the BSE scare to actual costs in terms of lives lost, injuries and damage to the environment caused by heavy transport traffic. None of this happened. Thus, propagators of ideas who want to change consumer mentalities have to use attractive or frightening messages to hang their ideas on and have to use means of information and encouragement that give the consumer a reason to pay for better and safer quality-controlled products.

One example of this strategy was used in the Eastern United States and Canada, where cans containing tuna fish were marked with blue dolphins only if the fishing methods used were those that prevented dolphins from being caught and killed in the tuna nets. Similar methods that can be employed in transport systems include safety-emblems or pointing out the safety standards of the contractors or the safety records of the producing companies. So another way to give consumers ideas is to inform them of higher safety and health standards in transportation and so create consumer demand for such products.

Producers and buying institutions

For all forms of organisation, the key role in changing attitudes towards transport starts with the recognition that the key factor in accidents, both on the premises with fork lift and other vehicles, as well as on occupational journeys, such as truck and taxi driving, commuting to and from work and even – to a lesser degree – private traffic accidents, can be predicted through the work stress factor (Trimpop *et al*. 2000; Kirkcaldy *et al*. 1997). Moreover, in examining 3 000 small and medium-sized companies, the above authors found that risk-taking and exposure to risk are far less influential than perceived stress at work. Frankenhäuser and Johansson (1986) were able to show that truck drivers who reported stress to their supervisors showed greatly increased hormonal levels in the urine even 8 hours after the end of work. Other studies show the importance of the shift schedule for both work stress and absence from work due to accidents (Kirkcaldy, Trimpop & Levine, in press). Therefore, the most important factor for any company seeking to reduce accidents both on the job and on the road during transport is to reduce work stress. In return, if companies want to take responsibility for their complete product, they have to involve contracting firms in their concept of safety. Passing the financial and transport risk onto the transport company might reduce the cost to the producer or buyer, but it also increases the overall cost to society. Also, accidents involving suppliers could mean a loss of productivity, reliability and quality. Although one can change suppliers, establishing new procedures, developing relations of trust and being able to get unusual requests fulfilled if necessary is costly for any corporation as well. Thus, large petrochemical companies and some automotive groups have extended their own safety concepts to their contractors, checking them but also providing them with guidelines, support and safety management through ISO 9000ff or SCC, for example. Of course, many companies, especially smaller ones, also have their own transport and logistics centres. Here, all

possibilities and strategies for transport companies apply, with the additional bonus of a larger production framework for health and safety measures as well as personnel (Littinski, 1996).

Some of the successful methods used in work safety depend on preventive or prospective safety management strategies rather than solely corrective ones. These strategies are introduced with the following basic ideas: corrective strategies entail accident analysis and the development of company safety standards after accidents or critical incidents. The main means available are goal setting, control and feedback. Information is provided through schooling and leaflets, posters, videos, etc. In traffic safety, speed checks, tire-profile measurement and information booklets are typical examples. Also, accident statistics and analyses are heavily relied on (Cerwenka, 2000; Lang & Müller, 2001).

Preventive strategies attempt to identify potential hazards or accident spots and design safety equipment such that the likelihood of an accident is greatly reduced. The means of implementing such strategies include checklists, audits, safety regulations, critical incident techniques, etc. The methods used to convey information are similar to those used for corrective strategies, but applied by the supervisor. Typical examples for transport systems would be the checking of on-board safety and warning equipment, technical safety standards on the transportation device, separation of people and transport routes, e.g. fork-lifts. Special emphasis is placed on technical features to warn of fatigue and prevent the disastrous consequences of falling asleep behind the steering wheel of a large truck (Sprenger, 2001).

Prospective strategies are designed to prevent organisational circumstances that lead to disruption, as the causes of accidents are often multifaceted and complex. Thus, any unplanned departure from safety and quality-controlled procedures is a potential danger for people, machines or products, which can be prevented by designing workplaces and procedures differently. Typical examples are “integrated safety management”, “total quality management”, or business reengineering. In the traffic safety context, this would involve strategies such as job rotation of loading and driving. To ensure that the tasks designed not only prevent health problems, but also offer an opportunity to further personal progress, responsibility and commitment to the task and the company, staff planning, route planning, customer contacts, loading strategies, time-management etc. should be part of the driver’s duties. In this way, it can be ensured that those most knowledgeable about the actual transportation task and conditions are influential at the planning stage, rather than intervening in the “rescue-improvisation” situation afterwards. Some especially successful examples of these strategies will be described later. To sum up, people propagating ideas can either work through close control and feedback in corrective work and safety design or, where that is not really possible, as in transport, through introducing responsibility in preventive or prospective design.

Transport organisations

Transport organisations can be either part of a production/sales company or independent or both. In all cases, the above methods apply, so I want to specify some of them. The key concept for ideas disseminators must be to create transport conditions that prevent accidents and are forward-looking in nature so that driving, logistics and loading staff solve their potential problems before they arise and are self reliant. How can this be achieved? There are two successful approaches, one based on the goal-setting theory of motivation (Locke and Latham, 1990), the other predominantly based on the Job Characteristics Model by Hackman and Oldham (1980). The goal-setting approach successfully uses incentive systems to shift behaviour in the desired direction (see Trimpop, 1994; 2000).

For example, Wilde (1985) cited a study conducted in a German branch of the Kraft Food Corporation with a vehicle fleet of 600 trucks and vans. In 1957, drivers were told they would receive

a bonus of about $150 for every half-year of driving without "culpable accidents". This arrangement was made because insurance premiums rise if accidents are judged to be the driver's fault, while they fall if the driver has no accidents for a year. The programme was still being continued in 1995, with remarkable reductions in accidents. In 1981, the culpable accident rate per kilometre driven was 14% of the 1957 rate (Wilde, 1985), while the total accident rate per km driven was 25% of the 1957 rate.

Fox *et al*. (1987) examined the effect of offering trading stamps for not incurring lost time through injury, not damaging equipment as a result of accidents, making safety suggestions that were adopted and preventing accidents. Trading stamps were withdrawn when co-workers in the group got injured, or caused accidents involving damage to equipment. Long-term reductions in lost time through injury and accident-related costs were noted in the two open-pit mines examined. Further reductions in accidents and accident-related costs thanks to incentive programmes can be seen in a study by Siero *et al*. (1989).

Harano and Hubert (1974) formed matching groups of 9971 subjects who received the promise of a one year extension of their driver's license without having to take the written exam if they stayed accident-free over the coming year. A second group constituted the no-treatment control group. Those drivers whose license renewal was due in the forthcoming year showed a significant reduction in accidents (22%), as compared to the control group and the drivers whose license renewal was coming up later; their accident rate remained unchanged. The approach was especially effective in the case of drivers below the age of 25, this being the group with the highest proportion of accidents and the lowest incomes. In subsequent years, the reduction in accidents was 33% before the experiment was stopped (Wilde, 1994).

Although incentive programmes (e.g., Fox et al., 1987) did show some long-term effects, it is to be expected that people will get used to these increased rewards and, after a while, take more risks again. It would therefore be advisable to change the kind of rewards periodically, to adapt them to individual needs and differences, and to make incentives non-material as well as material in nature. Non-material rewards, such as praise and fame, are often more conducive to intrinsic motivation than material ones. Findings reported by Trimpop (1999) indicate that incentive programmes, if properly conducted, are excellent tools for changing behaviour, but not for changing attitudes or instilling responsibility as regards anything other than the very specific target task. To achieve that, other measures have to be utilised, building on psychological models such as the "Job Characteristics Model".

Instilling a responsibility mentality in transportation companies

In a specially designed concept for organisations dealing with transportation and commuting, the German Traffic Safety Council (DVR) developed, in collaboration with experts from universities, insurance companies and independent traffic counsellors, a system for instilling responsible attitudes to traffic behaviour through participative means. As this approach can be easily used by ideas disseminators, it will be sketched out here, while detailed descriptions can be found in Kalveram et al. (2000) and Trimpop et al. (2000).

In this concept, the assumption was made that motivational processes in safety work are very similar in nature to those in health and quality circles and other team-based methods. Thus, the psychological processes underlying team work, such as intrinsic motivation, job enrichment, desire for control, etc. were combined in a working model of intrinsic safety motivation. Based on these concepts, a method was designed to instil or increase intrinsic safety motivation in the workplace. As a result, fourteen companies volunteered to participate in the project which involved examining the

effect of traffic safety circles on team members. Although the starting point was traffic safety, including stress reduction while moving trucks in narrow streets and customer parking lots, it soon became obvious how closely related were such issues as occupational health, work safety, communication between different divisions of the corporation, quality of customer relationships, route planning and work procedures. As intended by this holistic concept, therefore, traffic issues were expanded to include all factors that may have an influence on health and safety. To tackle commuting accidents, a number of co-operative workshops were held with company employees who either used their car to drive to and from work, or with those who used their car to do their job, such as truck drivers or maintenance personnel. Included were members of other divisions, such as the staff responsible for loading trucks, route planning or the department responsible for issuing tickets for using public transport. Also, individual problems with alcohol, drugs, sleepiness, etc. were discussed both from an organisational standpoint and also as regards what causes problems and how to solve them. In other workshops, representatives of client companies were invited to discuss and improve upon the conditions faced by truck drivers when parking and unloading. The workshops were chaired by experienced members of the DVR (German Traffic Council). By incorporating these issues, and with the support and integration of supervisors, a holistic approach was taken towards a team-based management strategy. The workshops, in series of between 5-7, each lasted 2-4 hours.

Evaluation of this pilot project was based on longitudinal control groups in four different companies, with several hundred questions examined several times during the course of two years. Control groups were given videos, brochures or other traffic-safety relevant material or nothing at all. The companies were located in the following sectors: transportation, construction, grocery, electronics, telecommunications, delivery of bakery goods and maintenance of telecommunications equipment. While one franchise of the respective companies served as the experimental group, with a series of 5-7 expert-moderated workshops, another one, similar in size, number of products transported and kilometres driven, age structure and workload, was used as a control group. Control groups became the next analysis groups for the companies being added to the programme. Attitudes were assessed via interviews and questionnaires and, in addition behavioural observations were made during driving and loading procedures. Also, accident and other company records were examined. The questionnaires used a variety of assessment methods such as danger recognition in pictures, illustrations and standard items. Significant changes occurred in the number of accidents, the number of days lost due to sickness, dangerous driving, speed, efficiency and safety of truck loading and unloading, perceived customer relations and attitudes towards health and safety, as well as towards work in teams.

While the above study covered only a few drivers in each company, a large-scale study was published by Gregersen et al. (1996). 4000 Swedish Telekom workers underwent four different kinds of experiment. One group of 1000 workers received regular schooling in one hour talks from a safety inspector, a second group of 1000 workers was informed about traffic safety through various media, such as videos, brochures, handouts. None of these groups showed any significant reduction in the accident rate as compared to the year before. Groups 3 and 4, however, were involved in a participative experiment whereby one group took part in safety training with a strong emphasis on the psychology of driving, how to choose and avoid stress situations, and how to handle not only unusual situations but time-pressure as well. The accident rate in this group fell by more than 30%. Finally, group 4 took part in a traffic-safety circle, similar to the one in the DVR study. Here they were given the opportunity to voice suggestions about changes at work, some of which were applied immediately and some through the course of the following year. The accident rate in this group fell by more than 50% on the previous year. This approach thus proved highly successful in changing behaviour, attitudes and working procedures and in reducing accidents. If instilled as an organisationally designed procedure, it can also serve as a basis for quality improvements, procedural processes and health and safety alike. People disseminating ideas can use this participative approach only if they are backed by supervisors in an organisation and if the company is willing to introduce a significant proportion of the

suggested changes. Furthermore, to have responsible workers who decide for themselves requires a personnel development system which will improve interpersonal skills, problem solving, communication and co-operation as well as different procedures for tackling tasks. The latter have to be instilled and made automatic before the full gains can be made from participative approaches. If that seems impossible, than the incentive approach can be better utilised, also with remarkable success. In traffic safety, such incentive systems should, however, be supported on the cognitive and behavioural side by psychologically based safe driver training, so that the individual transport driver has the chance to use alternative, safer driving skills.

In short, people disseminating ideas can use incentive systems, driver training and participative approaches to promote behavioural, attitudinal and cognitive changes within organisations and amongst their members.

Individual drivers

All the above methods of changing mentalities are ultimately designed to influence the transport system through the driver. Some use indirect approaches by changing working conditions and procedures, others use direct ones through information and participation. Of course, motivation does play a key role in the behaviour of the driver. The driver has to set priorities in such a way that his job can be performed well. Furthermore, he has to make sure that he lives up to his own safety standards or other regulations. Thus, if a driver or a pilot decides to keep on driving or flying - even if his level of tiredness is at the limit (Kiegeland, 2001) - in order to save money for the company, arrive in time, have a free day or earn a bonus, the decision is a typical risk-decision. What it means is that luck and dangers are weighed against each other and the short-term gain often wins over the long-term safer goals, as in the case of smoking, overeating, alcohol consumption etc.. If –and only if- the possible gains to be had from safe behaviour outweigh the costs and benefits of adhering to the rules and are subjectively evaluated as better for the driver than breaking the rules, will drivers adhere to the standards set. Trimpop (2000) shows that the average driver loses his licence about 3 times during a day of several hours' driving. Yet many people have been driving for ten years or longer without having an accident. Thus, they have learned 10 000 times that rules and accidents are independent and that breaking rules will gain them time-benefits, praise from the company and arousal hormones from pushing the limits of the vehicle and their own presumed skills. As testing one's limits is as inherent as the tendency to seek out risk and gain risk-competence (Trimpop, in press), this behaviour pattern is generally to be expected and can be considered "normal". Disseminators of ideas with the task of changing mentalities can therefore not expect people to behave differently, i.e. be safety-regulation oriented, as they are consistently rewarded for breaking rules and their experience shows them that luck outweighs the dangers. Thus, they have two options for instilling change: either they remove the choice from the driver, or they provide other ways of finding challenges while driving.

Removing the choice and thus the likelihood of mistakes is an approach that has been utilised successfully in work safety. For example, nuclear power plants are designed in such a way that, normally, errors and unwanted behaviour do not lead to major hazards. Only combinations of several errors and mistakes cannot be predicted and still cannot be ruled out (Perrow, 1984). In driving, technical devices to increase passive safety, such as special windshield glass, ABS, reinforcement of doors and flexible frames, but also driver support systems, such as automatic brake enforcing systems, distance warning systems, both for parking as well as driving, navigation systems, even automatic speed controls and limitations have been designed and tested. Ultimately, it would be technically possible to have driving and transport systems designed in such a way that speeds, distances, routes and emergency actions were almost completely under computer control, thus removing the possibility of driver error. Wake-up systems based on eye-lid closing frequency, heart-rate monitoring and even

EEG-measurements can and have been used and tested to give the driver feedback about his/her state and could also be used as automatic shutdown signals, forcing the driver to rest or change (Torsvall & Akerstedt, 1987; Hartley, 1998). While these approaches might produce the same results as automation has in work safety, namely a reduction in accidents by taking people off dangerous tasks, it is highly unlikely that such systems will be politically and financially acceptable in the foreseeable future. This holds true especially for countries less wealthy than Europe or the US or Australia. In developing countries, the individualisation of traffic is growing even faster than in Europe, where it is growing at an alarming rate (Neubert et al., 1993). So other approaches have to be taken.

There are very few professional areas that are as dependent on individual motivation as driving, especially in the transport system. All vehicles are technically equipped to be driven safely, slowly and carefully and without major technical defects. In fact, the number of accidents due to technical failures is less than 10%. Also, roads and regulations are so designed that accidents can generally be avoided. Yet people decide deliberately, or because of limited attention spans, changed values, etc. to utilise the system differently for purposes other than health and safety. Consequently, the only way to change such mentalities is to offer other ways of discovering as much freedom, enjoyment, independence, control, challenges, etc. as are provided by driving. The same holds true, though to a lesser degree, for professional truck and transport drivers as well. Here we find contrasting stress-reducing strategies. As driving at 80 km/h for hours behind other trucks with automatic gears, cruise-control and other support devices leads ultimately to boredom on the part of the drivers, they tend to do other things such as reading the newspaper, watching TV, telephoning, writing reports, sending faxes, etc (Riedel, 2001). These hours of utter boredom are then interrupted by a few seconds of horror when something unpredictable happens to the unprepared driver. As the effects of boredom are independent of personality and can hardly be influenced through training, the logical conclusion is that the business of driving needs to be enhanced by other activities that keep the driver alert (Kiegeland, 1997). These activities have to be related to driving, or at least to be a mixture of the job and the task of driving. In power plants, the control staff have to monitor and record different states of the system, carry out regular checks and safety measures, communicate with others and plan further steps and procedures. One option would be to get drivers involved through internet systems, CB or via mobile phones (UMTS) in talking/communicating with other road users about possible dangers, risks and solutions. Often, truck drivers can warn their colleagues about heavy loads, traffic jams, technical problems, driving errors or simply keep them awake. A unified communication device and standard would further this approach. People from organisations who disseminate ideas could also utilise this system to get business information and changes across to drivers, as well as to give them information about health and safety while driving. If supported by distance warning systems, any distraction caused by these systems could greatly be outweighed by the benefits of staying more alert and being informed. Also, time lost while driving could be used in a more meaningful way.

To give drivers in the transportation system the option to comply with safety standards without risking their jobs and thus their livelihoods, governmental regulations on the sharing of responsibility between the owner/supervisor/driver for any error occurring on the road would also take away the burden of responsibility from the shoulders of the last and weakest link in the consumer – organisation – driver system.

Conclusions and Summary

The purpose of this paper was to describe proven methods from different areas and apply them to the transport system, as well as to point out where and how ideas disseminators can begin to change the mentalities of buyers, producers, hauliers and drivers within the traffic system. Also, it has sought

to develop some new approaches and ideas that might prove successful and need to be tested on a larger scale.

The major message that should come across here is, however, that changing mentalities in the transport system cannot be achieved by focussing on the individual driver alone, but has to be aimed at those surrounding factors and actors that lead drivers to behave the way they do. Most traffic safety systems are aimed at individual drivers and thus do not utilise or even recognise the dependency of the person on the organisational framework. Also, official agencies responsible for traffic are not related to those responsible for health and safety, and neither is connected to those regulating prices, production and international transportation. None of the official representatives deals with the problems on a day-to-day basis. Developing an international platform for these agencies, with representatives from all groups, would be a first step towards tackling the growing problems in the traffic and transport system.

As with the participative approach described above, however, it is not sufficient to include official representatives of the truck and transport system, official country representatives, drivers or any of those groups. Official representatives have the task of defending their interest groups and are far removed from the actual day-to-day problems of those on the road and in organisations. It follows that those that do the work have to be included in such a task force for it to be successful and realistic. The same holds true for scientific and training workshops, where hands-on knowledge from various interdisciplinary areas has to be communicated and exchanged. This paper is supposed to be one element helping to transform the puzzle into a coherent picture.

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ROLE OF GOVERNMENTS AS CONSUMER / BUYER AND ACTOR FOR NEW DEVELOPMENTS IN THIS FIELD

At National Level

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Introduction

Over the last 3 years a new policy plan for traffic and transport has been developed in the Netherlands. Apart from setting new objectives, the plan has launched a debate on new responsibilities and on responsibility-sharing between the private and public sectors. The focus is no longer simply on traditional instruments like legislation, but on encouraging policy discussion as well.

This new approach will be presented here along with a brief introduction to the national traffic and transport plan, ranging from the new vision of public and private responsibilities to a description of the pilot "Safety Culture" project.

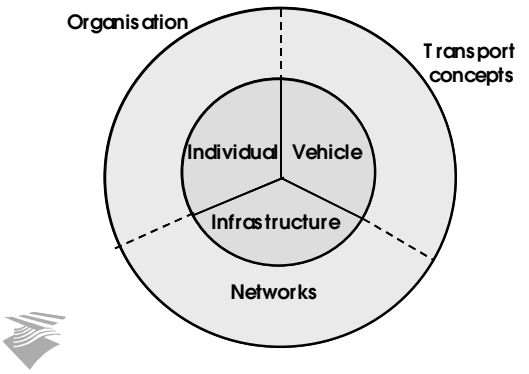
The National Traffic and Transport Plan in the Netherlands

The aim of the national traffic and transport plan, in the safety sphere, is to reduce the number of fatalities due to road traffic by 30% and the number of hospitalised victims by 25%. The effort required to achieve this is considerable, given that all the simple measures have already been taken.

The plan includes a decentralisation of responsibilities on a large scale. Whereas in previous years responsibility and budget lay with the central government, this plan gives both responsibilities and budgets to regional and local authorities. The underlying idea is that these authorities are more directly committed to their infrastructure and the related transport and will have a better idea of what measures are required.

Apart from this decentralisation, the plan discusses safety in using a model termed the "pizza" model.

Figure 1. **The Pizza model**



The core contains three traditional fields: infrastructure, vehicle and operator. Around this core, new areas have been identified: infrastructure network, transport concepts and organisation. In this paper, special emphasis is placed on organisation.

Discussion on public and private responsibilities: a changing world

The preceding section noted the extensive deconcentration of (political) responsibilities for safety. We now focus on three main issues related to that, seeing how the central government materialises its own responsibility:

1. How do citizens perceive security: what do they expect from the government?

2. What vision is used by the government as the strategic basic principle for its specific responsibilities? Which fundamental decisions must be taken in conjunction with this?

3. How can the government translate its vision and basic principles into tangible policy instruments and goals?

Citizens' perceptions: rising expectations

Measured by objective standards, the Netherlands is one of the safest countries in Europe. However, any society implies risks. A major explosion in a fireworks warehouse in the city of Enschede and a big fire in a café in Volendam, both causing many deaths and injuries, are recent examples which had a great impact. Reactions from society have made it painfully clear that safety is more than figures about facts and risks: the perception of facts is just as important as the facts themselves. Safety seems to be the product of facts and perceptions. Therefore government needs to include both in its own process of policy-making, which should in fact mean a more important place for subjectivity in relation to safety, in addition to the conventionally important facts and figures. The perception of safety in freight transport has recently been researched, and the results can be summarised as follows.

Citizens are not very concerned about the transport of goods - as expected

The transport of goods does not appeal to citizens' imaginations. Citizens are aware of transport, but they do not directly connect this to value judgements. Road transport, mainly HGVs, and railways are most often mentioned. Freight transport is mainly connected to the immediate environment: things people see on a daily basis. Most respondents are not fully aware that there are more relevant modes, such as transport by plane, pipeline or ship. Shipping, air transport and pipelines are often seen as remote.

The transport of goods has no strong negative image. It seems that citizens – when specifically asked – have a rather positive view. They are convinced that transport is an economic necessity, that it is important, and that it is quite significant for employment. Some respondents even express admiration for the technical performance involved.

Safety is no big deal for citizens… until something happens

Citizens hardly ever think about the safety of goods transport. Without great discussion, they think that overall it is safe. In their view there are differences in safety levels: air transport, for instance, is seen as safer than road transport or shipping. However, when citizens do express negative feelings about transport, it is mostly in connection with noise and other environmental issues, like exhaust emissions. Safety does not seem to be a big issue.

Some experts are of the opinion that matters such as the economy and the environment are of more importance to citizens than safety. Feelings about lack of safety are dormant, risks are accepted. Safety is thought to become significant only when incidents or disasters occur. We found that this connection does exist, but with the following qualification: safety is not a big issue because citizens take it for granted, and not because they think it unimportant! Citizens take it as a starting point that safety is guaranteed. Whenever this turns out not to be the case, e.g. when a disaster occurs, they are extremely disappointed and feelings run very high, especially when it appears that safety has been affected by economic considerations.

Citizens trust their government

Citizens trust that their government will do everything possible to make sure that safety is guaranteed. They accept that rules and regulations are necessary to keep transport safe. When asked whether they trust private enterprise as a provider of safety, most respondents say that they do not have much faith in its ability to make things safe. Government cannot leave safety matters to the market. Citizens think that making money is given a higher priority than ensuring safety.

The fact that most respondents believe that the government guarantees their safety, and that private enterprise is definitely not the main "safety-provider", does not mean that they think that private enterprise is not responsible for safety. There seems to be a gap between what people **expect** and what they **trust**.

It is for this reason that most respondents are of the opinion that enforcement should be stricter. Citizens believe that more inspections should be carried out. This runs counter to current policies where the tendency is to give the market a more important role.

The view of the central government

The safety of goods transport is a public interest, and therefore a core responsibility of the central government, in the existing context of decentralisation of public responsibilities. No one other than the central government can decide what level of safety is right. The government is responsible for safety and gives a promise to society. The central government determines the preconditions for transport, and is responsible for the enforcement of relevant laws.

However, government can never achieve the determined safety level on its own. All participants in the transport process have their own responsibilities. Transport companies have the largest responsibility for making transport safe: they have to do their bit, but it does not cover the whole matter, because they have potentially conflicting interests, and they cannot influence all factors that determine safety levels. Manufacturers, shippers and all other users of the infrastructure must make their contributions towards safety.

We must accept that we are dealing with both positive and negative influences on safety, and the central government has to search for the right balance between all the interests that are involved.

Translation into tangible policy instruments

Facts and figures about transport safety are our point of departure, but the public's perceptions of these are of equal importance. The government is not the provider of safety, but it is the player responsible for seeing that the other players make things safe. So the main question is how the central government can materialise this responsibility.

Central government is responsible for creating favourable conditions for safety. The starting point is: market where possible, government where necessary; but the final responsibility remains with the central government. The final interpretation of these conditions must be based on clear criteria, such as the availability of risk assessments, or the availability of competent players.

It is important to know the facts, and to know what society expects. The strategy to follow must accordingly be based upon monitoring developments in facts and in perceptions. The strategy should also be based on a balance between reaction to past events and developments on the one hand and a clear view of future developments on the other. By bringing these aspects together, it is possible to make rational choices between the reactive approach (avoidance strategy) and the pro-active approach (achieving strategy).

Below we give an example of what this approach means in a specific case.

Pilot project on Safety Culture in Freight Transport: best practice in human factors

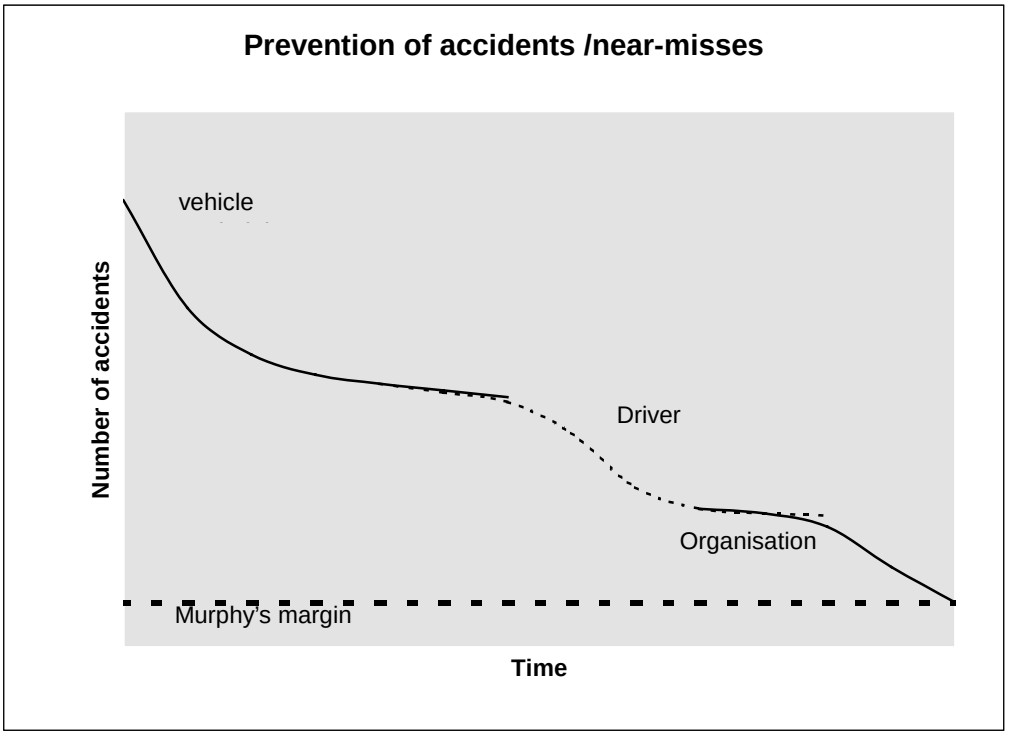
Introduction

Changing how people behave can be very difficult. We have probably all experienced this in our private life, and in our professional life too. To improve traffic safety, central government agencies try to change people's behaviour by enforcement of traffic safety rules, technical norms, education, awareness drives and so on. But is this always effective?

Top-level EU aims are to tackle the many incidents involving alcohol, drugs, fatigue and excessive speed, the accident risks among young drivers and the failure to use protective equipment such as seat belts and crash helmets. Safety measures are implemented to change drivers' behaviour. Sometimes this helps to achieve safety targets, but often it does not. More and more people realise that the latest findings of behavioural science should be used to devise innovative safety measures.

Our challenge is to establish safer roads by encouraging professional truckdrivers to act safely. Looking at the world of freight transport, safe driving is in the hands of the driver himself in his organisational setting. This professional environment provides the opportunity for innovative measures in changing behaviour. The "Safety Culture" best practice in road safety is based on the idea of making use of the drivers' organisational setting to improve safety performance (Figure 2). Lessons from rail and aviation, but from elsewhere too (the offshore drilling sector is an example) show that the importance of the human factor in safety management is predominant. In these industries the use of motivational theories has become common practice in the last few years.

Figure 2. **Prevention of accidents / near-misses**



Importance of the human factor

General opinion is that approximately 80% of all incidents and accidents in organisations can be put down directly to human behaviour. If unsafe behaviour is not corrected or prevented, chances of damage or personal injury arise. To be able to learn from earlier (mis) behaviour it is necessary to ask ourselves why human errors occur. Why do drivers exceed speed limits, why do they get tired, why do trucks tip over, why are signs ignored or missed? While answering questions of this kind, we see that human errors on the 'workflow' are often a consequence of decisions made earlier, e.g. in the

boardroom of a transport organisation. Safe behaviour requires that people are motivated to work safely and that the working conditions are such that the chance of making errors is small.

A balanced approach to secure transport safety and quality in general calls for attention to the human element, not only the individual driver but also the management - i.e. the organisation - of the company, the vehicle and its technical features, and the infrastructure (Figure 1). Considering the role which human actions play in many accidents, it would be appropriate to give attention to behavioural issues. The government strives to reach a certain level of safety by setting regulations. In the technical sphere this is a reasonably effective method, but regulations have only a limited effect on human behaviour. Too many regulations can even have the opposite effect. For example some technical measures are counterproductive: people imagine that these measures make things so safe that they can take more risks! We call this risk compensation.

If we really want to change drivers' behaviour, a change in culture -- a Safety Culture -- is needed. It has become clearer that the truck driver is not the only person who makes mistakes; the managers of the haulage company or even the designer of the truck make them as well. If we really want to improve safety in freight transport, then everybody from bottom to top needs to contribute. It should in fact be considered in a wider perspective: other industry participants, for instance the shipper, the insurer and the government, should also be involved in improving safety.

Towards a Safety Culture in road transport; a general framework

An organisational culture tells us something about the shared values and beliefs in a company (or even a sector): what is important, how do things work here, what is the way people do things around here. We can see that the culture of an operating company and the national culture together determine how the employees interpret and apply the same set of rules; rules must be managed with explicit attention to this aspect.

When safety considerations must take second place in a company's culture to, say, economic considerations, then this can put traffic safety at risk. How far is a company, for example, prepared to stop its transport operations if safety is at risk? How much is someone 'punished' if he/she questions unsafe behaviour? Does the bonus system put employees under such pressure that their health and/or safety is jeopardised? Is safety on the agenda?

A Safety Culture can only exist because the company wants to have it. Management and drivers should be all involved and convinced of its positive results for safety. After all, safety can only be improved where the knowledge is, at the point where the errors are made. Isn't the driver himself more conscious than anyone else of all the risks in his environment? In a safety culture, it is the driver who dares to opt for safety or the manager who decides to install a new and better mirror. The company has to be aware of the errors that systematically occur. It is very important that near-misses are reported and openly discussed, that earlier mistakes are analysed and improvements are based upon the feedback.

Important pillars of a Safety Culture are:

1. Commitment of management: shift of responsibility from the individual to the organisation.

   Set a good example. Do not wait for the judgement of third parties, look for the underlying causes of incidents, the risks in your organisation, yourselves! The impact of human resource management on safety and quality is substantial. HRM practices are the set of practices that

directly affect how employees perceive their jobs. Think of organisational design, staffing, employee and organisational development, performance management, reward systems /benefits and communications and PR. HRM is a starting point for safety and productivity in freight transport.

2. The existence of a Safety Code, from bottom up and from top down

   A Safety Culture will not exist without efforts from everyone, from the boardroom to the workbench. It is very important that the management draws a clear line between what is considered to be safe and what is not. Transparency and clarity and communication about this are the key issues.

3. Making Safety visible

   Organisational factors that are critical for safety should be measured and benchmarked. Examples of safety performance criteria are safety communication, HRM policies (e.g. training factors), quality of procedures, quality of equipment.

   To make Safety visible, people should not be afraid to report mistakes and mishaps, incidents and near-misses, even their own. To achieve a culture of this kind, it is important for reporting to be easy and, since anonymity may create distrust, it is better to have signed reports combined with a culture of confidentiality. Moreover, feedback is very important, so let people know that you appreciate the information.

   Only a collection of relevant data, in some kind of information system, gives the opportunity to process and analyse information in a pro-active way. This will give understanding of the activities in an organisation which are critical for safety, before an accident happens.

4. A learning culture

   To actively improve the level of safety, a learning organisation needs to exist. Organisations are often afraid of earlier mistakes: they try to forget them and to hide them away. But errors do have a positive side. Apart from learning how to recover from errors, they can create a 'learning' influence for new procedures and working methods.

The "Safety Culture" project

In the Netherlands approximately 1 000 people are killed in traffic accidents every year. The costs of safety in traffic are often underestimated. Accidents, injuries and environmental and economic damage caused by the lack of safety in traffic are valued at 12 billion guilders a year. Moreover, the degree of acceptance of this lack of safety is not always logical. Much work still has to be done in order to reach the national target for reducing the number of victims. If we really want to attain the safety targets, a *culture change* in the transport sector is necessary.

The Dutch Safety Culture project started at the beginning of 1998. The aim of this project is to create the conditions within the working environment by which the making of errors and the committing of violations will be reduced.

We very soon concluded that legal solutions were not the answer to these behavioural problems. We also discovered that improving the level of safety in transport will call for efforts from all

stakeholders. An unsafe act is often a consequence of an earlier decision, at another place and another time. Before an accident occurs, a chain of events has already happened.

Important actors for the delivery of a safety culture are:

- The transport companies: company goals should change from price competition alone to quality competition as well.

- The government (highways department, road maintenance authority): as the owner of infrastructure the government has the means to provide broader access ("window times", use of bus lanes) to quality transport companies.

- The shipper – as the consumer/buyer he can use safety as well as price as his criteria when selecting a transport company.

When shippers are aware of safety issues through transparency, they can take this into account (e.g. via the Internet). At the same time incentives can be given by the government for transport companies which are able to prove good safety performance.

A great deal of responsibility for safety is in the hands of management. The government's role is to create the preconditions, for example by introducing incentives.

Such incentives include:

- Transparency and visibility of the safety performance of transport companies and arranging their integration in quality assurance systems, e.g. a quality mark.

- Supplying preconditions, such as efficient enforcement, facilitation of accessibility, education, supply of "Best Practices", and devising and supplying to the industry a registration system for benchmarking safety performance. The gain is twofold: on the one hand, the industry will learn from the performance of competing companies; on the other, quality has been made quantitatively visible.

One year ago industry and government together started a pilot study in order to make safety visible. Sectoral organisations and other parties reacted very enthusiastically to the idea of a Safety Culture project. All agree that apart from an improvement in safety this will lead to an improvement in quality. Research is conducted in a number of transport companies to qualify the company's Safety Culture and to define the critical factors for safety within transport organisations. Road transport industry practitioners have tested the results of this study.

Interviews are also held with external parties such as insurance companies, shippers, inspection authorities and transport unions. Questions have been about what measures are taken to influence the safety level of transport companies, and about the extent to which these measures match up with the company's safety culture. Our finding is that measures that match up with the safety culture are a lot more effective.

Over the next few years a quality assurance organisation in freight transport will be established, to manage quality assurance systems and provide the quality information required by shippers or road authorities.

The new role of the government: corporate governance

New thinking requires our Ministry to assume a new role, and one that is generally more complicated. We think that, related to the concern for a Safety Culture, the new role requires a more indirect policy approach by the Department, with the following issues at stake:

- Transparency of quality and safety.
- Self-regulation and certification.
- Working together on safety conditions: combining initiatives from the industry as well as the public sector itself.
- Bringing in incentives for safety results.

A company has to start work on incorporating a safety culture, but what consequences may a safety culture in the industry have on governmental policies? In what way can legislation and enforcement be adjusted? Should a company with a safety culture not be given the responsibility for self-regulation? After all, too often safety legislation is the outcome of an earlier accident rather than a self-evident condition for new developments in the sector. We need to analyse our societal values to obtain a deeper understanding of why some kinds of legislation do help us and why others do not.

The industry does have the knowledge, and thus the responsibility, for its safety levels. This Safety Culture case shows us how the government and industry can deal with safety collectively.

At national level

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Task

The principal task was to examine the responsibility on the part of the public and private sectors for safe road traffic. The Committee of Inquiry was also to propose new or revised regulations, sanctions and systems of inspection emanating from the outcome of the inquiry. Further, the Committee was to conduct an inquiry into the establishment of an independent road traffic inspectorate, including recommendations concerning how such a body should be organised, its tasks and powers of authority and how it should be financed.

The inquiry has taken the name: Committee of Inquiry into Road Traffic Responsibility.

Traffic injury trend

Up until the beginning of the 1970's, the trend in traffic injuries was directly related to developments in automobile traffic; i.e., more cars on the road led to an increase in traffic fatalities and injuries. At the beginning of the 70's, this trend was broken and even reversed. During the 80's, the reduction in the number of persons killed or seriously injured stood at a standstill, and towards the end of the decade, there was an increase in the number of fatalities. The first half of the 90's witnessed another decline in the number of persons killed or seriously injured in traffic. However, the situation in the latter half of the decade up until the present time is extremely disquieting. The number of deaths and serious injuries in traffic is not decreasing at the pace stipulated in the goals in traffic policy (maximum 400 fatalities by the year 2000 and 250 by 2007). On the contrary, the number of traffic fatalities is tending to increase.

Despite the long-range positive trend in traffic injuries, the risk of being killed in the road transport system is substantially higher than in other modes of transport.

Political attention on the traffic safety problem

Traffic safety has been the subject of several different inquires, government bills and parliamentary decisions over the past decades. 1982 was the first year in which goals were established by the Swedish Parliament concerning traffic injuries. In October 1997 Parliament decided that the long-term goal for traffic safety was no deaths or serious injuries as a result of traffic accidents in the road transport system ("Vision Zero") and that the design and performance of the road transport system was to be adapted to the demands emanating from this. In June 1998 Parliament supported the Government's proposal that "Vision Zero" was to apply as a long-range goal not only for road traffic, but for all modes of traffic. In connection with this, Parliament also approved an interim goal, which

as far as road traffic was concerned, entailed that the number of persons killed as a result of a road traffic accident was to be reduced by 50% by the year 2007, calculated from the figures for 1996.

Public and private sector responsibility for safe road traffic

On the basis of "Vision Zero", the Committee of Inquiry into Road Traffic Responsibility has analysed the shortcomings in today's legislation concerning the system designers' responsibility for a safe road transport system.

Although traffic safety as such is a recurrent subject in road traffic legislation, it is still doubtful whether it -- and the responsibility for it -- can be assumed to be the actual main purpose of the different bodies of regulations. Several of the statutes serve as a guide for different processes within the road transport system, (such as the planning, construction and maintenance of roads, vehicle inspection, administration and maintenance of the national driving licence system, vehicle registration and establishment within the commercial traffic industry) and put their emphasis on regulating the different administrative procedures.

The system designer's responsibility concerning safety has not been made clear in the traffic legislation in force today.

Product safety

Regulations concerning product safety and product responsibility are intended to counteract any dangerous goods and services provided by business and industry from causing harm to people or property. The manufacturer essentially bears full responsibility for the safety of his products, and has an obligation not only to eliminate risks and potentially injurious situations beforehand, but also to undertake various counteractive measures even in those cases where a product has passed from production onto the market. The authorities can exercise coercive interference, but the desirable changes in behaviour on the part of a business or industrial enterprise should be implemented as far as possible on the basis of voluntary undertakings initiated by the company itself. Internal control has thus been assigned a prominent role.

The area of application of product safety legislation is limited compared with special product-oriented legislation. It can be ascertained that, to a large extent, special provisions do exist for the goods and services provided in the road transport system. Thus, it is not a question of applying the provisions in product safety legislation to the road transport system. On the other hand, product safety legislation ought to cover the possible gaps concerning the safety of goods and services that can exist in special legislation.

Safety responsibility within other sectors of society

The Committee of Inquiry has also conducted a survey of the regulations concerning the safety of products and services that apply within other modes of transport as well as in the working environment.

Within railway traffic, aviation and shipping and navigation, it can be said that a "Vision Zero" has been well on the way for a long time, even if not expressed in the way formally decided by Parliament in June 1998. Long-term, systematic work on safety has been conducted within these

modes of transport for quite some time, which is why the safety level is generally already quite high. Continued safety endeavours concentrate on maintaining and improving this level.

The "Vision Zero" idea also exists within the working environment area, even if it has not been clearly articulated that no one is to be killed or seriously injured as a result of an accident at work. Instead, the aim is to achieve steady improvement through providing action against accidents at work, promoting general well-being and otherwise attain a good working environment. On the whole, the responsibility for the different components in the activities intended to produce a better working environment can be said to have been carefully specified in this area as well.

Development issues within other sectors of society

During the 1990's, the educational system moved from detailed control to goal and result management, and in the opinion of the Committee, there is much of value to be learned from the experience gained through this development. The Committee has therefore chosen to illuminate the educational sector as well, not because it works specifically with safety and safety responsibility issues, but rather because the Committee feels that the way in which this system is being run demonstrates an approach that is of interest for achieving a fast and steady improvement of the road transport system as well.

In the opinion of the Committee, the educational system has come a long way in the development process, which the Committee also recommends for the road transport system: substantially less detailed control, and in its place, goal and result management in combination with quality systems and internal control.

"Vision Zero" – an important principle in the development of the road transport sector

Just as we cannot accept people being killed or seriously injured at work or in any other sector of society, we cannot accept this happening in road traffic. "Vision Zero", which is a long-term goal with respect to safety in the transport sector, is nothing other than an expression of this important principle and an approach to the development of the transport sector. The physiological tolerance level of human beings in combination with actual human behaviour must therefore be the basic parameter in the overall design of the road traffic system. This means that the road transport system must be designed so that everyone, both young and old as well as physically disabled persons, can travel safely.

System designers' responsibility to be regulated by law

Legislation within the road transport system, which puts the sole responsibility for traffic accidents and traffic injuries onto the individual, in all probability contributes to an erroneous outlook on how we can develop road safety, and is actually counteractive to traffic safety endeavours. Those who build up the traffic system, such as road managers, vehicle manufacturers, those legislating rules and regulations and those who use the system professionally, also exert a considerable influence on road safety. In order to achieve a safe road transport system, there must be a change in our views concerning responsibility, to the extent that system designers are given a clearly defined responsibility for designing the road transport system on the basis of human capabilities. This will prevent the occurrence of those cases of death and serious injury that are possible to predict and prevent. In light of this, the Committee proposes that the parliamentary decision based on the

principle of "Vision Zero" and the responsibility of the system designers for safety in road traffic be regulated by law.

System designers be required to manage a systematic quality programme intended to improve road safety

According to the law proposal, requirements would be imposed on the system designers to manage a systematic quality programme for the purpose of improving road safety.

If a serious accident occurs, it is urgent from a safety perspective to clarify the causes so that similar accidents or mishaps can be avoided in the future. Within the framework of modern quality assurance systems, it is fundamental to know where the problems lies within the area of operation, solve them, and learn from the past and prevent the problems from arising again. The Committee recommends that the system designers themselves study fatal accidents and likewise present their own proposals about what should be done to prevent reoccurrence.

Recommendation for the establishment of a road traffic inspectorate

The law proposal is a so-called framework act. Thus, a special body is needed that would be commissioned to elucidate and follow up the implementation of the intention of the law, and reinforce the prerequisites for safe road traffic. This is to be accomplished through inducing the system designers to assume responsibility for steadily improving and upholding safe road traffic so that human life and health is not placed in jeopardy. The Committee recommends that a special supervisory authority, a road traffic inspectorate, be set up and commissioned to uphold the purpose of the new law.

The tasks of the road traffic inspectorate are:

- To carry out general and specific evaluations and inquiries.
- To ensure that the system designers conduct accident inquiries of high standard and make decisions on undertaking adequate and effective measures.
- To draw up rules and regulations concerning requirements on a quality assurance system for road traffic safety.
- To initiate a certain degree of research and development.

The Committee of Inquiry is of the opinion that only relatively limited resources, 20-30 people, would be needed to conduct effective evaluations and inquiries. This would be possible under the condition that those employed to do so were highly competent "all rounders", and that these operations were carried out openly, through a dialogue with the system designers and in co-operation with other supervisory authorities, and that advantage be taken of the opportunity to engage both national and international expertise. The requirement on competence on the part of those employed is far more important than the size of the authority.

One question on which the Committee has had to take a stand is whether such an inspectorate would have the authority to order the system designers to undertake different measures with or without penalty, or otherwise forbid certain activities if shortcoming were discovered in road traffic safety.

There are arguments that both speak for and against providing the inspectorate with such an instrument of authority. The Committee chooses to propose however that the inspectorate should not be given a mandate entailing having coercive measures. This standpoint is based on the following assessment:

- Pointing out responsibility through legislation, as the Committee is doing, is something entirely new, and we are therefore unable to comment on how the system designers will live up to this responsibility.

- If the inspectorate is given the power to order the system designers to undertake different measures or to forbid certain activities, it would be difficult to assert that the inspectorate is not in fact a system designer itself.

It is important to emphasise that it is the system designers who are responsible for remedial action in the face of deficiencies and shortcomings. This lies at the core of a modern quality programme.

The road traffic inspectorate should, moreover, be a public authority that uses the potential in modern technology to full advantage and develops an efficient work procedure based on a geographically spread network and a common goal.

A network-oriented manner of conducting work would provide the conditions for recruiting people with high, all-round competence, establishing good contact with universities and institutes of technology while making it relatively easy to interact with system designers in their current arena.

The Committee therefore proposes that the road traffic inspectorate should have offices in Umeå, Borlänge, Stockholm, Gothenburg and Lund. Apart from the head office, each branch office should have a staff of between four and five persons.

The Stockholm office should be the hub in the network organisation and it is proposed that the top inspectorate management be placed there. This would enable good contact with the other offices and many of the most important system designers. It is proposed that the Stockholm office be comprised of about nine to ten people. If an alternative location for top management is advocated for other reasons, the Committee has no definite objection to this.

Impact on road traffic safety

The ultimate aim of the proposals we are presenting in this Inquiry is eventually to eliminate those deaths and serious injuries in the road transport system that system designers can predict and prevent. The system we are proposing is largely similar to those that apply in other modes of transport and in the working environment. Hence, a reasonable ambition could be that developments at least follow those that have occurred in the working world, i.e., a 50% reduction in the number of persons killed within a ten-year period.

Economical effects

A new public authority, the requirement concerning accident inquiries as well as a quality assurance system will entail direct costs for the Government, municipal authorities and companies.

The Committee estimates that the cost of its proposals will amount to between SEK 50 and 60 million per year. Of this, SEK 30 million should be redistributed within the traffic safety budget and SEK 10 million (5 + 5) should be redistributed from traffic safety to state and local authority negotiations. The remaining SEK 10 to 20 million per year is a cost to be assumed by the private sector and certain national authorities.

Part II.

SAFE AND SUSTAINABLE TRANSPORT MEANS A SAFE AND SUSTAINABLE ROAD USER

A NEW CULTURE FOR HUMAN BEHAVIOUR

How to implement an individual culture of safety and sustainability?

Contribution by Esa MIKKOLA
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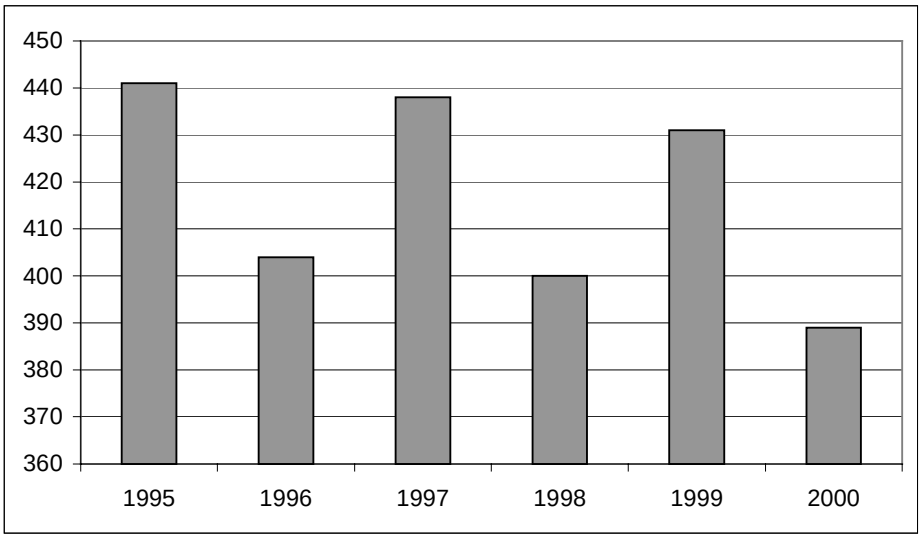
1. Introduction

The number of traffic accident deaths decreased steadily from 700 to some 400 in Finland in the 1990's, the trend also continuing in the number of injuries. Accidents that lead to injury usually occur at intersections and when driving in line in the traffic flow.

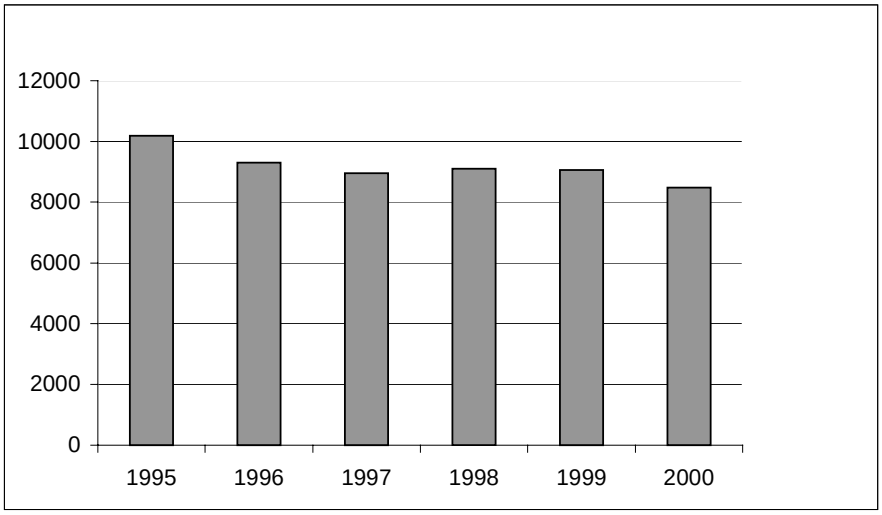
Drivers make a number of mistakes when driving. They may not notice a situation that would require action. They may interpret incorrectly a traffic situation ahead, drive too fast or too close to other road users, or make several of these errors at the same time. Many accidents are due to the driver not being in a fit condition to drive.

Figure 1. **Number of traffic deaths in Finland, 1995-2000**



Source: Tilastokeskus.

Figure 2. **Number of traffic injuries in Finland, 1995-2000**



Source: Tilastokeskus.

The best way to evoke any permanent change in the driver's attitude to driving is to change the way in which he thinks. Achieving this will lead to improved safer traffic behaviour with the new way of driving gradually becoming automatic.

Any attempt to change drivers' traffic behaviour must involve giving them a reason to act differently for the change must arise from within the person himself. This means that an incentive should be found that is sufficiently strong to affect the way in which drivers perceive traffic in general.

2. EcoDriving in Finland

EcoDriving education has been put in place due to the growing problem of CO_2 emissions.

The goal is to change driver's attitude to driving and traffic. This is one of the most important factors. If you can change the way you think, you begin to drive in a different way. The driver does not have to change his driving style but he wants to change it. It is important to motivate the driver, not only with environmental issues but also with financial incentives. To motivate a driver you must ask him to do some car tests further to which he can see a reduction in own fuel consumption.

The ideology of EcoDriving is the following:

1. You think more how you travel.
2. You buy an economic car.
3. You drive safely and economically.
4. You realise the influence of traffic to the environment and you want to decrease emissions. Everybody can do something to help decrease CO_2 emissions.

After this you think more how to travel, you drive less and compare cars more, etc.

During the course, drivers' consumption is reduced by 10-15% (average) during the course. This experience gives the driver new reasons to change his driving habits.

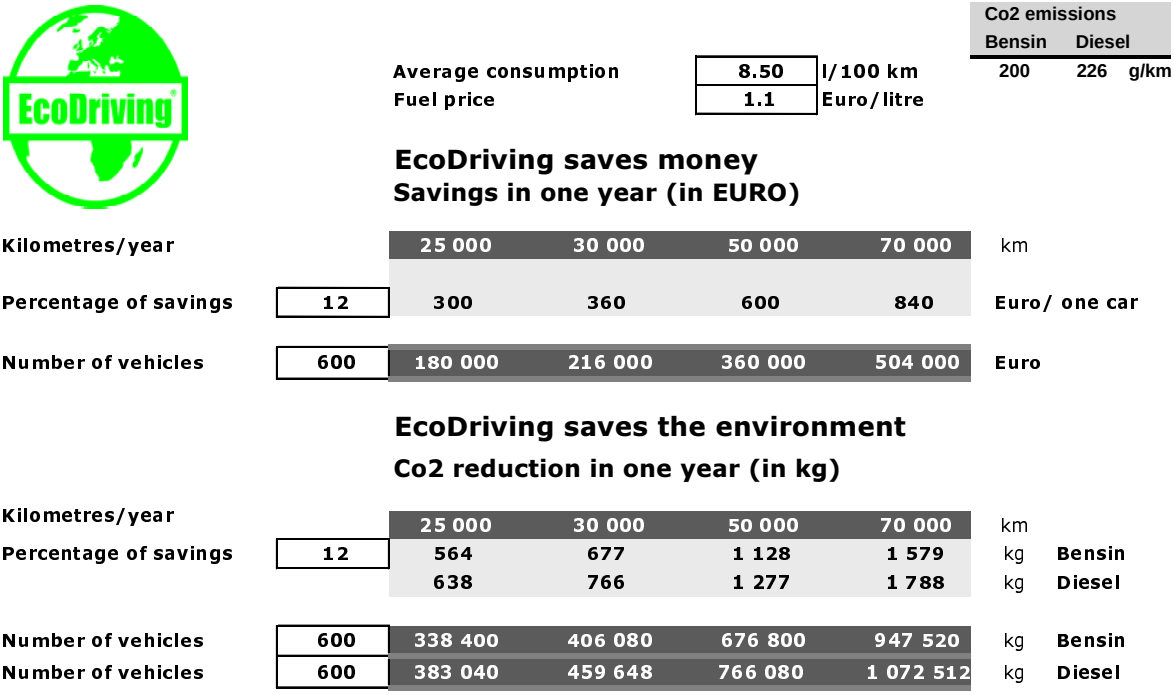
- The driver realises that he can do something to help the environment.
- The driver saves money and at the same time helps protect the environment.
- 70% of the results show that the driver can reduce his driving time.
- We have seen less of a need for vehicle maintenance.
- The driver is more relaxed.
- The driving style is more comfortable for the passengers.
- And the most important result: the risk of accident is reduced with EcoDriving.
- The interesting fact is that the driver loses nothing, he only benefits.

The driver is thinking more the situation around him in traffic because he wants to save. This means that in traffic the driver will not drive too close to the next car because he wants to see what is happening in front of the next car. He wants to avoid unnecessary stops in traffic.

He begins to observe the crossings earlier to see other road users and he slows down earlier to traffic lights; he wants green lights. As he is driving more safely, there is improvement in environmental and financial issues. Everybody wins something. There is less car maintenance. You can drive twice the distance with the same brakes for instance.

During the test we analyse driving habits and give a written report to the driver. Figure 3 shows drivers can make savings of up to 12% and the same percentage reduction in CO_2.emissions.

Figure 3. **EcoDriving saves money and the environment**



The objective is to encourage the driver to understand how easily he can save money at the same time as doing something good for nature.

During 2000-01 EcoDriving was integrated into the driving school programmes. It is very important that the students learn only the economic way to drive. One can say that in Finland new drivers drive more economically than their parents. About 75% of the driving schools (there are about 500 schools altogether in Finland) are working with the economy driving programme. There are 50 000 new drivers in Finland every year (same amount in other phase).

About 100 000 students receive information and training with economic driving every year.

In Finland about 5 000 licensed people have taken the EcoDriving test. The amount is growing all the time. The average saving percentage during the EcoDriving course has varied between 10-15%.

How to achieve drug-free driving - Testing, alcohol ignition interlock?

Contribution by Bo LÖNEGREN
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1. Introduction

It is estimated that about 15 000 drunk drivers are on the Swedish roads every day. In Sweden about 10 000 driving licences are revoked every year as a result of drunk driving offences. The period of revocation is often at least 12 months. If longer, the driver must pass a new driving test and undergo a new personal suitability test to get a new licence. The long suspension period is not a penalty but rather an administrative road safety measure. However, many of the offenders who are dependent on their car for work consider the revocation of their licence a severe punishment. Losing one's licence can be life-shattering. Social isolation or losing one's job can lead to intensified alcohol abuse. About 30% of those convicted of drunken driving relapse into impaired driving within a few years. The question is whether it is possible to reduce the frequency of this recurrence.

Through a decision of Parliament, three counties in Sweden were granted permission to conduct trials involving an alcohol ignition interlock; i.e. the counties of Stockholm, Västerbotten and Östergötland. The trial started on 1 February 1999. Those persons taking part are issued a special driving licence that allows them to drive a specific car equipped with an ignition interlock, within Sweden, for a conditional two-year period.

During the trial period, the participant must undergo a medical examination every three months, the results of which are sent to the county administrative board. After one year, the participant must be able to provide proof of a sober lifestyle. In principle this means that all alcohol markers show normal liver values.

Alcohol ignition interlocks are generally used as mentioned above as an alternative to driving licence revocation but could there be a way to use them for the prevention of drunk driving?

In its eleven-point programme for traffic safety, launched in 1999, the Swedish government pointed out a number of prioritised areas. Two of these are the quality assurance of transports and drink-driving. Experience from the work on quality assurance of transports has shown that it is difficult to monitor impaired driving without using technical aids. One such technical device is the so-called alcohol ignition interlock. In order to be able to show transport companies and those engaging their services how an alcohol ignition interlock system could work on a full-scale level, the Swedish National Road Administration (SNRA) is conducting a demonstration project in partnership with Dalabuss AB, Maserfrakt and Taxi Uppsala Trafik AB. In this project, one hundred vehicles from each of these transport companies have been equipped with an alcohol interlock. In this context, and according to international practice, this refers to a technical device that prevents driving under the influence of alcohol. The aim of the project is to be able to demonstrate the use of an alcohol interlock in practice as well as to monitor its effects as outlined in the appended project plan. The following is an account of what has happened during the first stage of the project.

2. Technical device

All alcohol ignition interlock systems on the market function in much the same way. Prior to starting the vehicle, the driver blows into a tube to detect the presence of any alcohol in the air exhaled[1]. If the alcohol level is found to exceed the legal limit, the engine will not start. The system can also be programmed for random checks during travel. The interlocks used in the project are also able to store data concerning other items of interest such as the time when the engine was turned on, registration of any alcohol detection, and the concentration of alcohol in the air exhaled (BAC). This data is extracted regularly, and can be used as input in evaluations conducted by the companies taking part. It can also be used as grounds for any necessary action. The interlock must also be calibrated regularly.

The interlocks primarily used in this project consist of a handheld unit about the size of a larger mobile telephone and a computer unit, which is mounted on the dashboard and about the size of a standard time manager.

3. Launching

The project was organised in such a way that an agreement was drawn up between the SNRA and each company. This agreement concerned participation in the project and included a subsidy to each company taking part in the trial. The transport companies in turn negotiated the delivery and installation contracts with suppliers of the alcohol interlock system. The contracts between each respective company and the suppliers were drawn up carefully. At an early stage, the companies initiated discussions with employee representatives from the Swedish Transport Workers Union, both at local and national level.

4. Installation

Modern vehicles are equipped with multiplex electrical systems with coaxial cables and nodes instead of conventional cables to the different supply points. It was therefore necessary to engage the assistance of design engineers for the different vehicle makes to find suitable places for connecting the interlocks.

The interlock has been programmed for 30-minute stall protection and adjusted so that the ignition can be on without the motor running, something that is necessary for the parking heater, radio and some other functions to work. The interlock also has a reset function that is used in connection with changing drivers and when the engine has not been turned off for 30 minutes. There is no randomly repeated exhalation test requirement, something that should be considered, especially in the case of long-distance lorry transports.

1. A Swedish alcohol interlock, the Sniffer, analyses the air in the vehicle interior instead of automatically requiring a breathalyser test. This is only required when alcohol is detected in the air inside the vehicle.

5. Information

The project was launched with a press conference, which gave broad, positive coverage. It was also presented at the so-called "Research Days" conference arranged by the Swedish Road and Transport Research Institute at the beginning of January 2000.

Both the transport companies and the project managers have been contacted by other interested players in the community, which has resulted in interesting spin-off projects.

Dalabuss and Uppsala Taxi have had signs made to inform passengers that the vehicles were included in a demonstration project.

In conjunction with the derailment in Borlänge of a freight train carrying LPG, where the engineer was found to be under the influence of alcohol, an attempt was made to convince the media to expose the need for interlock systems. However, this near crisis basically only received local coverage. Nonetheless, one positive outcome is that the Swedish National Rail Administration now intends to test alcohol interlocks on its X2000 trains.

The Ministry of Industry, Employment and Communication as well as the Ministry of Health and Social Affairs have also expressed keen interest in the subject. In a draft government bill concerning a national plan of action for the prevention of alcohol-related accidents, it is stated that an interlock stipulation should be considered in connection with public procurements of dangerous goods- and school transports.

6. Evaluation

An examination of attitudes concerning the alcohol interlock has been conducted amongst drivers, employers, purchasers of transport services and passengers. This examination shows that the interlock is widely accepted.

A study has been conducted at Uppsala Taxi and Dalabuss to learn more about the implementation process. A few key conclusions that could be drawn were that the implementation went too quickly, that information to those concerned suffered because of this, that the technical problems were irritating, but that the alcohol ignition interlock has come to stay!

So far we can also see that the interlock has stopped a few cases of drunk driving. This fact is highly appreciated by both the companies and the drivers!

7. Future requirements?

The requirement that transports must be carried out by sober drivers can elicit different responses from transport companies. Today, drug test routines and company culture are key factors behind the response given. Different technical solutions can play an increasingly important part in the future. In this respect, the interlock (i.e. a device to prevent impaired driving) is one possibility; another is a device that warns the driver that he or she is not sober. Particularly in the latter case, follow-up routines are essential for the system to win credibility. However, in the case of the alcohol interlock, there is a choice between considering it good enough that the interlock prevents impaired driving or combining this with different follow-up routines linked to a rehabilitation programme. The requirements placed by the purchaser in transport contracts and the attitude of the general public will play a decisive part in future developments as will demands from the general public on trustworthiness and the need for feed-back.

Prevention plans at company and administration level

Contribution by Yves BONDUELLE
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La Défense - France

Work-related car trips are responsible for nearly 1 300 fatalities a year in France and currently account for over 50% of deaths in work-related accidents. They are therefore a major human and economic challenge for both the community and firms.

Background

While on the whole firms have managed to introduce effective programmes to prevent accidents at work, traffic accidents, given that they usually occur outside the workplace, have not as yet been received sufficient attention.

In too many instances, poor road safety is seen as a social phenomenon that is primarily the responsibility of government. Furthermore, road accidents, which usually occur outside the workplace, are caused by drivers left to their own devices who would seem to be outside the control of their employer who is powerless to take any action. The act of driving is not seen as a full-time activity in itself, but as an everyday action for which each person is individually responsible.

A firm that takes account of the safety of trips made by its employees for work purposes optimises its overall performance in terms of the quality of the products it manufactures or the services it supplies.

To be efficient, management techniques such as the introduction of quality plans, zero-fault procedures and just-in-time logistics require high standards of safety to be achieved in the transportation of people and goods. In addition, firms want to project an image of quality and its vehicle fleet is one means of doing so. However, if the vehicles operated by a firm are frequently involved in accidents, dirty or in a poor state of repair, the subsequent damage to the image of the firm may act as a brake on its future development.

A methodological approach to taking account of the risk of road accidents within the firm

To be effective, the road safety strategy of a firm must be underpinned by a structured and coherent approach comprising the following elements:

- Establishing a preliminary diagnosis exercise to allow the firm to acquire a precise understanding of the specific road safety risks that apply to its activities and the consequences of such risks.

- Preparing and implementing a programme of action based on the outcome of the diagnosis exercise. This programme consists of measures designed to bring about a significant and sustainable reduction in the level of risk. The implementation of the programme calls for the active and full involvement of the firm's management structure.

– A system for monitoring and assessing the results achieved in order to evaluate the relevance of the project and, if necessary, adjust its focus.

Government action

It is against this background that the Interministerial Road Safety Committee (CISR) decided, on 2 April 1999, that the government, working in partnership with insurers and the National Health Insurance Fund (CNAM) would encourage the introduction by firms of road safety risk prevention schemes.

The government must set an example in this respect, and has therefore decided that its central and local departments must implement a road safety risk prevention scheme within a period of three years.

The procedures applicable to the implementation of such schemes are set out in a Circular issued by the Prime Minister on 7 March 2000.

Progress with implementation

Ministry for Infrastructure, Transport and Housing

In 1999, the Ministry for Infrastructure, Transport and Housing volunteered to try out the system.

The Ministry asked the National Road Safety and Research School (ENSERR) for methodological and technical assistance in the preparation and implementation of programmes to manage road safety risks in the Ministry's departments. The ENSERR duly provided training for all officials appointed by individual departments to the project team responsible for drawing up and implementing prevention programmes.

To date, most central and local departments have completed the preliminary diagnosis exercise and some have already drawn up and started to implement programmes of action.

Other government agencies

In accordance with the provisions of the above-mentioned Circular, six Ministries have issued work programmes, namely the Ministry of Defence, Interior Ministry, Ministry of Education, Ministry of Economic Affairs, Finance and Industry and the Ministry of Employment and Solidarity.

Private sector firms

Road safety charters -- "Clubs"

Since the mid-1990s, the DSCR has entered into, and in some cases renewed, partnerships with firms of different size and sector of activity (insurance firms and their brokers, transport firms and industry groups, oil firms, pharmaceutical laboratories, vehicle rental firms, vehicle testing centre networks, etc.).

Under these partnerships, the firms involved have undertaken to design and implement road safety risk prevention schemes applicable to trips made by their employees and/or customers.

In this respect, the active participation of insurance firms and their brokers, the CNAM and regional health funds, as well as specialised consulting firms, has significantly enhanced the professionalism of the approach.

The results were as follows. Firstly, a number of firms have genuinely succeeded in incorporating the issue of road safety into their corporate culture. Secondly, the insurance firms and their brokers have taken a highly promising initiative by offering lower vehicle fleet insurance rates to companies that agree to implement a road safety risk prevention scheme.

The results achieved to date are highly encouraging, particularly in the case of the most strongly motivated firms, in that the number of accidents can be reduced by as much as 30-50% over a three-year period. If nothing else, they serve as an example for the private sector as a whole.

Road safety charters (partnership and target agreements between the DSCR and a firm or federation of firms) is currently an excellent means of promoting road safety schemes in firms and offers a genuine test bed for determining the relevance of the methods of prevention put in place. The firms which sign such charters have clearly understood this fact since they have expressed a desire to exchange their experiences and make them known to a wider audience within “local clubs” and within the national association for the promotion of road safety within firms set up in 1998.

How to improve a safe and sustainable driver behaviour - Driver's fatigue?

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Abstract

Reducing the number of accidents that are caused by drowsiness or fatigue could be achieved by applying different strategies. This paper focuses on the on-line, real time detection of deteriorating driver state and driving behaviour, and on the question what should be done after this has been detected. It reports three studies performed in the TNO driving simulator. The first one leads to the conclusion that an in-vehicle monitoring device is best based on measures of steering activity, to which the registration of not keeping to one's lane boundary could be added. The second study points to the importance of certain personality attributes that determine who is a drowsiness-prone driver. The third study demonstrates that an alertness maintenance device (gamebox) can have positive effects on the onset of drowsiness and on the occurrence of critical events that it may cause.

Altogether, the results lead to a positive conclusion with respect to the possibility of implementing of a strategy that focuses on the on-line detection of drowsiness and its consequences. Behavioural adaptation from the side of the relevant drivers to this strategy, however, is an issue of concern that needs further investigation.

1. Introduction

1.1 The problem

The extent of the problem that we are talking about needs hardly be reiterated here. Apart from official statistics, about everyone seems to remember an experience of his own in which he was dozing off at the wheel and was saved – at that time – by a mere coincidence. Asking yourself: "What should have been done, and by whom, to have prevented this particular experience?" is a good way of beginning to consider the available strategies.

1.2 Available strategies

The chain of precursors leading to this type of event might have been interrupted at different stages. First, I might have stopped driving before I became drowsy, or never left to drive at all. Second, someone else might have stopped me before I even set out, pointing to the risk I might incur. Third, I might explicitly have tested my own fitness to continue at some stage. And fourth, someone might have installed a device in my vehicle that would have told me to stop in time.

In this paper we will focus on the last strategy, without suggesting that the other possibilities would have less impact if applied properly.

Also, we will not bother very much about the distinction between 'drowsiness', 'fatigue', or other driver states that may result in bad driving. Although there are differences, as far as real-time detection in the vehicle is concerned these states have so many common elements that they can be treated within a single framework.

2. The detection of deteriorating driving performance

2.1 What should we watch for?

Many studies on the effects of drowsiness, fatigue and sleepiness have been reported already. These differ widely in the variables used to measure these states and/or their effects on driving behaviour.

Several parameters related to *eyelid closure* – such as PERCLOS - have become particularly popular, and are even seen by some as the 'ground truth' against which to validate any other variable. Their use indeed has high face validity, as it is generally observed that as people get drowsy they close their eyes more frequently and during longer periods. However, there is also evidence that PERCLOS, the percentage of time the eyes of the driver are at least 80 % closed, does not predict drifting off the road very well (Wierwille, Lewin and Fairbanks, 1996). For this reason driver behaviour, rather than driver state, should be monitored as well.

Another problem with PERCLOS and related measures is that presently the technical problems related to their on-line and real-time measurement appear quite formidable. Several efforts are presently under way to accomplish this (in particular, the AWAKE Project: Bekiaris, 2001), but it remains to be seen how and when practical solutions will emerge. Existing commercial applications that claim to have solved these problems, by the way, do not stand minimal tests of scientific scrutiny.

So what are the behavioural and performance variables that may index deteriorating driving? *Steering activity* is one group of candidate parameters. In general, steering activity becomes jerkier when driving for long periods of time: the number of large steering movements increases while the number of smaller steering amplitudes decreases. The pattern appears to be that failures to commit a correcting steering action in time occur more frequently. This results in smaller safety margins to the lane boundary, crossing the lane boundary, or moving off the road. Error correction may be defined as turning the steering wheel in the opposite direction, with large peak-to-peak amplitude, when the driver notices that the lane boundary is about to be crossed or has been crossed. It is these error corrections that prevent accidents to occur. However, with progressing drowsiness, error corrections may come too late to prevent running off the road. For this reason it may be that effects on steering amplitude-related measures, show up earlier than effects on lane keeping itself.

There are, furthermore, no major technical problems in the non-intrusive, on-line measurement and processing of driver steering activity. What problems there are are much easier to solve than keeping track of eye closures.

Now for the *lane keeping performance* and the registered results of steering wheel movements made by the driver. The standard deviation of the lateral position on the road, and not respecting the lane boundaries, are more or less classical parameters that are used as indicators of the quality of driving behaviour. In recent years, TLC (time-to-line crossing) parameters have shown their capacity to index the risk associated with a certain lane keeping performance. Their real-time measurement is somewhat complicated, but approximations are now known that represent real TLC-values to a high

degree (van Winsum *et al.*, 2000). Thus, their practical implementation into a real-time device would present no insurmountable difficulties.

2.2 A comparative study of candidate parameters

A comparison of a set of candidate parameters has been performed within the SAVE-Project, the predecessor of the recently started AWAKE-Project, both of them EU-initiatives under the 4th, respectively 5th, Framework.

In this simulator study (van Winsum, 1999) it was examined whether older drivers differ from younger ones in the effects of time on task on driver state and impairment indicators, the reasoning being that older drivers are possibly more subject to "deterioration" at an earlier stage, which should then be picked up by the more sensitive parameters.

The study was performed in the driving simulator of TNO Human Factors. There were a total of twenty subjects. Ten were in the 'young' group (average age: 31), and ten in the 'old' group (average age: 69 years). They drove continuously for a three-hour period, during daytime. Speed was controlled by a cruise control that was set at a constant 80 km/h. This was expected to facilitate the occurrence of drowsiness because of the relatively low speed in a visually boring environment: the road was a standard two-lane road, and no other traffic was encountered.

Eye closures were measured by EOG, and analysed off-line. The following indicators of drowsiness were obtained:

- PERCLOS, the fraction of time during which both eyes are closed.
- BLINK, the blink frequency.

Steering behaviour parameters were:

- SDST, the standard deviation of the steering wheel angle.
- P3-6, the power of fast steering movements in the FFT-transformed spectrum, in the 0.3 - 0.6 Hz domain, as a fraction of all steering activity.
- STAMP, the average of peak-to-peak steering amplitudes.
- STDIS, the fraction of large peak-to-peak steering amplitudes.

Finally, the following indicators of *driving performance* were used:

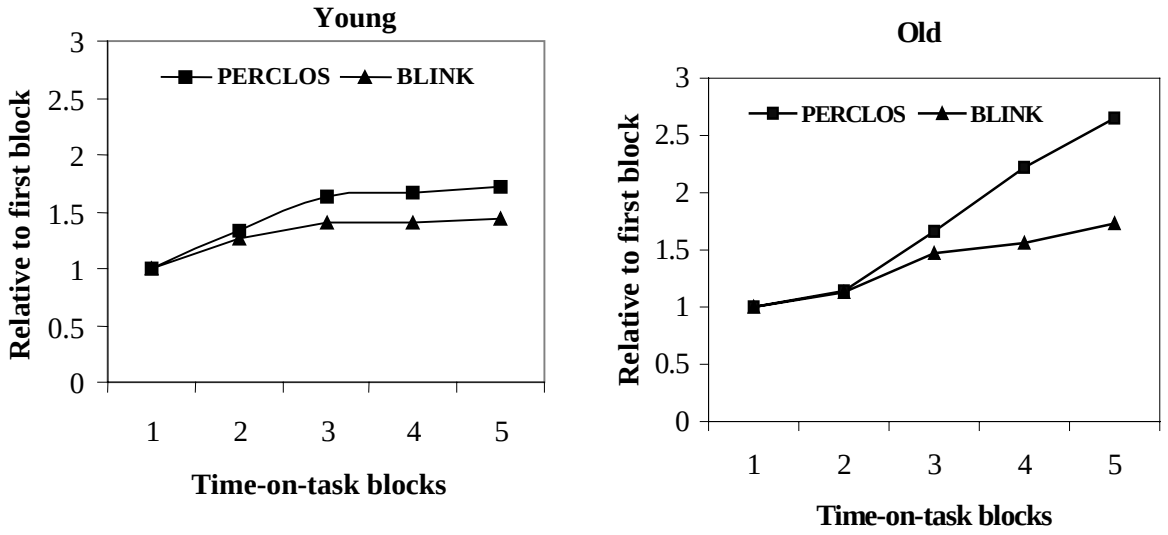
- SDLP, the standard deviation of the lateral position.
- LANEX, the fraction of time during which any of the vehicle's wheels exceeded the right lane boundary.
- Several TLC parameters, including (1) the average of TLC minima (2) the lowest 20th percentile of TLC minima (3) the fraction of TLC minima below 0.5 s; and (4) the fraction of TLC minima below 1.0 s.

The results are shown in the following series of graphs.

Figure 1 shows the development of the eyelid closure parameters over time, i.e. in 5 successive blocks of 30 minutes driving each, after the initial 30 minutes (relative to which the data have been normalised).

Both PERCLOS and BLINK increase significantly with progressing time-on-task, in particular for the older group of drivers. Thus, both indicators appear to be sensitive indicators of drowsiness, although much more so for PERCLOS.

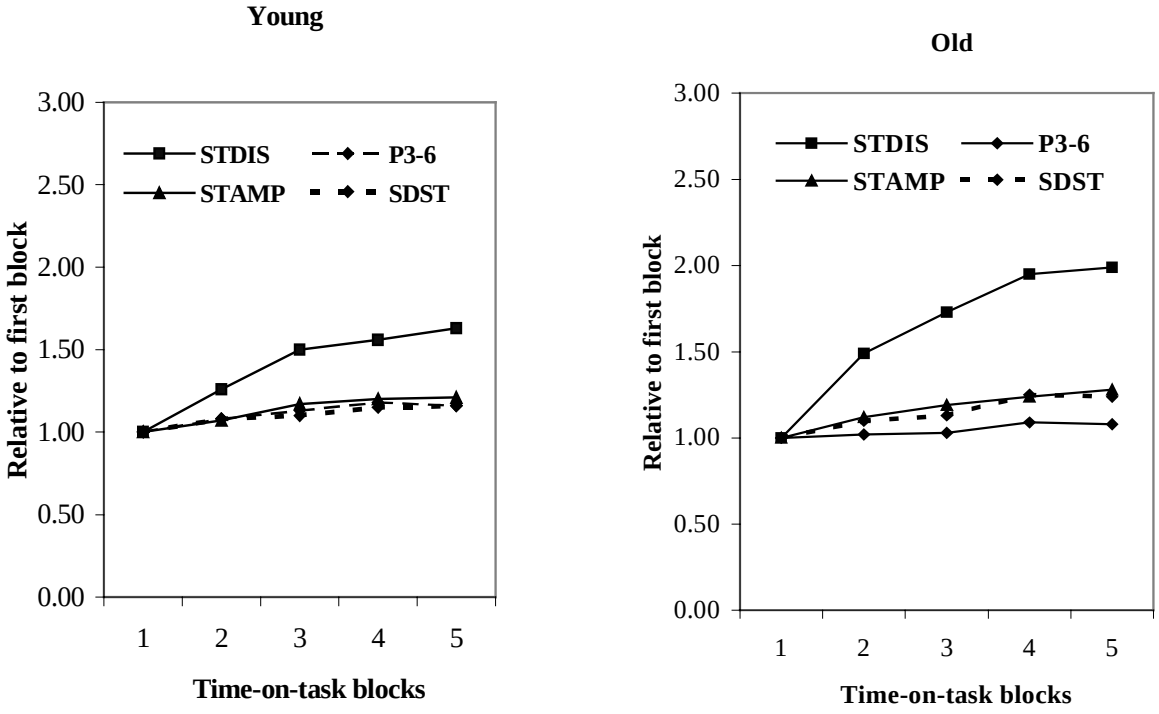
Figure 1. **Eyelid closures and blinks in successive 30 minute blocks of driving**



Source: Van Winsum, 1999.

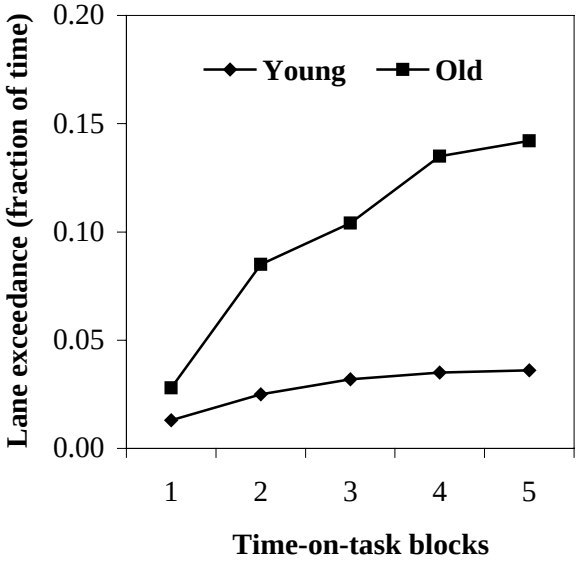
The development of the different *steering behaviour indicators* is shown in Figure 2. It may be noted that all parameters are affected by time-on-task. However, STDIS – indicating the relative frequency of large steering corrections – appears to be the most sensitive indicator.

Figure 2. **Development of steering activity indicators over time**



Source: Van Winsum, 1999.

Figure 3. **Development of LANEX over time**



Source: Van Winsum, 1999.

The ultimate effects on *driving performance* are shown in Figure 3, for the parameter that appeared to be the most sensitive among those studied (LANEX).

Apart from the effects *within* the separate categories of parameters it is interesting and important to compare their respective developments over time. Thus, the question is which is the most sensitive of all the separate parameters, irrespective of whether they have to do with eyelid closures, steering activity, or performance. This can be judged to some degree from the graphs, but a formal statistical analysis of the results has been devoted to this question. This resulted in the finding that STDIS, the frequency of occurrence of large steering wheel movements, should be considered to be the most sensitive parameter overall. Lane exceedances (LANEX) were a close second, and the eyelid closure parameters were slightly less sensitive to time-on-task.

2.3 Conclusion

There are three groups of variables to which we may turn in order to detect deteriorating driver condition and/or the associated performance decrements. PERCLOS appears – still – to be the most prominent eyelid closure parameter. With respect to steering activity, the frequency at which large steering corrections occur (STDIS) is the most sensitive. And when turning to performance parameters, lane exceedances (LANEX) is the parameter to look at.

When comparing these three STDIS appears to be the favourite, followed closely by LANEX. This is good news for the possibility of implementing this type of knowledge into a real-time, on-line monitoring device. On the basis of the present results it looks as if this can be done by relatively simple means that hardly intrude upon the driver, and that nevertheless yield valid information on which to base corrective action.

3. Who are drowsiness-prone drivers?

3.1 Personal characteristics and impaired driving

Whereas the previous section has dealt with the identification of symptoms of deteriorating driver behaviour, it is also a legitimate question to ask whether there are individual differences in drivers' susceptibility to become drowsy. If so, this could be ground for measures directed towards singling them out before they get into the risky zone.

In all experimental studies of driver drowsiness and fatigue there have been drivers whose performance was greatly affected by the conditions of the study, and others who were relatively little affected. For example, in one particularly demanding study (Artaud *et al.*, 1994) drivers were required to drive continuously on a test track, at night, for no less than six hours. Under these conditions, 50 % of the test drivers had episodes of falling asleep, but 50 % did not, and 20 % did not even display any physiological signs of drowsiness. In another study (Wylie *et al.*, 1996) 80 truck drivers were monitored during a week of their regular long haul trips for the incidence of drowsiness periods, as judged from video records. During about 5 % of the accumulated trip time, the driver's face indicated drowsiness, on average. However, 14 % of the drivers accounted for more than half of the drowsy periods, whereas 36 % of the drivers did not show a single drowsy period at all.

These apparently large differences between individuals raises the question what differentiates drivers who maintain reasonable levels of alertness and safe performance from drivers who succumb more readily.

Among the proposed personality constructs that might account for this we find 'boredom/drowsiness susceptibility', 'extroversion-introversion', being an 'evening' versus a 'morning' type, differences in having an 'internal' or 'external locus of control', and differences in 'sensation seeking'. A number of these characteristics have been evaluated in terms of their prediction of performance over long-term driving in a study in the TNO driving simulator, which will briefly be described now (Verwey and Zaidel, 1997a).

3.2 A comparative study of driver characteristics as predictors of extended driving performance

Drivers participating as subjects in the simulator study were initially selected on the basis of their scores on a simple questionnaire on self-rated tendency to get drowsy, tired, or sleepy during monotonous activities. There were 13 drivers in the 'low drowsiness' and 13 in the 'high drowsiness' group. When they arrived for the experiment participants filled out a further number of questionnaires, comprising standard personality questionnaires, driving behaviour related questionnaires, 'morningness' vs 'eveningness', and 'locus of control' questionnaires, etc.

The experiment took place in three shifts during the night. The first one was from 23:00 to 01:15 hrs, the second one from 01:30 to 03:45 hrs, and the third one from 04:00 to 06:15 hrs. Separate groups of drivers did separate shifts. In each case, drivers performed the task following a regular day of activity, and without any sleep prior to the driving task.

The roadway scenario was designed to be monotonous, as in the previous study, but it also had some situations and traffic events that required more attention from the drivers (i.e., sharp curves, oncoming traffic, parked cars, and slowly moving vehicles that were to be overtaken).

Driving performance was assessed in terms of:

- Accidents, which were events in which the vehicle entirely left the road.
- Critical events, defined as events in which the vehicle left the road with one or two wheels only.
- The occurrence of time-to-line crossings (TLCs) below 0.5 s.

From the numerous results of the experiment, the most relevant – in the present context – pertain to the predictive power of specific personality aspects with respect to driving performance.

First, it turned out to be the case that what the entire set of questionnaires measured could be described in terms of no more than three underlying dimensions. That is, only three components appeared to underlie the personality constructs in the questionnaires:

- *Free from inhibition – honesty* (typical descriptors: propensity to make traffic violations; lack of social inhibition).

- *Extroversion – boredom* (typical descriptors: level of mobility and of experience seeking).

- *Optimism – stability* (typical descriptors: level of overall optimism and level of neuroticism).

Second, the linking of these dimensions on driving performance are shown in Table 1.

Table 1. **Link between personality attributes and occurrence of certain events during extended driving**
(in bold: coefficient is statistically significant at 0.05 level)

	Component 1: lack of inhibition – honesty	**Component 2: extroversion – boredom**	**Component 3: optimism – stability**
Frequency of accidents	0.10	**0.40**	0.05
Frequency of critical events	**0.23**	0.04	0.06
Frequency of TLCs below 0.5 s	0.08	0.07	**0.43**

These results indicate that different underlying components are predictive of different performance indicators. Drivers who scored high on the *lack of inhibition - honesty* dimension had somewhat more critical events in the experiment, but they did not have a higher accident probability. Drivers who scored high on *extroversion – boredom* were the most accident prone in the experiment. And drivers who scored high on *optimism – stability* had fewer short TLCs, but did not differ from others in accident and critical event frequency.

3.3 Conclusion

Measurement of personality profiles is a cumbersome job. However, the results of this study demonstrate that a monitoring system which would use information about driver's personality would very likely be an improvement with respect to predicting who is more prone to experience accidents or critical events as a consequence of driving for extended periods of time. The usage of a smart card-based card key that incorporates this type of information on its habitual user, and which modifies the thresholds that are used by the system to determine acceptable driving performance, might be a way of achieving this.

4. Countermeasures to be taken after detection of deteriorating driving performance

4.1 The possibilities for action

Suppose an unwanted driver state has been detected, so that something should be done to alleviate the problem. There are two ways of acting. One is to issue a warning to the driver, possibly followed by an intervention from the system, such as stopping the car at the roadside automatically. Second, an attempt might be done to bring the driver in better shape again, by presenting him with additional stimulation. This approach can be traced to the interpretation of drowsiness as reflecting, at least in part, lowered arousal due to lack of stimulation. The provision of extra stimulation would then

restore the loss of alertness that has originated for that reason. Thus, whereas an extra attention-demanding task is usually seen as something to be avoided in driving in this case it might be beneficial to performance. In the area of train driving this has been in practice for many years, in the form of monitoring and alerting devices for train engineers (Fruhstorfer *et al.*, 1977).

It is to the design and evaluation of an alerting device for in-vehicle use that a recent study, using the TNO driving simulator, was devoted (Verwey and Zaidel, 1997b).

4.2 Evaluation of a gamebox

The gamebox, named CarMate, was an experimental prototype of a commercial device developed by Dimyon Brain Storm Ltd., Israel. This gamebox invites drivers to play any of several (12) games in three main categories: games based on measuring time, distance, and speed; auditory analogues to known games such as the card game '21' or the computer game Tetris. It also has activities based on recording and playing back the driver's own voice. This ensemble of tasks was considered to be interesting, self paced, usable at will, and not overly difficult (in particular, not inducing interference with driving itself).

The study used the same subjects as in the previous experiment (i.e. a group of 13 'low drowsiness' and a group of 13 'high drowsiness' drivers, as determined by self-rating), and it applied exactly the same methodology. Subjects now drove once with and once without the gamebox. However, when driving with the gamebox installed it was always their choice whether to actually turn the device on.

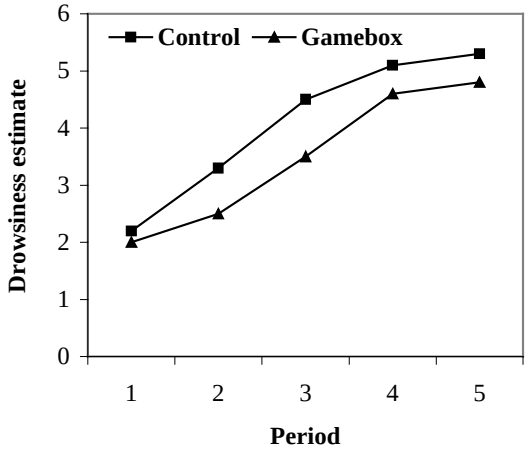
As a first measure of the gamebox's effect subjective ratings of drowsiness by the participants themselves were collected. These are shown in Figure 4, where they are averaged over the two driver groups. On this 6-point scale, however, high driver drowsiness types rated drowsiness on average 1 point lower in the gamebox than in the control condition, whereas for low drowsiness drivers this difference amounted to only 0.1 point. Thus, subjective drowsiness was less with the gamebox for high drowsiness subjects in particular. This could be related to the actual frequency of using the box, which was much higher for the high drowsiness subjects.

The effects of gamebox use on driving performance can be seen in Table 2.

Table 2. **Effect of gamebox on the occurrence of accidents and incidents during extended driving**

Measure	Control	Gamebox
No. of drivers with accident	6 (23 %)	2 (8 %)
Mean time to first accident	87 min	103 min
No. of drivers with an incident	10 (38 %)	7 (28 %)
Mean number of incidents per incident-driver	4.6	3.0
Mean time to first incident	83 min	94 min

Figure 4. **Development of drowsiness ratings over extended driving with and without the availability of an in-vehicle gamebox**



Source: Verwey and Zaidel, 1997b.

Clearly, there is an advantage for the gamebox condition on all measures of driver errors and their consequences. Compared to the control condition, fewer drivers in the gamebox condition ended up with an accident or with incidents.

Because of the relatively small number of accidents/incidents that occurred it was not really feasible to make a further distinction for the two groups of subjects. However, there was a suggestion that high drowsiness drivers had more benefit from the gamebox than their low drowsiness counterparts (see Table 3).

Table 3. **Numbers of low and high drowsiness drivers with accidents, in control and gamebox conditions**

	Control	**Gamebox**	**Total**
Low drowsiness drivers	2 (15 %)	1 (8 %)	3 (12 %)
High drowsiness drivers	4 (31 %)	1 (8 %)	5 (20 %)
Total	6 (23 %)	2 (8 %)	8 (16 %)

4.3 Conclusion

The results of this study clearly demonstrate that the gamebox counteracted the driving performance deterioriation which is typical for monotonous driving. Moreover, the device seems somewhat more useful in this respect for high drowsiness drivers.

When thinking of relating this result to that of the previous studies discussed here it appears that timing the onset of an alerting device to a detection system that will identify very early signs of impaired performance could be an optimal combination. The device would then start alerting the driver already when he is not even aware of an imminent performance deterioration. Of course, this would take away the self-paced character that was a characteristic of the gamebox studied here. It would remain to be seen what effects that would have, if any.

5. A word of caution

Many authors have, in one context or another, expressed concern that taking away the consequences of impaired driving would actually encourage bad driving. For example, drivers who know that they are being guarded by a monitoring device that will warn them whenever something goes wrong could now become inclined to really go on driving for a much longer time than previously. This could then create risks that even the guardian angel could not overcome.

The phenomenon, otherwise known as 'behavioural adaptation' or 'risk compensation', is to be taken very seriously. Although no sufficient research exists that permits us to predict exactly when it would happen, and what its extent would be, we should be prepared to find that the safety benefit we offer is sacrificed for better mobility. For example, the fatigued driver now gets home earlier, the normal driver has to pay less attention, etc. Obviously, these are also gains that count. What the final trade-off between mobility and safety will be no one knows. Our own guess is that something like between 30 and 50 % of the offered safety gain will actually materialise, while the remaining part will be in improved mobility (cf. Janssen, 2001).

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The Austrian Experience

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Higher responsibility of professional drivers

Professional drivers is the collective term for those people whose working place is the vehicle. At least three groups with different missions can be distinguished (Braun 1995): drivers of cargo vehicles (including dangerous goods), drivers for passenger transport (buses, tramways, taxis), and drivers of emergency service vehicles. Michalke (1981) emphasises that a professional driver has to cope with higher demands compared to a non-professional driver because:

- He has to ensure the safety of high-value objects and vehicles as well as human lives.
- His annual mileage goes far beyond the driving record of non-professional drivers, hence an increased probability of being involved in traffic problems and accidents.
- He is exposed to various driving conditions that non-professional drivers can choose to avoid, for example driving in bad weather conditions or under time pressure.
- He is confronted with monotony on long-haul drives, while schedules have to be observed.

Due to these demands, it is of great importance that professional drivers show a high degree of responsibility.

In passenger transport, the higher responsibility of professional drivers is evident because in any accident the passengers are always involved as well. Passengers are entitled to be transported by fit and responsible drivers.

Dreskornfeld (1989) supports the concept of higher responsibility for lorry drivers as well. He points out that they have to be responsible not only for themselves but also for the surrounding traffic (cars, etc.), because serious material and personal damage may result from an accident. This is confirmed by statistical data from the Austrian Road Safety Board (see Table 1). In the year 2000, accidents involving heavy goods vehicles (HGVs) led to a disproportionately high number of traffic deaths. While vehicles over 3.5 t had been involved in 5.3 % of all accidents, 15.2 % of deaths ensued. On motorways the situation is more striking: HGVs had been involved in 16.9 % of all accidents but in 36 % of deaths.

Table 1. **HGV accidents (vehicles over 3.5 tonnes with and without trailers, semi-trailer trucks and tanker trucks with and without trailers) in total and on motorways in Austria in 2000**

	Accidents with damage to persons		Accidents with vehicles >3.5t		% of accidents with vehicles >3.5t	
	in total	on motorways	in total	on motorways	in total	on motorways
Accidents	42 126	2 485	2 242	420	5.3%	16.9%
Injured	54 929	3 949	2 991	650	5.4%	16.5%
Killed	976	136	148	49	15.2 %	36.0%

An in-depth analysis of HGV accidents on motorways in Austria between 1995 and 1999 carried out by the Austrian Road Safety Board (Robatsch 2000, 2001) showed the following results.

- The injury level is very high when lorries are involved compared to all other accidents on motorways: 26.3% of persons killed on motorways lost their lives due to accidents involving HGVs.

- Fewer HGV drivers than drivers of the other vehicles were injured or killed (26.9% of the lorry drivers vs 60.8% of the drivers of other vehicles).

- Main causes of HGV accidents are misjudgement (of weather, road conditions, a preceding car, driving dynamics, etc.), 38%; vigilance problems, lack of attention (distraction, lack of concentration, falling asleep, etc.), 30%; unexpected events (caused by another driver, by freight load, etc.), 27%; and technical failures (brake defects, tyre problems, etc.), 5%.

Psychological assessment of professional drivers

While technical inspection of cars is an established procedure designed to prevent technical failures that might cause safety problems, analogous 'inspections' of drivers, especially of professional drivers, are not at all standard in European countries at present. Yet road safety is less a technical than a human issue. The majority of accidents are not caused by vehicle problems but by human-factor problems. The Austrian Road Safety Board mentioned above also confirmed this for professional drivers in the in-depth study: only 5% of the accidents involving HGVs were caused by technical problems. Moreover, accident causes like misjudgement, vigilance problems or unexpected events clearly indicate that the ability to drive is a psychological question rather than a medical one. So in any 'inspection' of professional drivers it is more important to check their fitness to drive from the psychological standpoint by evaluating performance, attitudes and personality. This is the task of driver assessment.

In Austria professional drivers have in fact been evaluated for many years from the psychological standpoint at the Austrian Road Safety Board. Extensive know-how has thus been gathered about the psychological assessment of professional drivers:

- Starting in the 1970s all applicants under the age of 21 for a class C or E licence (vehicles >3.5t - 40t) were assigned by the traffic authorities to driver assessment at the Austrian Road Safety Board, under government regulations (§31a, KDV 1967). Moreover, in several of

Austria's federal states, applicants for a class D licence (passenger transport by bus), regardless from age, had to undergo driver assessment on behalf of the licensing authorities during this time.

- Since November 1997, when the Driving Licence Health Act (FSG-GV) came into force, the requirements have changed. From that time on, mandatory driver assessment for truck drivers under the age of 21 ceased (due to new EU regulations). But all persons applying for a class D licence now have to undergo traffic psychological screening (§ 17, par. 3 FSG-GV). This screening is a shortened traffic psychological assessment. As a minimum, observation and concentration capacity, stress resistance and co-ordination have to be examined, and the reason for wanting the licence is one subject covered in a shortened personal interview. If the screening indicates deficiencies regarding traffic-specific performance and/or personality (willingness to adjust to traffic), the applicant has to take the full psychological assessment (§ 18, par. 4 FSG-GV).

- Besides this obligatory assessment, a number of Austrian transportation companies have been making use of driver assessment for many years. In particular, applicants for emergency service vehicles (Red Cross, etc.), applicants for tanker driving or for public transport in major Austrian cities (tramway drivers, bus drivers, underground drivers) are sent for traffic psychological assessment at the Austrian Road Safety Board.

An overview of the frequency of assessments of professional drivers at the Austrian Road Safety Board is presented in Table 2. In the period 1994 – 1996, before the Driving Licence Health Act came into force, 18% of all drivers being assessed were in the professional group; for the year 2000 the figure was 14.2%.

Table 2. **Percentage of professional drivers assessed at the Austrian Road Safety Board, during two time periods**

	Number of driver assessments	Number of professional drivers assessed	
	in total	absolute	%
1994-1996	22 134	3 995	18.0
2000	11 769	1 672	14.2

As far as passenger transport is concerned, similar developments have taken place in Germany. Since 1999 all passenger transport drivers have to prove their traffic-related psychological performance if they want to obtain a class D licence, or if they want to renew the licence at age 50 or over (driving licence regulations-FeV § 11). Taxi drivers are subject to the same procedure, but the lower age limit for renewal checks is 60 (FeV § 48).

Concept of driver assessment

Since its beginning, traffic psychology has focused on the issue of which performance and personality aspects are most important in order to drive a vehicle safely. Based on numerous research findings on driver behaviour over recent decades, the following performance and personality

dimensions are now considered to be of most relevance (Bukasa and Risser 1985, Kroj 1995, Hutter, 1995, BAST 2000):

- Traffic-related performance aspects cover above all visual perception and observation capacity, attention, concentration and reaction, and stress resistance, sensori-motor co-ordination, intelligence and memory as well.

- Traffic-related personality dimensions and attitudes cover above all social responsibility and traffic-related rule acceptance, self-control, emotional stability, risk awareness, tendency towards aggressive interaction in road traffic, and reasons for driving.

Even though these performance and personality aspects are listed separately, they are not at all independent. They interact and affect each other in a complex way (Brenner-Hartmann and Bukasa 2001). For example, reaction capacity is important for safe driving, yet this aspect alone is not sufficient. For example:

- The driver cannot react to something that he has not seen.

- The driver cannot perceive traffic-relevant details comprehensively if he is not concentrating.

- The driver cannot interpret traffic-relevant information adequately without sufficient memory and intelligence functions.

- The driver cannot navigate adequately in traffic if his/her co-ordination capacity is impaired.

- The driver cannot drive safely if he/she disregards traffic rules, shows a high degree of risk acceptance and/or aggressiveness, is emotionally too much involved, overestimates his capacities, shows disrespect towards other traffic participants or drives to compensate his personal deficiencies.

From the psychological point of view, driver assessment evaluates these aspects in the frame of the individual's past, present and planned future regarding traffic participation and traffic-related issues, taking into account know-how not only from traffic psychology but also from other areas of psychology (e.g. developmental psychology, clinical psychology, differential psychology, general and experimental psychology). In general, the assessment is based on three different sources: performance tests, personality tests, and a personal interview.

ART 2020 – the New Test Units for Driver Assessment

The Austrian Road Safety Board can draw upon decades of assessment of different groups of drivers, and upon long-term experience in the development of traffic-psychology test systems for this target group. The first generation of computer assisted tests and test units, ART 90 (**A**ct and **R**eact **T**est System) was developed at the Austrian Road Safety Board in the late 1970s and introduced into daily driver assessment in the early 1980s (Kisser and Wenninger 1983). In order to further optimise and modernise driver assessment from the psychological, technological and administrative point of view, the Austrian Road Safety Board developed the second generation of driver assessment units, the multimedia test system ART 2020.

Two different ART 2020 models allow flexibility in application (Bukasa, Wenninger and Brandstätter 1997, Bukasa 1999):

- ART 2020 Standard is a multifunctional test unit that allows a comprehensive assessment of traffic-relevant performance and personality dimensions. It is a user-friendly, ergonomically designed device and is equipped with two monitors, accelerator/ brake pedal, steering wheel and peripheral display as well as several reaction buttons; similar, in fact, to an unsophisticated simulator.

- ART 2020 Mobil is a small portable test unit, particularly suitable for decentralised testing. Functionally, the user interface of the Mobil unit has been designed similarly to the panel element in the monitor part of the ART 2020 Standard, resulting in ergonomically comparable testing conditions.

The following list summarises the most important quality aspects of the ART 2020 system:

Test development:

- The ART 2020 test system (hardware and software) has been developed on a scientific basis and incorporates actual findings of traffic psychology, diagnostics, general psychology, and experience from daily routine testing with the precursor model.

- The ART 2020 system has been developed on a specific target-group basis, focusing on different groups of drivers.

- Complex reality-based testing approaches with enhanced user interaction, including dynamic traffic scenarios.

- Multimedia support for test instructions based on the concept of learning by model imitation.

Further development:

- Permanent further development of the ART 2020 test system, taking into account new scientific findings in traffic psychology, technological progress and traffic-relevant changes in society.

- Continuous optimisation of the system based on feed-back from daily routine testing.

Standardisation:

- Standardised testing interface (both hardware and software).
- Standardised test instructions including a training phase.
- Standardised presentation of items in the test phase.

User acceptance:

- Reduction of stress, by hardware and software design, easy handling.
- Easy learning, by means of multimedia instructions.
- Test fairness, by supplying multimedia instructions (acoustic and visual information supply) and foreign-language test versions.

Specification of standards:

- Standards drafted for the ART 2020 tests are tested using drivers in decision-making situations (driver assessment).
- Comprehensive databases containing thousands of testing data.
- Regular updating of standards.

Validation:

- The ART 2020 tests are empirically evaluated and validated using drivers in decision-making situations (driver assessment).
- Different validation approaches, in particular criterion validation with actual driving behaviour as the external criterion.

ART 2020: Traffic psychology test-battery for professional drivers

The ART 2020 traffic psychology test-battery for the assessment of professional drivers examines the major traffic-relevant performance and personality dimensions mentioned earlier. There are often several tests for a given dimension, allowing individual results to be checked and tests to be varied in some cases.

The tests are described briefly below.

Visual Perception

Several aspects can be examined:

- Visual orientation capacity in a complex environment under time pressure (LL5 – test for measuring visual structuring ability).
- Visual scanning ability, i.e. the power to grasp relevant details of a road environment in a short time (TT15 – test for measuring traffic-specific overview).
- Peripheral perception capacity (PVT - test for peripheral perception when performing a tracking task simultaneously).

Attention and Concentration

Two aspects are measured:

- Concentration capacity under monotonous conditions (Q1 – test for concentration under monotonous conditions).
- Flexibility of attention (FAT - test for concentration under changing conditions).

Reaction Capacity

Several aspects can be checked:

- Speed and accuracy of reaction (DR2 - test for measuring decision and reaction behaviour in a dynamic driving environment).

- Complex reaction capacity under different levels of stress, i.e. time pressure (RST 3 – test for measuring reactive stress tolerance).

- Complex reaction capacity under mental load, i.e. considering reaction hierarchies (SET3 - test for reactive behaviour regarding reaction priorities).

Co-ordination Capacity

Eye-hand-foot co-ordination can be evaluated as a single aspect and in a dual task condition:

- Steering ability on a track with varying difficulty (SENSO - test for measuring sensori-motor co-ordination).

- The tracking task of the PVT test measures co-ordination capacity while engaged in a peripheral perception task at the same time.

Intelligence and Memory

Two aspects are checked:

- Logical reasoning (MAT – Non-verbal intelligence test).

- Ability to memorise relevant information for a short time (GEMAT – optical memory test).

Traffic-Relevant Personality Dimensions

The following aspects are examined:

- Realistic self-evaluation, social expressivity/self-confidence, social adjustment, emotional engagement, self control and self perception (VPT2 – traffic-related personality test).

- Orientation towards social expectations, uncritical self-perception, aggressive interaction, emotional relationship to vehicle and driving (VIP – traffic-related item pool).

- Willingness to take physical risks, social risks and financial risks (FRF – questionnaire on willingness to take risks).

- Disposition to drive while intoxicated, covering alcohol-specific dissimulation, lack of knowledge about alcohol-specific issues, risk awareness related to DUI, alcohol-specific rule acceptance, attitudes favouring alcohol consumption, influence of alcohol-related social environment (TAAK – test for alcohol-prone drivers).

Evaluation of Assessment Results

The evaluation of the results is based on comparisons with representative test samples of drivers. The sample for the ART 2020 tests now covers up to 35 000 drivers. For professional drivers, further comparison is made with tests starting at age 50. These large test samples allow the examinee's performance to be accurately positioned in relation to the representative driver population.

Regarding the minimum performance level which a professional driver has to meet, the regulations in Austria and Germany are not uniform. There is, however, common ground.

- The minimum performance level for professional drivers has to be above the minimum for non-professional drivers.

- The minimum performance level for professional drivers should be twice the minimum for non-professional drivers in most of the relevant dimensions (and at least in the 33-50% range).

On personality, professional drivers have to meet a low-risk/high-responsibility profile, based on the representative test sample of drivers described above. Moreover, the findings of the personal interview, which mainly focuses on individual history as a driver including job motivation, play a decisive role in the evaluation of personality.

Comparing the findings of all psychological assessments of professional drivers at the Austrian Road Safety Board in 1994-1996 and in the year 2000, Table 3 shows similar results for the two periods: about three quarters of the psychological assessments led to an positive result, and one quarter negative. This means that most of the persons assessed met the requirements for professional drivers from the psychological point of view. On the other hand, a not insignificant number showed deficiencies in performance and/or personality.

Table 3. **Outcome of assessment of professional drivers at the Austrian Road Safety Board, during two time periods**

	Number of professional drivers assessed	Outcome of assessment of professional drivers	
	in total	positive	negative
1994-1996	3 995	79%	21%
2000	1 672	73%	27%

Conclusion

Professional drivers are one of the most important groups of traffic participants, and have generated increasing safety problems over recent years. In order to halt this adverse trend in traffic safety, all relevant measures have to be considered. Based on decades of experience of assessing professional drivers at the Austrian Road Safety Board, and through identifying about 20% of drivers who fail to meet the higher requirements for professional drivers, the following conclusions must be drawn.

- Driver assessment should become a mandatory procedure for drivers who apply for class C and E licences.

- Driver assessment should become an obligatory procedure for extension of HGV driving licences.

- Driver assessment should become a mandatory procedure for all kinds of passenger transport.

- Driver assessment should be introduced in other European countries as well.

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Education and information for road users

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Education and information are important tools for influencing road users and their behaviour. They can consist of separate campaigns and educational projects or materials, or they can be integrated into a broader package of road safety measures. Education and information projects must be implemented in a co-ordinated fashion with coherent links to other initiatives in order to make a significant impact.

By its very nature, the education of road users is a long-term process, where basic information and skills are being offered at multiple stages of life. Advertising, on the other hand, has more short-term goals: relaying new information, and, most of all, drawing attention to current issues regarding traffic in order to elevate public awareness and the level of debate.

Lifelong traffic education

In the Nordic countries, we regard road safety education as a lifelong process targeted at all members of the community -- from babies to grandfathers. Road safety requires that we develop our skills, knowledge and our way of thinking in line with our changing needs at different stages of life and in our different roles as road users.

Road safety education is a long-term process and it has many aims. We should always remember that as road users we make mistakes. We forget and we fail to notice many things when we are walking and driving. Traffic education should focus on these behavioural human factors.

The main aims of traffic education are:

- To promote the right attitude and give all road users sound background knowledge of road safety.
- To offer people survival skills, such as knowledge of traffic rules, ability to take other road users into consideration, readiness to anticipate traffic situations and to observe and size-up different factors in traffic in advance, as well as use safety equipment properly.
- To raise the level of public appreciation and awareness of safety issues in the community.
- To make people more willing to accept and demand measures to promote road safety.

The “Vision Zero” thinking emphasises the road user’s role as a demanding consumer. It is required that the road user has sufficient knowledge of the rules and regulations and knows how to act accordingly; in addition, he/she needs to have knowledge regarding the use of safety devices as well as willingness to actively pursue solutions to problematic issues involving traffic safety. In order to achieve these goals, the road user needs information about the way the officials work and about the various channels through which he can voice concerns and help to make a difference.

Key objectives for improved results

Nordic road safety education has been upgraded by adhering to the following objectives:

Step One: Road safety education must be systematic

Since road safety education is targeted at people of all ages, it is an essential part of all operations to promote public health and safety -- from day-care centres to businesses. This has resulted in a closer collaboration between various authorities and organisations, particularly in the field of local administration.

Step Two: The various channels and measurements are used in combination

Various approaches can be integrated in education; such as traffic surveillance and co-operation with local press and media.

Step Three: Promoting grass-roots initiatives

Traffic education is often seen as a matter for experts. It is equally important that all road users are encouraged to take initiatives. Individual members of the community often become motivated through an interest in neighbourhood problems and through wanting to promote the safety of their families. It is important that road safety education takes into account the specific needs of each target group, whether young or old.

Step Four: From theory to practice

The issue of learning how to cope with traffic -- especially for the youngest members of the community -- must be addressed in relation to the roads and the traffic problems the children have to face every day. Practising in traffic is of great importance in order to achieve effective learning methods. Understanding "why" and "how" is far more important than simply learning the rules by heart. Pointing out danger spots in the neighbourhood is also an effective approach to teaching traffic regulations.

The detailed content of lifelong road user education changes depending on the age group: with the youngest children, the goal is protection; with young people and adults the objective shifts to promotion of self-control; and with the elderly it returns to safety and protection issues.

With adult education, the main focus is on awareness campaigns and on up-to-date information on road safety and relevant traffic issues. The problem in educating adult drivers is that they do not seem to recognise the need for further training. However, the results have been quite promising when the training has been carried out in collaboration with some private companies as part of their labour protection activities.

Information

Informing various interest groups about traffic safety issues is at its most effective in a situation where the road user feels that the information is useful. Informing the public is primarily a service

function that involves new safety products, weather and road conditions in a certain area, accident locations and advice on how best to avoid trouble spots etc.

The effectiveness of publicity effects can be enhanced by linking them to other safety operations. As road users are informed on such issues as repair/building of road networks, changes in police surveillance or legislation, they can take this into consideration in their own movements. As people get information on what is about to happen, when it is about to happen and why it is about to happen, they can accept these procedures more easily and the operations can be implemented smoothly. For example, a road construction venture can be effectively promoted by a related campaign.

Every action that is being performed in order to enhance traffic safety (including training) should therefore be publicised.

Quite frequently, traffic safety work relies on separate campaigns that use strong messages. It is believed that they are effective. More often than not, this belief is false. The cynical view about such campaigns is that the decision-makers feel that they are easy-to-use, comfortable options instead of harder, forceful measures (such as speed limits). In fact, one should not expect too much from the campaigns. The best results have been achieved by campaigns that have recurred repeatedly over several years and have involved other traffic safety measures such as law enforcement control, reforms in legislation and also training.

Some desirable lessons from practical campaigns follow:

- The campaign is seen as one option among others and it has been implemented in order to support other measures. The campaign alone has been considered to be the wrong tool -- an ineffective one -- to solve the problem at hand.

- The realistic objective of the media campaign has been “only” to draw attention to the issue.

- The campaign has effects that can be categorised as domino-like or hidden in nature; in order to control these effects, the advancement of the campaign has been evaluated in phases and the process has been modified according to feedback.

- The campaign has offered people new information and a fresh view point or alternatives to consider.

- The target groups have been viewed as active participants with whom a means to a successful dialog has been established.

- The language used in the campaign was the language of the recipients; the channels used to distribute the information were familiar to them.

- Activities and communication efforts on the local level have supported the campaign.

- In-house communications have ensured that the personnel are committed to the campaign.

In designing a campaign, the customer and his/her needs should hold centre stage. Around this focus point, it is possible to proceed with integrated communications measures and training.

Education and information for children and young people in France

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Mobility (whatever the mode of transport used) is participating in a universal social activity. The risk of road accidents stems from the multitude of individual decisions taken in response to the multiple interactions of a constantly changing situation. Road safety education is not just about teaching skills, it is part of the socialisation process. That is why schools are asked to play a part.

A single aim: to foster the emergence of social awareness of the technical and cultural environment by educating the public. Educating an entire population at once acts like a catalyst. Those of us who have taken part in illiteracy programmes know that teaching mothers as well as children produces a dramatic improvement in results. A minimum core of shared knowledge is crucial.

Over and above informing and sharing knowledge, what we are aiming for is good behaviour. The aims of this statutory obligation of "national" education are to develop:

- Respect for the law.
- Respect for oneself and one's own limitations.
- Respect for others.

First, we need to ensure that everyone is aware of:

- The *laws of biology* as they apply to our useful field of vision: 90 per cent of the information needed in traffic is visual, the useful field of vision varies with age, position, mode (speed) of driving etc. The effects of alcohol, fatigue, alertness (or lack of it), reaction time, knowing one's own limitations.

- The *laws of physics*, mechanical forces kinetic effects as they apply to the risks and consequences of collisions.

- The *laws of society* -- the common rules warranted by the foregoing -- the Highway Code, assistance to persons in danger, prohibitions, obligations, etc.

Early childhood and continuity in education

Even infants can become accident casualties, and it is therefore only right to try to alert the youngest children to danger on the roads.

There are also stages in childhood development that must not be missed, as they are crucial opportunities for teaching both psychomotor and social skills.

A study conducted in Lyon, where for 14 years a nursery school designed its school plan around road safety, allows us to evaluate the medium-term impact of early road safety education.

A European Union study conducted under the "PROMISING" research programme estimates that road safety education measures have an impact that lasts for three years.

The time factors in education and its temporary impact are the reasons for the long-recognised principle of the need for continuity in the educational investment. Government proposals are aimed at achieving this educational continuum on a life-long basis.

The French government's approach

Road safety education:

- Cross disciplinary cutting across the organisational model of secondary school education which follows the principle of discipline-specific teacher qualification.
- A subject matter that is non-academic.
- Implies debate on the "role of the school": to teach or to educate.

The legislative and regulatory approach

In 1993, a decree signed jointly by the Prime Minister, Minister for Transport and the Minister for Education made road safety education compulsory for primary and lower secondary schools. "In order to enable pupils as road users to learn responsible behaviour, road safety regulations shall be taught to primary school and lower secondary school pupils and to classes at the same level in state and government-subsidised private schools. Road safety education shall be a compulsory part of the school timetable and curriculum. It is a cross-disciplinary subject. The conditions of its introduction shall be set forth in an instruction by the Minister for Education with a view to assuring, primarily, continuity in the learning of road safety regulations."

The decree also stipulates, with regard to basic and continuing training, that teaching staff in the schools concerned shall be trained to teach pupils road safety regulations and behaviours that are consistent with them.

Other articles in the decree provide for a compulsory test at the end of the second and final years of lower secondary school resulting in the award of a formally validated road safety education certificate.

The certificate at the end of the second year of lower secondary school will be a requirement for learning to ride mopeds and the final year certificate for the driving licence.

The decree is being phased in.

Phasing in

1993-1994, introduction of the test provided for in the decree in the second and final years of lower secondary school. The test is in the form of a multiple-choice questionnaire based on 20 video sequences. Every pupil who answers one out of two questions correctly is awarded a road safety

education certificate. The video lasts a total of approximately 45 minutes and is prepared by a National Committee composed of representatives of the Ministry for Education and the Ministry for Transport.

In order to enable teaching staff to prepare pupils for this test, booklets were sent out to all schools with suggested teaching outlines for each academic subject.

After three years, when all the schools had understood that this was a requirement not a suggested innovation, ALL pupils in the second year of lower secondary school had to sit the theory test in the third week in March and ALL pupils in the final year in the fourth week in March.

1996-1997, a first level road safety education certificate became compulsory for 14-16 year olds wishing to ride a moped.

After an additional three-hour practical course, the first level certificate can be converted into the *Brevet de Sécurité Routière* (BSR) certificate. The practical training is given by qualified professional instructors (driving school instructors certified for motorcycles), accredited by the *Préfet*.

The introduction of this provision was accompanied by a substantial reduction in the number of young moped riders injured in road accidents. Contrary to the fears of cycle manufacturers and importers, this provision did not kill the market and seems to have saved lives. Accordingly, the Interministerial Road Safety Committee of October 2000 decided to extend it to all moped riders.

This provision will apply to all those born after 31 December 1986 so that all those to whom it is applicable will be able to benefit from advance training.

The full effect of this provision should therefore be seen in 2003 when those born in 1987 will be 16 years old.

The Interministerial Committee of October 2000 also decided to make the road safety education certificate in the final year of lower secondary school a formal qualification by making it the first module of the driving licence which henceforward will consist of three parts: the final year lower secondary certificate, general theory test and the driving test.

Lastly, the Interministerial Committee, meeting with the Prime Minister, decided to introduce a road safety certificate for primary school children. A top-down management model was chosen, with legislators putting in place an evaluation system for young people that is universally recognised in France, leaving teachers to get on with training pupils. Coupling together road safety education with driver training ensures educational continuity.

Support measures

For teaching staff

– The Ministries for Education and Transport are working in partnership to produce videos that will enable teachers to evaluate pupils' knowledge.

  Pupils have to give the answers to multiple-choice questions after watching 20 video sequences each lasting about one minute. Pupils who answer 10 questions correctly are awarded the first level road safety education certificate in the second year of lower secondary school and the second level certificate in the final year of lower secondary school.

– In order to help teachers to prepare pupils for the tests by including the above subject matter in their lessons, the two Ministries send out booklets giving illustrative teaching outlines.

For parents

– In order to make parents more aware of the seriousness of a problem that did not exist when they themselves were children, the round table on road-users recommended parental support initiatives.

– Road safety begins with the parents of very young children (initiatives in maternity units, working with the major parent-teacher federations and family association unions).

For young adults

In order to give young adults and novice drivers a chance to change their behaviour, a call for youth projects supported by associations was launched two years ago in all *départements* in France.

Conclusion

The effect of these efforts (investment in education is only one of a range of measures to promote road safety).

Over the long term it has been found that, despite the considerable increase in road traffic (x 6 since 1953), fewer lives are being lost. After a peak of over 17 000 deaths in 1 year, the latest estimates put the death toll for 2000 at around 7 600.

Road deaths are down in the 20-24 age group (-10.1%) and 15-19 age group (-7.3% compared with 1999).

The very least one can say is that the effort made to begin introducing a road safety content into the education of the wider population has not been counter-productive. As with any measure in the education field it takes (a great deal of) time to develop and disseminate a proposal and rally the support of parents and teachers. It takes even longer for the benefits to appear.

Nevertheless, we have begun two road safety evaluation programmes in nursery schools and the introduction of the BSR certificate for young adolescents. We hope to have conclusions on these programmes in the course of the third quarter of this year.

The British Experience

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This is a summary of a full Powerpoint presentation made at the Seminar.

A good road safety policy is one for which there is strong public support. That means a high degree of understanding of what the authorities are trying to do and how they are trying to do it. Road users need to know the facts about the risks and consequences of irresponsible driving and be persuaded to change their attitudes and behaviour. When that fails, we must resort to stronger methods. That means the law, its sanctions and penalties and possibly technical solutions where they are available. Education through publicity, and enforcement, complement each other but it is important to get the balance right. It is a balance of sticks and carrots. In Britain we have always put much store by our publicity campaigns. Over the past thirty years we have had a continuous programme of campaigns on different issues. Among these effective publicity campaigns in recent years are those most notably concerned with drink driving, seat belts, speed and child safety. Our current budget is over £12 million a year.

We have moved to a new style of Road Safety advertising based on the theme of "THINK". Illustrations mostly used in posters or as part of specific campaigns are geared to pedestrians - to children - to drivers in play streets - drivers on rural roads through villages where they may be tempted to speed. The theme or "brand image" as the professional media people call it, sits on top of all the advertising. Furthermore, private sector companies – motor industry – people who make child restraints can use this brand. But there will also be bad driving, careless driving and inconsiderate driving. As far as possible we seek to persuade people out of this behaviour and if that doesn't work we resort to stronger means.

Seat belt wearing

Seat belt wearing is probably the single most significant factor in reducing death and injury at road accidents. It costs nothing. It is compulsory in front and back seats. For children, restraints are recommended but they can use an adult belt if a suitable restraint is not there. It is not easy for the police to enforce, nor is it a priority. But to a large extent they do not need to do so. We have achieved a very high level of compliance by persuasion with some effective messages and powerful advertisements.

Wearing rates are 90% drivers; 92% front seat passengers; 77% rear seat passengers; of *which* 90% for children and 56% for adults. Obviously we have one particular area of concern which is adults in the rear.

We have had two major campaigns in the last 10 years. First the "elephant" campaign which achieved some improvements in the early 1990s. We reached 50% but it's not easy to maintain without sustained pressure. Then in 1998 we produced a very powerful TV advertisement.

Success with motorcycle helmet wearing was achieved in the 1970s. We had, largely by publicity, attained a very high wearing rate before we made it compulsory. So when the law changed there was little resistance. Obviously breach of this law is easier to detect than failure to wear seat belts and the compliance is very high. Evidence from other countries shows the value of the policy. Cycling is a different matter. It is not compulsory and there is no current plan to make it so. But by publicity we have encourage more people to take the precaution.

Drink driving

Drink driving is a more serious issue. We are not happy that over 500 people die - and that half of them are passengers, pedestrians, cyclists - "innocent" road users. Even though things have improved over the last few decades. This area has been the target for more television publicity than any other has. But over thirty years the number of persons killed in drink drive accidents has fallen from around 1 700 to 500 a year. Police try to breath test all drivers involved in injury accidents but that is not feasible for practical reasons. They manage to test half of them, leading to 7 500 prosecutions. But that is far from the complete picture.

We do not investigate drivers only when they are involved in accidents. Police can breath test drivers they suspect of drinking or anyone who has committed a moving traffic offence. And they do. Total number of tests is 1 million leading to 100 000 convictions. How do we deal with drink drivers? They are in court within a day or two of the offence, and the penalties are pretty severe. Drink drivers can be banned for a year, possibly with a EUR 300 fine and even imprisonment.

There is little sympathy for drink drivers. At the national level drink-driving is now seen as anti-social. Local communities frown on those who commit the offence.

Drugs

Most drugs can affect driving ability. We have a common offence of driving under the influence of drugs or alcohol. That can mean prescription medicines as much as illicit drugs. But it is necessary to demonstrate impairment. The ability of our police to do that is improving.

Sleepiness

Sleepiness is a serious problem. At least 10% of accidents have sleep as a factor and up to 20% on high-speed roads. There is some scope for control among professional drivers but we have sought to influence the ordinary motorist by means of targeted publicity and hard hitting campaigns. It is very difficult to prove that an accident was caused by a driver falling asleep but our courts have seen several prominent cases recently and this have helped to raise concern about the problem.

Speeding

There are one million offences a year - over half detected by cameras that read number plates. We also wage campaigns against speeding as being dangerous and anti-social. But the emphasis here is much more on enforcement. Most offenders pay a fixed fine of about EUR 100 but persistent offenders will be disqualified from driving for at least 6 months. The challenge is to detect drivers who break speed limits or, better still, to deter them from doing so. Technology is providing the answer.

Over 60% of speeding offences are now detected by roadside cameras that read number plates. Drivers are easily traced and fined. The fine revenue may be used to fund further enforcement. We are finding this very effective in reducing the prevalence of speeding and of road accidents in areas where camera use has been intensified.

Our recent experience with safety cameras used to catch people violating red traffic lights or exceeding speed limits. In order to invest in more of these cameras for widespread use we have had to adopt a self-financing approach whereby the fine revenue collected was made available to fund further enforcement activity. We undertook a project to set up thousands of new cameras. The results were remarkable:

- Excess speed (more than 15mph / 25kph over the speed limit) at camera sites has virtually been eliminated. The percentage of drivers exceeding the speed limit by more than 15mph at camera sites has reduced from an average of 5% before enforcement to just 1% afterwards.

- On average the percentage of drivers exceeding the speed limit at pilot camera sites reduced from 55% to 16%.

- On average there were 35% fewer collisions and **47%** fewer people killed and seriously injured at the camera sites - a estimated saving of some 109 lives as a result of increased enforcement. Evidence indicates that the initiative has been particularly successful in reducing casualties among those most at risk from road collisions - children and pedestrians.

- Using DTLR figures it is possible to estimate that EUR 40m has been saved by the reduction of casualties and collisions at safety camera sites.

But this has not been achieved without a great deal of work to secure and sustain public acceptability. Important motoring organisations have had serious misgivings about the project to the extent that some of them, and other organisations and the national press, have campaigned vociferously against the cameras. But the police, local authorities and DTLR sought to persuade the objectors that the scheme was not being used purely to raise fine revenue. And in the end the figures are beginning to speak for themselves. No one can argue against the saving of lives - and costs. But what is also crystal clear for us is that the monitoring and evaluation of the experiment was of paramount importance.

Conclusion

We have been looking and the complementary roles of publicity and enforcement for road safety objectives. I showed the use mainly of publicity for seat belts, mentioned the importance of public acceptability and ease of enforcement for helmet wearing, the strong enforcement tools for drink drive and the mixture of publicity, innovative enforcement methods for speeding. The message to be taken, particularly from that last example, was very powerful. The condition that runs through the whole policy of effective enforcement is public acceptability. That has to be won.

European co-ordination

Contribution by Peter TER MEULEN
Tispol Organisation
Leeds - United Kingdom

Today in Prague, I want you to think about one of the worst tragedies in modern history: the 11 September 2001. According to the latest estimates, 4 000 people died in New York, Washington DC and Pittsburgh.

Now think about 43 000 people dead in one year, on the roads in the European Union. Apart from the figures of the Czech Republic, Poland and Hungary we have no clear figures of the fatality and injury situation in Central and East European countries.

Yes, today in Prague, I want you to think about one of the worst tragedies in Modern History. This tragedy is so horrific, that society tries to hide from the reality - this results in denial.

But today I want you to be confronted with the awfulness of the tragedy on Europe's roads. You must face up again to the enormity of this European tragedy.

Only within the European Union:

- 43 000 road deaths a year.
- 1.6 million hospitalised casualties a year.
- Costing EUR 160 billion a year.
- With 780 000 road deaths in the last 10 years across Europe.
- This is without the figures of Central and East Europe.

For instance in the Czech Republic we had 1 486 road deaths in 2000. During the last 10 years more than 13 000 road deaths and 230 000 hospitalised casualties. And you must face up to the enormity of the regional tragedy.

All these deaths are huge tragedies - heart-breaking tragedies. But why is it that society seems intent on ignoring or even belittling road death and road carnage, despite the fact that road carnage dwarfs all the social problems of this age? There is no excuse for this mental block, this denial syndrome.

Over 95% of all road collisions are caused by human error – and most of them are preventable.

We simply must face up to the tragic realities of road carnage:

- The European Tragedy.
- The Regional Tragedy.
- The Local Tragedy.
- The Personal Tragedy.

I believe the statistics themselves already give people an escape from the reality.

After all they are only numbers - 43 000 road deaths in Europe and 1.6 million hospitalised casualties in Europe.

The tragedy becomes abstract until you are forced to face up to the personal tragedy.

Now, here is Phoebe Lyle, aged 3 - the week before Easter 2001. She was on holiday in Spain, here at Leon. On a remote mountain road in Spain, where the local police say the traffic flow is only six cars per two hours, Phoebe was knocked down by a hit-and-run driver. Today Phoebe is in Belfast's Royal Hospital for Sick Children. I visited Phoebe some months ago. She is quadriplegic. Mentally very bright. She has learned how to talk with her tracheotomy. She needs a ventilator to breathe. Phoebe is ONE of the 1.6 million casualties you have heard about. Don't let the statistics anaesthetise you to the tragedy. Phoebe reminds me, reminds us all that every road casualty statistic, is:

- a Personal Tragedy.
- a Family Tragedy.
- a Community Tragedy....

and in Phoebe's case, a hit-and-run victim in Spain, whose life was saved in Spain, but is now in Intensive Care in Belfast - a European Tragedy, truly a European Tragedy.

As you face up to the very personal tragedies behind the enormity of European road carnage, two questions need answered:

- Why does it happen?
- What can we do?

First, why does it happen?

Every two miles the average driver makes 400 observations, 40 decisions and one mistake. Once every 500 miles one of those mistakes leads to a near collision and once every 61 000 miles one of these mistakes leads to a crash - in other words, mistakes are endemic.

Mistakes are endemic because road use is a habitual activity. Being habitual we are conditioned by repetitive road usage into being over-optimistic about our safety, over-confident about our ability to survive and into underestimating the risks we face.

Add to this the fact that there are 201 million licensed vehicles on Europe's roads, weaving through an overpopulation of 377 million.

And you begin to see why one mistake every two miles means that the ROADS are the most dangerous place in the world – by far. As the London Times said last year:

"When the numbers become large enough, the improbable becomes certain"

But ultimately Road Carnage is not about numbers, statistics, or traffic growth.

It's about mistakes - in other words human error that brings us to…

What can we do?

The answer is to design and plan interventions:

- Engineering interventions - to make roads and vehicles safer.
- Enforcement interventions - to tackle human error and mistakes on the road.
- Education interventions - to improve the awareness, attitudes and behaviour of all high-risk road users.

What will you do?

Unless we share this responsibility we cannot succeed. TISPOL and the Traffic Police Forces of Europe are working together to save lives and to reduce the human costs of 43 000 killed and 3.5 million injured on European roads annually.

The TISPOL Organisation has been established by representatives of Traffic Police Forces from 12 EU countries in an effort to improve the quality of enforcement of the road traffic laws.

At this moment we already have police forces of 15 EU countries working together. Within 3 years it is expected to have 25–28 countries involved in the work of TISPOL.

TISPOL's objectives are:

1. Continuous exchange of ideas and collection of information on road safety methodologies, policies, and techniques applied in the member states.
2. Initiating and supporting research on road safety.
3. Providing an informed police opinion on road safety issues.
4. Serving as a transfer point for 'best practice' throughout Europe.
5. Organising and co-ordinating multinational operative enforcement campaigns.
6. To achieve more efficient and effective approach to traffic enforcement by harmonisation and standardisation.
7. To represent or co-ordinate traffic police participation in international projects.
8. To initiate new Trans-European projects.
9. To organise an annual TISPOL conference and participation in other workshops.
10. To expand the TISPOL Network.
11. To advise the EC on new or adjusted legislation and policy matters.

On the 9th of November 2000 in Amsterdam, the TISPOL Organisation appointed the first 14 representatives in the Council from:

England/Wales, the Republic of Ireland, Northern Ireland, Scotland, the Netherlands, Belgium, Berlin-Germany, Slovenia, Switzerland, Finland, Madrid-Spain, Rome-Italy and Oslo-Norway.

The TISPOL Council meets twice a year and the Executive Committee four times a year. One Council meeting will be combined with the annual TISPOL Conference

The TISPOL Operation-group holds special meetings twice a year to debrief, and if possible, to harmonise, standardise and co-ordinate the operational actions for the next year. During the TISPOL Conference there is a joint meeting with the Council.

TISPOL has the following working groups:

- Operations (alcohol/drugs, speeding, commercial vehicle enforcement). Standardisation and legislation.

- Enforcement, using IT Technology and EU-type approval recommendations.

The TISPOL co-ordinated activities in 2002-2005:

1. The TISPOL Operation-group will carry out four special enforcement events to check the commercial coaches.
2. Trans-European enforcement actions with respect to Heavy Goods Vehicles.
3. To give more priority to speeding and drugs and driving offences.
4. To start standardising a EU alcohol enforcement approach.
5. To co-operate with governmental and non-governmental organisations.
6. To co-ordinate the involvement of traffic police specialists in the high-level groups of the EC and other EU consultation bodies.

The next TISPOL Conference will be organised in Spain in the last week of October 2002. The theme is: “Human rights versus Enforcement, using IT technology”

What can TISPOL do for you?

TISPOL can provide you with vital information to improve the quality of traffic enforcement in your country:

- You can join the Organisation.

- You can join the Trans-European enforcement activities.

- You can use the available knowledge, ‘best practice’.

- You can use the results of pilot studies and operations.

Good traffic enforcement will have a significant influence on road safety. It can reduce the number of fatalities and injuries by 30%!

Psychology applied to the relations between road users and the police

Contribution by Ms. Sehnaz KÖKSAL
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Summary

The present paper discusses briefly the enforcement officials' behaviour in dealing with traffic violations and the effect on road user behaviour. This paper uses basic concepts of learning literature as a frame to cover the subject. The discussion is centred around the experience with Turkish enforcement officials and the results of a small scale research study which aims to find out to what extent opinions or beliefs regarding the enforcement are shared among the police officers. Since the data is obtained from a small scale pre-study of a research, the content of this paper is limited to the discussion of the rationale of main research.

Although results of present pre-study does not allow any clear comment, some evidence exists to suggest that enforcement officials have certain beliefs and ideas about what the enforcement is and how it must be practised, some of which may have an effect on their behaviour. To what extent these beliefs and ideas dominate and to what extent they reflect in their behaviour is suggested to be of great importance in the sense that some of them may have a good effect or be detrimental on the enforcement activity. It is suggested that, in any case, it is necessary to support enforcement officials through increased awareness about the psychological effect and relative importance of enforcement activity on road user behaviour. Moreover, it is also necessary to reconsider whole enforcement practice to support relevant officer behaviour and to integrate this approach with the whole traffic officer training programme.

1. Introduction

The critical subject in traffic psychology is the road user behaviour and it is therefore necessary to investigate the factors that may have an effect on road user behaviour. These factors and their specific effects may vary across cultures. According to Rothengatter and Manstead (1997), cultural differences are reflected in traffic law and enforcement activities, as law and law enforcement are supposed to reflect the norms of the land. It is also stated that in some countries, the intention to violate traffic law is strong while in other countries drivers are law-abiding in general (Rothengatter and Manstead, 1997). The whole social context may account for the differences in both road user behaviour and enforcement officials' behaviour. Therefore, studying the behaviour of enforcement officials in relation to road user behaviour seems to be especially important for countries that have a traffic system which does not function.

2. Enforcement Activity

Enforcement is a punitive act focused on the unsafe behaviour of the road user and it is designed to decrease the occurrence of risky behaviour. As a legal and rule governed punitive act, enforcement

competes with some other factors that function as "rewards" on unsafe behaviour. Some of these "rewards" are thought to be inherent in normal human behaviour such as pleasure of speeding. Some other types of "rewards" may stem from the disorganised or improperly working traffic systems especially in the presence of conflicting demands of environmental conditions on the road user such as in the case of illegal parking which is usually condoned by the enforcement officials in irregular urban areas. These contradictory demands increase as the basic requirements of traffic environment left unsolved and may strengthen the existing social norms which proceed against road safety. Since the negative outcomes of such norms can not be observed directly or immediately, the road user may easily comply with such "violation" norms.

Increasing the perceived risk of being apprehended is a very efficient way to cope with violations. Strategies aimed to increase the perceived risk of detection, especially through visible surveillance, is generally accepted as the most effective measure and risk of detection seems to work better than the severity of punishment (Åberg, 1997). It is also stated that only rules that are possible to enforce should be implemented (Åberg, 1998). However the traffic system is not in a vacuum and not independent from other social, technological and administrative systems of the society. If priority for safety is not supported consistently by other systems or the parts of the system do not interact harmoniously, the result can only be a maladaptation. Implementation of the rules become problematic in a "maladapted traffic system" and the strategies or rules which work well in a properly organised traffic environment may have only limited positive consequences. For example, is it possible to suggest that each violation detected results in punishment in an improperly working traffic system? If the answer is no then it should be concluded that it is impossible to decrease the occurrence of unsafe behaviour through a detection which is lacking in its punishment component.

The reason why a detection does not result in punishment requires a closer look to the traffic systems which do not work efficiently. Although the responsibilities and the authority of an enforcement official is strictly defined, they usually face a judgement problem (Zauberman, 1998). In handling a traffic violation case, the official must observe a set of well defined rules but still have some behavioural choices as a result of his or her own subjective judgement. It seems to be reasonable to suggest that the more indices of irregularity in the traffic system the larger the possibility to deviate from rule based solutions to handle the existing situation. In one extreme side the behaviour chosen can be a result of an effort to be fair to the road user who is also suffering from deficiencies, the other extreme choice can be a result of an intention to abuse the existing situation.

Whatever the basic motive behind the inconsistent treatment, every case has several negative consequences for traffic safety and for public order which require ethical, legal, administrative, psychological and organisational approaches. This paper recognises the importance of all aspects of the problem but primarily concentrates on a point which is common to each case: They all weaken the association between the punishment and unsafe behaviour and it is reasonable to expect an eventual detrimental effect on the safe traffic behaviour.

3. Behavioural dimension of law enforcement

Rothengatter (1990) views the approaches to influence traffic behaviour as two alternative theoretical positions: mass media campaigns which are generally attitude oriented and traffic law enforcement which is directly behaviour oriented. Actually it is possible to formulate the whole traffic enforcement activity in behaviourist terms. It is a well-known relation that as the strength of association between the suppressed behaviour and punishment increases, the probability to observe the suppressed behaviour decreases. It is possible to suggest then the enforcement activity and the whole

possible strategies must be compatible with this principle. Studies related to the effect of perceived risk of detection can be considered as the empirical evidence for the relevance of this suggestion.

It should be added that the behaviourist approach does not account for the whole road user behaviour because it does not cover the cognitive dimensions of human behaviour; but it is possible to suggest that the behaviourist approach is relevant for handling the core aspects of enforcement activity. Among these, the delay, intensity and the consistency of punishment can be considered to be the most relevant characteristics to evaluate the quality of enforcement activity.

4. The enforcement activity in Turkey

With the same reasoning based on behaviourist terms, the effectiveness of enforcement depends on lessened delay between the behaviour and punishment, the relevance of both severity and type of punishment and the consistency in delivering punishment. The delay between the occurrence of unsafe behaviour and punishment can be interpreted as a function of the legal and bureaucratic procedures of fining and the technology implemented in enforcement. Therefore, most of the time, delay of fining is out of the control of the enforcement officials. The severity and type of punishment are other dimensions that are determined by the traffic law and can not be manipulated by enforcement officials. However the consistency dimension is prone to manipulation intentionally and unintentionally.

Since it is unrealistic to expect to detect all violations and offences, the perfect consistency can be considered as an ideal in traffic enforcement. Therefore it is possible to suggest that the consistency is not a matter of the contingency between the violence and the punishment but the contingency between the detection of the violation by enforcement officials - or automatic police systems - and the punishment. In a successful enforcement activity, presence of enforcement officials – or any sign of detection by police - may function as a strong discriminative cue which signals a possible punishment in case of violation. Therefore, in behaviouristic terms, strengthening the association between the presence of enforcement activity and fining can be a realistic goal in traffic enforcement.

4.1 Some relevant findings from a survey study

The findings of a stress survey on traffic police officers (Trafik Araştırma Merkezi Müdürlüğü-Directorate of Road Safety Research Centre, 2001) provides some evidence for the existence of the problem related to the punishment -or fining- component of enforcement activity. Four open ended questions included in this survey were: A. "W*hat is the public opinion about traffic police officers in general?*", B. "A*re you satisfied with your job in traffic branch?*", C. "*Do you think the enforcement activity of traffic police officers is influential in preventing accidents?*", D. "*Is there any case that you can not issue a ticket, although you have to do so?*". The question A was designed as a true open ended question and therefore subjected to a content analysis in three categories as "positive-negative-neutral evaluations". Questions B and C included "yes-no" response choices and subjects were asked to state the reason why they think so. Question D included "yes-no" response choices as given and three choices defined under yes response. If the subjects were to choose yes response, they were allowed to choose more than one choices or make additional statements. Table 1 indicates the distribution of "positive-negative-neutral" responses for question A and distribution of "yes-no" responses for other questions.

Table 1. **Frequencies and percentages of responses of the subjects to four questions regarding traffic police officers evaluations (N=1356)**

A. "What is the public opinion about traffic police officers in general?"

	Frequencies	Percentages
Positive	439	32.4 %
Negative	452	33.3 %
Neutral	228	16.8 %
No response (missing)	237	17.5 %
Total	1356	100 %

B. "Are you satisfied with your job in traffic branch?"

	Frequencies	Percentages
Yes	911	67.2 %
No	393	29.0 %
No response (missing)	52	3.8 %
Total	1356	100 %

C. "Do you think the enforcement activity of traffic police officers is influential in preventing accidents?"

	Frequencies	Percentages
Yes	1037	76.5 %
No	263	19.4 %
No response (missing)	56	4.1 %
Total	1356	100 %

D. "Is there any case that you can not issue a ticket, although you have to do so?"

	Frequencies	Percentages
Yes	943	69.5 %
No	338	24.9 %
No response (missing)	75	5.5 %
Total	1356	100 %

Source: Stres Tarama Çalışması-Rapor II, Trafik Araştırma Merkezi Müdürlüğü-Directorate of Road Safety Research Centre, 2001, Ankara.

Although most of the subjects seems to be satisfied (question B) and confident (question C) with their job, it is still questionable if the rate of negative responses is acceptable or how much it reflects itself on the job performance of traffic police officers. The responses to the question A interpreted as uncertainty about the public opinion regarding their enforcement behaviour. Sample is divided into three equal groups as positive, negative and rest of the sample which is equally divided into two groups as those who do not reply at all and those who remain neutral in their evaluation. Question D reveals an undesired behavioural consequence which is undoubtedly detrimental on enforcement activity. Majority of subjects report that there exist at least one case for which they can not issue a ticket although it is necessary to do so. It is obvious that this exerts a negative influence on effectiveness of enforcement activity. It is therefore thought to be very important to examine the specific content of self report statements gathered as a response to each question. A careful examination of self reports may shed light on the ideas, beliefs, attitudes, intentions related to the

enforcement behaviour of officers and further research may show if it has any effect on road user behaviour.

4.2 Results of a pre-study

As a first step to begin examining to what extent certain responses are shared by other traffic police officers, a small scale pre-study has been planned. A questionnaire including 71 items rated on a 7-points scale was administered to 29 traffic police officers whose rank is the lowest in hierarchical order. One of the subjects was female and the mean age was 34.2.

The items in the questionnaire drawn from the pool consist of the responses to 1 356 subjects to the four open ended questions discussed above. The rationale behind this was that the open ended questions may reveal critical statements or opinions which are high or low in frequency but their frequencies do not reflect to what extent these statements are supported by other respondents. Therefore items are selected on subjective base guided by the experience of the researcher. The opposing ideas which are questioned by traffic police officials such as if tolerance is acceptable or not, if the most important issue for traffic safety is enforcement or education, how the traffic police officials are viewed by drivers, what is the basic purpose of enforcement and how it must be practised are considered to be critical by the researcher since they may have an influence on their behaviour during enforcement activity. Therefore, items regarding the opinions mentioned above are thought to be a reflection of their attitude and behaviour on these issues and included in the questionnaire.

The mean responses are presented (Table 2) under four subtitles: “tolerance”, “enforcement-education comparison”, “public relations” and “enforcement”. Since the study is at a very early stage and the primary aim is to examine the relevance of items, results presented here do not reach any conclusion but provide a general view on the subject. It is possible to suggest with caution that averaged responses gives an impression of uncertainty on public relations and mean responses on other dimensions seem to be questionable. Tolerance related opinions may be a reflection of officials’ attitudes and their final behaviour which is interpreted as inconsistent with the basic purpose of enforcement activity. Further examination is required to see if these responses show a normal tendency or an inclination to be tolerant for sake of “good public relations”. It is obvious such a conclusion requires a systematic effort to overcome undesired behavioural consequences.

The items under the other subtitles can potentially influence each other. They seem to be intertwined in the sense that they can not be evaluated separately and must be handled in relation to the motivation, commitment, attitude and behaviour of traffic police officials regarding their practice during enforcement activity.

Table 2. **Responses to the items which are mainly related to the evaluations of the subjects regarding "tolerance", "enforcement-education comparison", "public relations", "enforcement" (0=absoluately no; 6=absoluately yes)**

TOLERANCE				
No	**ITEM**	**MEAN**	**S.D.**	**N**
3	It is necessary not to be tolerant (it is not acceptable to be tolerant) for errors and violations.	4.64	1.73	28
28	Every body must be fined for errors and violations.	4.62	2.03	29
12	I can not treat people equally although I desire to do so.	4.07	2.29	28
52	It is necessary to be tolerant during traffic controls to establish good public relations.	3.04	2.22	28
61	It is acceptable not to issue ticket for those who will not behave in the same way any more.	3.00	2.10	29
21	Sometimes it is more appropriate to be tolerant to the offenders.	2.72	2.33	29
30	Sometimes it is acceptable not to issue a ticket for those who can not afford the fine.	1.52	1.85	27
ENFORCEMENT-EDUCATION COMPARISON				
No	**ITEM**	**MEAN**	**S.D.**	**N**
51	To establish traffic safety it is more efficient to educate pedestrians and drivers than fining.	5.17	1.28	29
4	The basic purpose of my profession is to educate pedestrians and drivers.	4.72	1.85	29
68	If drivers and pedestrians are not educated enforcement has no function at all.	4.61	1.89	28
5	Conversation is (to initiate a conversation is) more effective than fining.	4.32	1.98	28
59	Education has no function without enforcement.	4.31	1.98	29
57	Admonition (warning verbally) is effective as much as fining for those who are educated.	3.72	2.31	29
34	It is better to give some advice instead of fining.	3.64	2.06	28
PUBLIC RELATIONS				
No	**ITEM**	**MEAN**	**S.D.**	**N**
40	We are good models of true behaviour in the society.	5.38	0.94	29
69	How people treat us depends on how we treat them.	5.07	1.44	29
39	It doesn't matter how much we try, nobody is pleased.	4.72	2.00	29
47	People think that the traffic police officer abuses his/her authority.	4.28	1.69	29
18	The traffic police officer has a negative impression in the society.	4.25	2.03	28
56	I'm respected and loved by the people around me because of my profession.	4.14	1.41	29
71	People view the traffic police officer as an official who helps them.	3.93	2.09	29
20	I have a respected profession in the society.	3.86	2.07	29
10	People view the traffic police officer as a person whose business is enforcing law.	3.69	2.07	29
60	People respect (recognise) the authority of the traffic police officer.	3.52	1.82	29
7	People avoid contact with the traffic police officer.	2.07	1.98	29
65	People think that the traffic police officer treats everybody equally.	1.86	2.17	28
ENFORCEMENT				
No	**ITEM**	**MEAN**	**S.D.**	**N**
11	The basic purpose of my profession is to deter unsafe behaviour of pedestrians and drivers.	5.38	1.47	29
27	What the traffic police officers do is an effective measurement to prevent accidents.	5.07	1.31	29
9	The efforts made by the traffic police officers have a substantial effect on the prevention of accidents.	4.36	2.13	28
16	The present effort to enforce the law is insufficient.	3.72	2.22	29
13	The present traffic law in our country is powerful enough to deter.	2.24	2.15	29

5. Conclusion

Although results discussed above are consistent with the observations and experience with the police officers, it should be added that present study does not attempt to measure any dimension since items need to be reconsidered in terms of factorial and other relevant statistical analysis. It should also be added that these impressionistic suggestions are subjective in nature and prone to be biased. Therefore the study must be broadened to include more specific items and administered to a large sample to draw reliable conclusions. Close examination of other specialists is also required to suppress possible bias.

Inconsistent treatment during enforcement is not just a behavioural problem but a serious legal problem which causes a vicious circle in terms of traffic safety and the "image of traffic police officials" since it creates a very suitable social environment for abuse. Therefore any influence being cultural, technological, legal, physical or behavioural on the effectiveness of enforcement must be viewed seriously and handled carefully. Lajunen (1999) stresses the need for cross-cultural studies to identify "universal" and "local" antecedents of traffic accidents and he also suggests the main measure against road deaths in Turkey are speed limits and police enforcement. Recommending police enforcement as a measure just as if it does not exist is found to be interesting. This suggestion must be an expression of uncertainty about the effectiveness of existing enforcement activity in Turkey from the perspective of a experienced traffic psychologist and the way the traffic police officials deal with violations can be one of the "local" antecedents of road safety level in Turkey.

Possible sources of inconsistent treatment of road users by the traffic police officials are: a non supportive physical environment which makes some rules impossible to apply such as lack of parking areas; efforts to compensate criticism against police activity; uncertainty about the effect of enforcement activity; lack of training necessary to handle stressful situations especially in face to face relations with road users; differences in perceived support from the colleagues and their organisation; lack of information about the effect of particular enforcement strategies; subjective evaluation of the effect of a particular rule or a particular situation in which the violation occurs.. All of these require multidimensional approaches to be solved in which the behavioural orientation is only a part of it.

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Part III.

SAFE AND SUSTAINABLE TRANSPORT FOR A SAFE AND SUSTAINABLE JOURNEY

ROLE OF TRANSPORT PLANNING AND PERFORMANCE

How to use logistics as a means to provide safe and sustainable transport? Examples of "goods" logistics in order to reduce environmental disturbances and secure maximum traffic safety

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1. Safety and environmental performance - driving forces

1.1 Demands of interested parties

There are many interested parties in our environmental work. These are mainly customers and authorities, but we must not forget our employees, subcontractors, the media, finance and banking institutions, the general public and - last but not least - our stock owner.

1.2 Increased focus on road transport

There are currently some critical factors in the environmental and safety situation as it relates to road transportation. Investigations carried out during the 1980s have foreseen the problems that we are now facing. At the same time we are seeing changes in public attitudes, customer behaviour and political decisions at a central level. An interesting point is that a reduction in environmental impact goes hand in hand with greater road safety, simply because many environmental solutions make transports more efficient. This means that fewer trucks now do the same transport work that many lorries have done previously.

The EU White Paper *"Time to Decide"* from DG Transport & Energy, September 2001, highlights some of the greatest problems of increased mobility:

- Damage to the environment.
- Challenges to safety.
- Growing congestion.
- Poor quality services.
- Isolation of some regions.

The European Environment Agency also points out the transport sector as the major challenge for the future with respect to meeting CO_2 emission targets. In their report *"European Community and Member States Greenhouse Gas Emission Trends 1990-99"* they list the sectors that show decreases in emissions – the energy sector, the chemical industry, the manufacturing industry, landfills and solid fuels. One sector shows extremely high increases in emissions between 1990 and 1999 - the transport sector. Transportation is responsible for 21% of the total EU greenhouse gas emissions and will increase by 18% by the year 2010 as a result of expanding road transport in almost all Member States.

Eurostat's report, 2001; EEA, 2001, shows that the emission trend in freight transport shows a faster increase than in passenger transport. Today, heavy goods vehicles account for one-third of the CO_2 emissions of total road transports.

In the same report we learn that road transport causes 41 000 fatalities a year. The total cost for this is 2% of the total EU GDP.

This makes this meeting extremely valuable and important. It is time to move from overall policies and theory to practice because actions speak louder than words.

2. The situation today

2.1 Environmental impact

We know that transports, mainly those by road and air, have adverse effects on the environment. The transport sector is responsible for 26% of the global emissions of CO_2 through the combustion of fossil fuel. Transport's share of climate impacting emissions continues to grow while the contribution from other sectors is decreasing. The expected overall increase, entirely due to transport growth, goes totally against the international UN agreements striving for a 5% reduction of global greenhouse gas emissions compared with the 1990 level by the year 2012.

The environmental impact of transportation cannot only be seen from a global perspective. Regional and local effects such as acidification, over-fertilisation and effects on people's health can also be attributed to the transport sector.

Land use is another crucial consequence of increased traffic. Roads and other transport infrastructure occupy 25-30% of the land in urban areas. Moreover, increased traffic means increased risk of accidents and our cities face problems with impaired air quality and a noisier environment.

2.2 Safety

Of all transport modes, road travel presents the highest risks and the most serious consequences for public health. The recent road and rail tunnel accidents have put further focus on the vulnerability of the transport system and confirmed the need for improved safety standards and action programmes. Although the number of deaths in road accidents has been significantly reduced since the 1990s, road accidents killed over 41 000 people in the EU last year - a number that must be halved by 2010 according the target set by the EU commission.

The cost to society of road crashes has been estimated at over 160 billion Euro annually (= 2% of the Union's GDP). A systematic approach is required to achieve this target and to overcome the great difference in risk levels between the member states.

Among the measures currently discussed are the heavy vehicle ban in certain vulnerable areas, promotion of new technologies, harmonisation of certain regulations, penalties and controls, combating the use of alcohol and drugs, compulsory use of seatbelts, use of speed limitation devices in heavy vehicles and roadworthiness testing of all vehicles.

2.3 Technical improvements

Considering environmental aspects, vehicle manufactures have shown good progress in developing new and cleaner engines. A big step has been taken if we compare the regulated emissions of trucks from 1990 (Euro 0) with those of the new trucks coming out of our workshops today (Euro 3) - a reduction of more than 70%. But this is not enough if we consider the fact that we in the European Union and on a national level have an annual increase in road transport of 3-5%. And the potential for further and large reductions of CO_2 from traditional diesel trucks is shrinking.

2.4 Policy-making and monitoring

The major problem with safety and environmental factors is that laws and regulations are often inefficient, unclear, inconsistent and difficult to understand. In addition, they are not harmonised and lack follow-up and supervision measures. Hauliers complying with laws and regulations have difficulty competing with 'hooligans' that entirely ignore restrictions on working hours, rest time regulations, loading routines and speed limits and that do not maintain and service their trucks as often as needed. The police responsible for checking compliance with all these regulations lack the resources and adequate competence to do so. The result is, as often reported in the media, that drivers use drugs to stay awake, and drive too fast in vehicles that have inferior brakes if any at all.

3. The situation tomorrow

3.1 Benefit from market forces

Our international customers are slowly waking up. Their greater awareness of the situation makes them fumble for instruments and tools to support improvements. The customers see costs increasing every year because of the higher taxes on diesel fuel, new mileage-based taxes and charges/limitations of transits through certain sensitive areas, e.g. Switzerland and Austria. We also see new traffic regulations being put into effect in larger cities, such as environmental zones and road fees. This will have an impact on the cost of road transportation in the future. And the transport buyer will be the one that pays.

The large companies in Europe are also heading the area of sustainable development, which, beside environmental concerns, also includes economic and social responsibility. One driving force is the financial sector, which has started to evaluate and rate companies' sustainability performance. The environmental impact of transports is a major environmental aspect in almost all large companies, and they would like to perform well. We are thus seeing an increase in demands to reduce the impacts that transports have on the environment, mainly in the Scandinavian countries, but more and more in other parts of Europe as well.

The authorities can trigger future development by introducing a number of activities and decisions. Five examples of concrete actions are:

- Calculate the emissions from transports.
- Include transports in the EMAS and ISO 14001 systems.
- Set up goals for road transports as concerns CO_2.
- Supervise compliance with regulations.
- Include transports in the future trade of CO_2 emissions.

This will have a great impact on the whole transport industry. When customers are forcing their suppliers to compete in terms of environmental and safety performance, market forces will become an important and powerful part of the solution.

3.2 Political decisions and fiscal instruments

Another solution is to define and consider alternative tax reforms. Transports today are too cheap in comparison to other costs in society. As a consequence, we are transporting too much. In this context it is important to remember that logistics companies do not earn money in relation to kilometres driven. We earn money by offering our customers smart logistics solutions, which means fewer transports and better efficiency.

We expect that primarily air and road transport will bear a greater burden in terms of environmental taxes in the future. These taxes must be harmonised in Europe as far as possible – to make them easy to understand and consistent in following the basic intention of the Polluter Pay Principle. The best current example of this tax is the Swiss Heavy Vehicle Fee (HVF), which is based on the year model of the truck, its emission level, the distance driven and the total gross weight of the truck, independent of the loading weight. This tax scheme certainly stimulates the haulier to be as efficient as possible.

A good infrastructure is needed in the future, but we do not need very many new roads if political decisions are in line with the examples highlighted in this presentation. In fact, the major problems are in some large transport corridors in Europe, but there will be alternative solutions in the future. One example is further use of intermodal transports where the combination and connection between lorry and train can help a great deal. Here customers' demands are important and a liberalisation of the European railways will be necessary to bring about any changes in the future. But there are no such alternatives in the large cities. In all European cities, distribution by trucks will still be the only possible way to deliver goods to stores in city centres. Because of congestion problems we sometimes need 10% more trucks than before to be able to deliver the same amount of goods in time. This generates more traffic and this bad spiral will end up in chaos if business-as-usual is allowed.

3.3 Transport industry views

The major transport companies in Europe work according to the "public transportation" concept – a European-wide transport network that consolidates goods and operates according to a set routing and time schedule. One way to be more successful in the future is to become larger and to have access to a Trans-European Network. If companies are big enough, they have a greater number of possibilities to increase their efficiency. But smaller hauliers and transport companies that maintain high standards and comply with laws and regulations should also be rewarded and encouraged.

- The transport industry needs both 'carrot and the stick'.

- We want clear-cut and explicit demands from our customers. However, they should be easy to understand and they should be followed up automatically.

- Authorities should promote environmentally adapted solutions and sustainable fair taxation. The Polluter Pay Principle (PPP) is a good example.

- We do not need branch organisations if they are conservative and fail to understand the demands of the future. It is better to learn from pro-active organisations and companies that can present practical, concrete examples (Best Practice).

4. Best practices

Below are some examples of Best Practices from the Schenker world, illustrating various measures to reduce environmental disturbances and secure maximum traffic safety**.**

4.1 Green Logistics

Green Logistics is Schenker's competence area for developing tools and processes to integrate environmental aspects into logistics development. It is a customer-oriented function that provides calculations and reports of environmental impact (Eco-Map), analyses customers' transport needs, suggests alternative transport means and recommends relevant technological solutions (Eco-Log).

Together with our customers we look into different solutions for reducing environmental impacts using logistic and technical solutions. Our emission calculation tool, described below, is a valuable and important support in these efforts.

4.1.1 Emission calculation

Demands to reduce the negative environmental impact of the transport sector are being voiced more and more by customers and the public sector. At the same time, transport is increasing as a result of more intensive and more rapid goods flows. Reducing the environmental impact of transport presupposes access to good calculation systems. To satisfy this need, Schenker-BTL has developed an emission calculation tool to help determine the total environmental load caused by transport and logistics systems within their European land transport network. This is the most advanced and comprehensive tool currently available on the market.

The application consists of three parts **- Emission on line, Emission report** and **Emission analysis** - each of which is designed to meet specific aims and satisfy various targets groups.

Common to all three parts are the following:

- The application is linked to an **internal database** that continuously provides actual information about transports in Schenker's European network.

- It is characterised by a **high level of accuracy**, where individual consignment data constitute the lowest common denominator.

– Allow emission calculations of **complete transport chains**, although various transport modes are involved.

The calculation provides information about transport-related emissions expressed as kilos of carbon dioxide (CO_2), nitric oxides (NOx), hydrocarbons (HC), sulphur dioxide (SO2) and particulate matter (PM); information about the total energy consumption in kWh, and a socio-economic evaluation of the harmful effects on society in monetary terms.

The tool has to date been introduced in parts of our organisation and is successfully applied in some long-term customer-related projects. It has also been positively recognised by other external parties and is recommended for use by for example the financial market and business sector when collecting green key figures for companies quoted on the stock exchange.

4.2 The 'Meat Sausage' – a logistics challenge

This case builds on a realistic request for an assignment that Schenker offered in the year 2000. A company, in this case called "Meat Sausage", produces three different types of fresh meat products, such as ham, sausages and pâté. They make the products in three different production sites and want to make their logistics solution more efficient. The three production sites create unique products and it is not possible to move production. Another demand was delivery in 24 hours, because all the products were fresh and had to reach customers as fast as possible. Each production site has between 140 and 460 customers, consisting of different groceries. Several groceries receive products from all three production sites. This means that one customer gets three deliveries from the same company every day. In total they have over 2 000 deliveries per month. The distance between the production sites is 300-500 kilometres.

One of the logistics solutions that Schenker Consulting presented was to use "cross docking". Schenker Consulting are experts in large, complex logistic solutions. Cross docking means that all the products that were made at two of the sites were sent by bulk transports to the third production site. Here the different products were consolidated and the deliveries went out every day to the customers. This solution gave 80 bulk transports and 1 500 deliveries every month.

The "Meat Sausage" company was interested in this solution but wanted to know the costs and the environmental impacts of a new logistic solution like the cross docking method. The environmental impact was calculated by using our emission calculation application, described above. The result was very interesting. "Meat Sausage" decreased their logistic costs by nearly 15% over a year. Even more interesting was that their environmental impact decreased by 45% over one year.

The result shows that logistic solutions can be as good as technical solutions in vehicles or fuels. As a large transport and logistics provider Schenker was able to offer the customer this solution, and we are proud today to say that this is the way "Meat Sausage" now solves its logistic problems.

4.3 CO_2 unit - a cooling unit for transport of refrigerated goods that uses CO_2 instead of diesel and cooling agents

Most people are not aware of the fact that many of the trucks on our roads need two diesel engines - one to operate the truck and one to run the cooling unit. Compared to the vehicle engine, the cooling unit consumes rather low quantities of diesel – approximately 2.5 litres/hour. However, on a yearly basis, a truck transporting chilled goods runs its cooling unit for about 3 000 hours, which gives

a yearly diesel consumption of 7 500 litres. Translated into carbon dioxide emissions, this means almost 20 tonnes per year.

For nearly two years, a completely new refrigeration technology has been used in Schenker's transport of chilled goods. Our supplier of cooling units, Thermo King, has developed a completely new kind of unit that runs on carbon dioxide. The unit "re-uses" the residual gas carbon dioxide from industrial processes for both operation and cooling and thus uses neither diesel nor coolant. Its cooling capacity is higher than a traditional diesel-driven cooling unit and the noise levels are considerably lower. As the unit consists of very few moveable parts, it also requires very limited service and maintenance resources. The purchase price is the same as for a traditional unit.

So, where is the drawback? As long as the infrastructure does not yet exist, a tank for the carbon dioxide is required. This tank has been installed at Schenker-BTL's terminal in Växjö, Sweden, where two trucks have been equipped with the new technology. To date, only about four CO_2-powered cooling units are in operation – two in the U.S. and two in Sweden. Experience after twelve months of use continues to be positive. Schenker-BTL is therefore preparing a further introduction of the units in its European network, the Norwegian company being the next.

4.4 GPS - increases transport efficiency by 15%

4.4.1 Background

The introduction of GPS in the transport sector means increased vehicle control, which reduces unnecessary mileage by making sure that the right vehicle is directed to the right place, just in time. This makes it a most valuable technical tool to improve efficiency in the transportation sector and hence reduce its environmental impact. Reducing mileage means reduced fuel consumption and consequently lower emissions of both carbon dioxide and other regulated pollutants.

4.4.2 Description of application

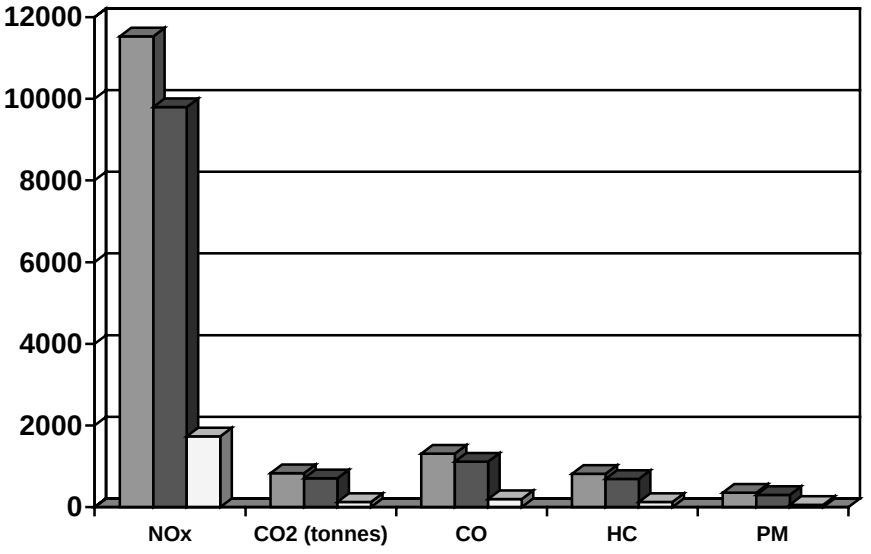
In 1995, Schenker-BTL implemented a GPS-based traffic control system in the district of Växjö in Småland, Sweden. There, their fleet of 32 trucks mainly works with local distribution although some trucks also operate on long haul. At the office, the traffic planner can monitor the fleet on two digital screens and consequently allocate consignments to the most suitable truck.

4.4.3 Concluding results

The introduction of GPS (Global Positioning System) together with Mobitex has led to:

- A 15% reduction of driven distance transporting the same quantity of goods.
- Increased capacity utilisation.
- Lower transportation cost.
- Decreased transit time.
- Improved security.

Figure 1.



Source: University of Chalmers, MoT Thesis 99:03.

Other documented advantages refer to qualitative improvements in the work environment of drivers and traffic controllers as well as a higher customer service level.

The investment analysis showed a return of the investment in 12 months, which is half of the lifetime of the GPS.

4.5 DNOx catalyst - an emission control technology that upgrades old trucks

Today, we see a rapid development in the area of exhaust emission control also for diesel powered heavy vehicles. After-treatment systems that reduce carbon monoxide, hydrocarbons and particles have been available for some time although dependent on the use of low sulphur diesel. However, nitrogen oxides are not affected, due to the fact that diesel engines are run with large excess of air. This makes nitrogen oxides one of the major challenges to the transport sector, next to greenhouse gas emissions.

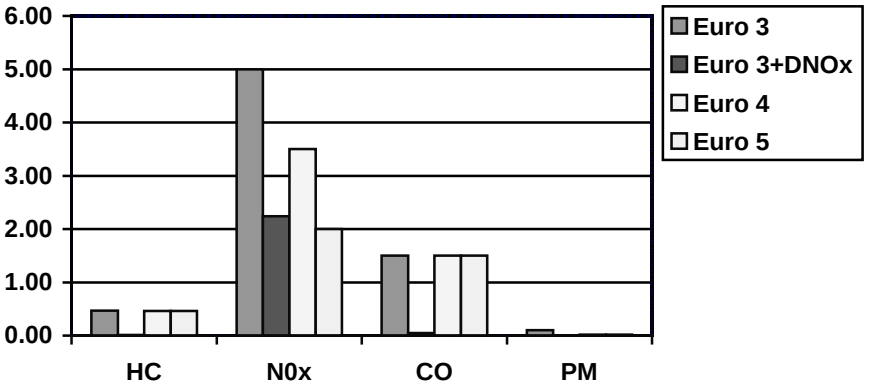
Based on a further development of the EGR technology, a low-pressure system to recirculate cooled and particulate-free emissions, a unique emission system called DNOx is now being subjected to commercial testing.

This particular produce involves recirculating exhaust gases to the engine intake.

Evaluations made in accordance with the applicable European testing procedures show that the impact represents a halving of nitrogen oxide content, and a 90% reduction of carcinogenic particulates, hydrocarbons and carbon monoxides. Another advantage of this system is that it can be

fitted to both new and used vehicles. When installed on a Euro 2 engine, you will fulfil the Euro 4 emission standard.

Figure 2.



Source: Results from test according to ESC on Scania engine DC9 04 230, Septembre 2001.

During the last 12 months, we have been testing this DNOx system on a distribution vehicle in Stockholm, Sweden. The recently performed evaluation showed test results that exceeded all expectations – a little more than halving of the NOx emissions.

Several other manufacturers are developing similar systems based other technologies. Siemens have developed an after-treatment system based on the SCR technology, which has been tested in our operations in Germany. Our aim is to continuously test and evaluate alternative methods to reduce NOx emissions in order to increase our knowledge and identify the devices most suitable and efficient in our operations.

4.6 Biogas and CNG driven distribution trucks

4.6.1 Background

Today, nearly all large European cities have local problems with congestion and emissions, mainly the regulated emissions. Globally we have the problems with greenhouse gases. All cities need efficient distribution of everyday commodities to their citizens, everything from groceries to office paper and other types of goods. Today, there are no alternatives to these distribution trucks. To reduce emissions from these trucks many people are relying on the coming fuel cell technique. But there are other solutions that can bring down the emissions in the short term - distribution trucks driven by a combination of natural gas and biogas.

4.6.2 Project description

In Sweden Schenker joined a project together with five other large transport companies, Danzas, ICA, COOP, Swedish Post and DAGAB. The project aimed to rapidly reduce emissions from trucks

where there were no other alternative means of transport. It was found that it is already possible to run trucks on natural gas CNG. With small changes to the engine manufactures could deliver a truck that could also use biogas. Biogas comes from landfills and sewage treatment facilities as a residue product. All large cities have these residue products and currently have difficulties getting rid of the gases. Mixing natural gas with biogas solves more than one problem.

4.6.3 Environmental benefits and costs

The environmental benefits are good in the short term. The trucks will meet the Euro IV standards that will be implemented 2005 in terms of regulated emissions. Biogas does not give any direct CO2 emissions and thus the benefits will be great in comparison with diesel trucks. Below we compare the emissions from the new CNG Volvo using an engine called the G6 and the EURO IV standards as of 2005, and the coming EEV demands. All data are compared with the ETC transient test cycle and with g/kwh as the result:

Emission	**EURO IV**	**Volvo G6**	**EEV**
NOx	3.5	< 3.0	2.0
NMHC	0.55	0.40	0.40
CH4	1.1	*	0.65
CO	4.0	< 3.0	3.0
PM	0.03	0.03	0.02

* Total HC 1.1 g/kwh, of which NMHC 0.40 g/kwh.
Source: Volvo Trucks, Gothenburg 2001.

The cost for these new trucks is nearly 100% more than traditional delivery trucks of the same size. This is due to the small production series. In the long run we can expect the price to fall to 50% more than a traditional truck. We hope that authorities will offer all trucks driven by alternative methods lower taxes and other permits in city centres.

4.7 Eco-driving

4.7.1 Background

Training drivers in EcoDriving, an economically and ecologically sound driving style, is a cheap method to save fuel and money and contributes to road safety. It was a measure initially designed to reduce fuel consumption and emissions of carbon dioxide, but it has also demonstrated that it is capable of reducing travelling times and the cost of accidents.

The average reduction in fuel consumption amounts to 10%, which indicates that payback periods of the EcoDriving lessons are reasonably short. Nevertheless the development of the market for EcoDriving is slow, at least on a European scale.

So far, only a few European countries have set up broad national programmes to promote EcoDriving, e.g. Finland, the Netherlands and Switzerland.

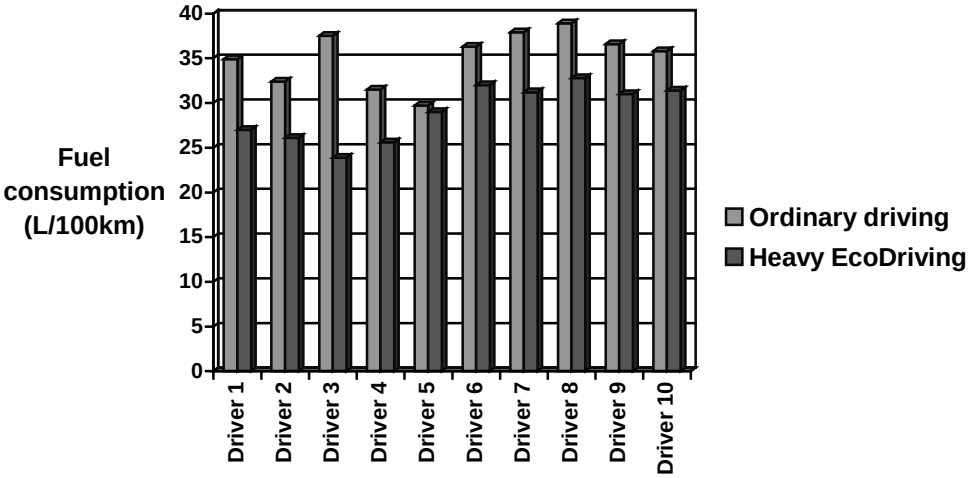
4.7.2 Schenker experience

In Schenker's operations in Stockholm, Sweden, a pilot training course for 10 drivers was held in 2001. The course was a mix of theory and practice. The tutors were professional drivers themselves, which increased the credibility and acceptance of the participants. Each driver was closely observed when driving a certain track set up especially for the occasion. After receiving some advice and suggestions for improvement, they drove the same track a second time.

4.7.3 Results

The mean reduction in diesel consumption was 17.4%, while at the same time the average speed increased by 2.4 km/h. Comparing a driving distance of 100 km, the fuel consumption was reduced by an average of 6.15 litres. Considering only these ten drivers and their activities, this would lead to an annual savings of approximately 20 000 Euros, a diesel reduction of 30 750 litres and a decrease in carbon dioxide emissions of around 81 tonnes. These figures are based on an annual driving distance of 50 000 kilometres/vehicle/year and a diesel price of 0.65 Euros/litre.

Figure 3.



Source: Schenker 2001.

5. Conclusion

The current and future challenge to the transport sector requires new and proactive thinking on the part of all interested parties. Results from the projects presented in this report shows that the transport sector can reduce its environmental impact and increase road safety. To be successful, the transport sector needs strong support and demands from customers and clear-cut and harmonised objectives from the authorities, but it is also necessary that other groups in society, such as NGOs, highlight the problems related to transport.

Customers must take more responsibility for logistics solutions, keeping problems like environmental impact and safety in mind. They have to put a pressure on their suppliers and demand smarter logistic solutions, evaluate their subcontractors, co-operate and give feedback - so that all transport companies know that their work will be repaid in one way or another. Together we can find smart logistic solutions, sponsor new techniques and technology and use the technical and transport modes that are available today. Many reports have shown that use of intermodal transports is better for the environment and will also decrease the number of accidents on European roads. The transport sector is rather conservative and needs strong signals from customers and authorities to change their old behaviour. We also need a liberalisation of the European rail administrations, to open up the railways and increase the number of intermodal terminals. There must also be research and development in new solutions for combining trucks and trains.

The authorities can give the possibilities for the future by implementing tools for the market forces and give incentives to companies that are investing in better and safer logistic solutions. We need clear and consistent goals on a long-term basis.

The transport sector has to open the dialogue with non-governmental organisations (NGOs), the finance sector and authorities. We must also be more proactive in our solutions with our customers. Some help can also come from proactive branch organisations.

Safe and Sustainability Audits: In-depth Studies of Accidents

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The Vision Zero

The inherent safety of the road transport system needs to be radically improved. In the long run it is not possible to continue using a system in which thousands of people are killed. In Sweden the parliament has decided that the long-term goal is that ultimately no person should be killed or receive impairing injuries on the roads. This decision is based on the Vision Zero concept. The Vision Zero is not only describing a very demanding goal, it is also a complete package containing new approaches to traffic safety.

One cornerstone in the concept is the shift in responsibility. Up until today the responsibility for the safety of the system has to a large extent been put on the individual road user. As individual road users it is our responsibility to behave in such way accidents will not occur. This means that the road user at all times must behave and perform perfectly and use his capabilities to the maximum to stay alive. There has been very little tolerance built into the system that can compensate for human mistakes and misjudgements. This approach cannot be found in other technical systems planned by society. To be able to create a safe and sustainable road transport system all partners influencing the design and use of the system must take a larger responsibility. These partners, hereinafter called system designers, play an important role in the Vision Zero concept. Typical system designers are road designers, regulators, the police, vehicle designers, educators and bodies buying and selling transports. Together the road users and the system designers have a shared responsibility to design and build a system that is tolerant to human errors, mistakes and misjudgements. Such human behaviour should not lead to fatalities or impairments.

To create an error tolerant road transport system the Vision Zero concept is focusing on the outcome of accidents more than what causes them. As described earlier people will continue to make mistakes and misjudgements in traffic even though the majority try to perform to the best of their ability. Consequently the system must be designed to handle the consequences of the accidents. To reach that the system must control the energy and forces within the system in such way that the human tolerance to mechanical forces will not be exceeded. In an accident resulting in fatal or disabling injuries the forces acting on the human body are been larger than the biomechanical tolerance. One way to decrease these forces is to protect the road users better. Another way is to decrease the force levels by lowering the travel speeds. From a Vision Zero perspective these are the two major strategies to solve the traffic safety problem. Either investments could be made to improve the safety of the roads and vehicles to a level that allows the mobility we have today or the mobility can be adjusted to a level that is in balance with the safety that can be found in the system today. This does not result in lower demands on the road users. They must continue to do their best to follow the rules set out by the system designers (for example, respect the speed limits and seatbelt use). If these rules are obeyed they should not be killed or severely injured. But if these rules are not followed the responsibility for countermeasures goes back to the system designers.

In-depth studies of fatal accidents

The knowledge of the traffic safety quality of the road transport system is often based on accident statistics gathered by the police. Accident statistics only give a brief description of the problem and have a limited value as a tool for identifying countermeasures, especially for injury mitigating countermeasures. Such screening data are also insufficient to describe road accidents as a public health problem.

A traditional approach to in-depth studies focuses on information gathered for statistical description and analysis. Such studies are often directed towards restraint effectiveness and injury mechanisms and mainly focus on the individual components of the system. An alternative approach to in-depth studies based on the Vision Zero instead focuses on the road transport system as a whole. The combination of the design of the roads and the vehicle are "inter-related" with the possibilities of how the system can be used, taking into account that mistakes and misjudgements by the road user can occur. With such approach, every case with a fatality or disabling injury is judged as a failure of the road transport system, and must therefore be treated as an individual case.

In Sweden the parliament has decided that all fatal accidents in the road transport system shall be investigated in detail. From 1st January 1997 an organisation has been set up within the Swedish National Road Administration (SNRA). The main purposes of carrying out in-depth studies of fatal accidents are:

- To make the decision-making levels in society aware of the public health problem and the human tragedies that are hidden behind the brief accident statistics figures. The aim is to make these levels aware that they have a responsibility to act and possibilities to mitigate the problems.

- Since SNRA has a general responsibility for traffic safety and hence the co-ordination of the traffic safety work within the road transport sector, detailed insight into the system failures is necessary. Therefore a more accurate tool other than traditional accident statistics is needed to be able to monitor and control the traffic safety quality of the road transport system. In-depth studies shall be regarded as a tool for quality assurance in order to identify in detail where problems occur in the system and their nature from a system point of view. This will lead to increased knowledge about effective and sustainable countermeasures to solve the problems, learn from past experience and prevent the problems from reoccurring.

At the SNRA the in-depth study work is integrated in the organisation since it is important to effectively connect the results from the studies with efforts to carry out effective countermeasures that fall within the responsibility of the SNRA. People representing different disciplines gather important information about the vehicle, the road and the injury patterns. This work must be done in close co-operation with the police, rescue teams, forensic medicine etc. The information is then put together and an analysis is carried out to identify the chain of factors that lead to the fatal outcome of the accident. The next step in the analysis is to identify where the chain can be cut in the most effective way, not only for the actual case but for many other cases as well. After that it is possible to search for countermeasures that can cut the chain effectively and system designers that can contribute to these solutions. After the analysis is carried out each case is reported to the regional board of directors within the SNRA. There is a continuous work to develop homogeneous routines for collection of information and analysis and identification of the chain of factors and effective and sustainable countermeasures.

A model for classifying fatal accidents

Using the results from the in-depth studies a model was developed that is used to classify fatal accidents according to what caused the fatal outcome. This classification clearly reflects the system approach that follows that of Vision Zero. The accidents are divided into three groups as follows:

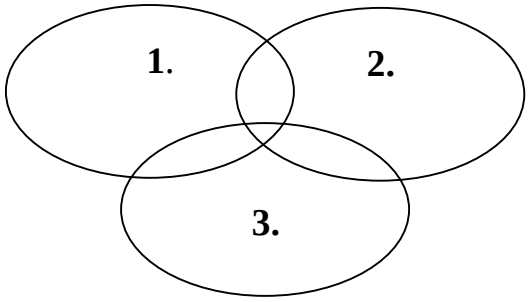
1. The fatality was generated because the accident occurred under conditions outside the criteria of the system. The road user has made a strategic and conscious decision not to obey the rules set out by the system designers and this violation highly influences the severity of the crash. An example might be excessive speeding leading to a crash severity beyond what can be handled by the combined passive safety of the road and the vehicle. In these cases countermeasures must be directed towards preventing those people access to the system or detecting their behaviour with for example technical systems in the vehicle, such as systems that prevent driving under the influence of alcohol. Police surveillance is also an important countermeasure in these cases.

2. The fatality was generated due to improper vehicle or restraint protection. The road use not protected in a proper way and that has played an important role for the injury outcome. Examples can be non-use of seat belts, motorcycle- and bike helmets or the use of a vehicle with low passive safety. In this group, countermeasures must be directed towards the increased use of restraints and other safety devices and the increased passive safety of cars. In the case of increased seat belt use, studies have shown that the most effective way to increase it is to introduce intelligent seat belt reminders in cars.

3. The fatality was generated due to an imbalance between the speed limit and the design of the road infrastructure (mainly its passive safety) in combination with the passive safety of the vehicle. In these cases people have done their best to protect themselves and perform according to the rules but the system has not been able to mitigate the consequences of a mistake or misjudgement. Examples might be poor design of the roadsides with trees, poles and other rigid obstacles, not separated oncoming traffic, the mix of unprotected road users and motor vehicles at speeds above 30 km/h. It is important to clarify that the in-depth studies cannot detect smaller violations of speed limits that are of great importance for traffic safety. In this group, countermeasures must be directed towards increasing the safety of the road infrastructure and the vehicles and especially the interface between these two elements of the system. The speed limits must also be set according to the safety of these elements.

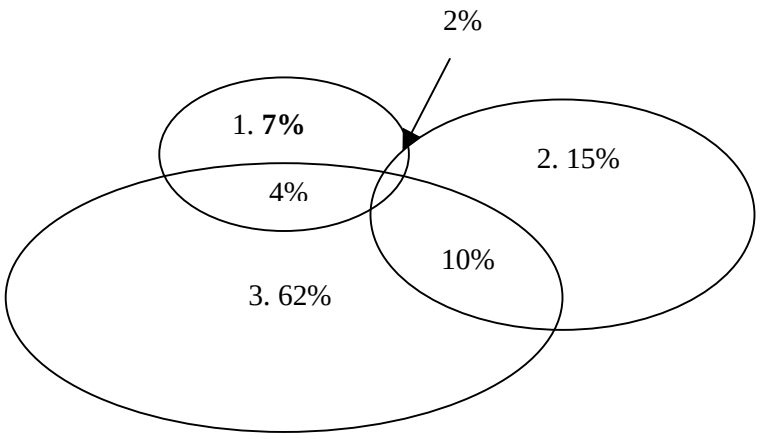
When analysing a fatal accident part of it can belong to more than one of the groups mentioned above (see Figure 1).

Figure 1.



All fatal accidents that occurred in the Swedish road transport system between 1998-1999 were classified according to the model above with the results showed in Figure 2.

Figure 2.

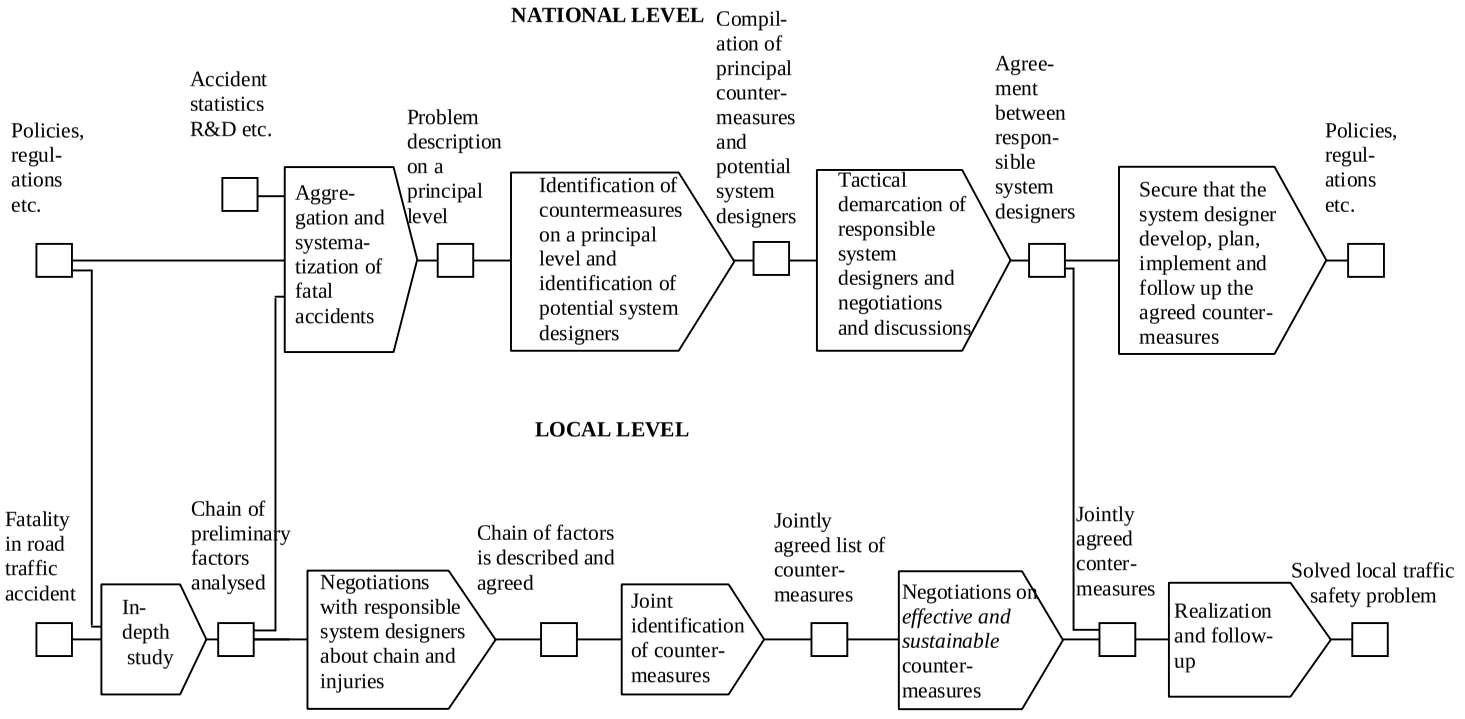


It is a common belief that the first group constitutes the majority of the traffic safety problem. The analysis of Swedish fatal accident does not support this belief. Of course the accident risk is higher among road users in this group but as a whole the majority of the problem falls within group 3. This clearly shows that focus must be put on designing a road transport system that is tolerant to human mistakes and misjudgements.

A new approach to use in-depth studies as a strategic tool in the traffic safety work

Up until today the results from the in-depth studies have mostly been utilised within the SNRA to increase the awareness of the traffic safety problem as a public health problem and that there is a human tragedy behind each figure of the accident statistics. It has also started to be used in the internal work with quality assurance and the development and assessment of countermeasures within in the SNRA´s area of responsibility. It is now of greatest importance to widen the area of application in accordance with the shared responsibility between the system designers that is described earlier. This has also been focused in a governmental inquiry that has proposed the establishment of a road traffic inspectorate to deal with these issues. The SNRA has started to implement a new method of working which means that the in-depth studies should constitute a focal point for the system designers to work towards. The system designers who are influenced by an individual case should, based on the information in the in-depth study, together carry out an analysis of the chain of factors that led to the fatal outcome in that case and where to cut that chain in the most effective way(s). They shall also together analyse the countermeasures needed to cut the chain and decide who is responsible for implementing these commonly decided countermeasures. In Figure 3 the process describing this new approach is briefly outlined.

Figure 3.


NATIONAL LEVEL
Policies, regul-ations etc.
Accident statistics R&D etc.
Aggre-gation and systema-tization of fatal accidents
Problem description on a principal level
Identification of countermeasures on a principal level and identification of potential system designers
Compil-ation of principal counter-measures and potential system designers
Tactical demarcation of responsible system designers and negotiations and discussions
Agree-ment between respon-sible system designers
Secure that the system designer develop, plan, implement and follow up the agreed counter-measures
Policies, regul-ations etc.
LOCAL LEVEL
Fatality in road traffic accident
In-depth study
Chain of preliminary factors analysed
Negotiations with responsible system designers about chain and injuries
Chain of factors is described and agreed
Joint identification of counter-measures
Jointly agreed list of counter-measures
Negotiations on *effective and sustainable* counter-measures
Jointly agreed conter-measures
Realization and follow-up
Solved local traffic safety problem

This process contrasts with earlier attitudes in such way that countermeasures are not decided and enforced by an independent body. The new working process relies on co-operation between the system designers where possible countermeasures are decided by negotiations. An advantage with such an approach is that the system designers will participate more actively in the work which will lead to a greater creativeness and commitment in identifying countermeasures and a greater acceptance for and willingness to implement them.

Conclusions

In-depth studies are a valuable tool for monitoring and controlling the traffic safety quality of the road transport system if they are carried out with a system approach. They are also an effective tool for identifying effective and sustainable traffic safety countermeasures especially from an injury mitigation point of view. To utilize this tool to its full potential, the responsibilty for identifying, developing and implementing those countermesures must be shared between the different system designers. This calls for a shift in the view of the responsibility for traffic safety from the individual road user to the system designers.

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Safe and Sustainability Audits:
When Planning and Maintaining the Infrastructure

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1. Audit as a process

Safety audit as a concept originated through accident investigators recognising that accident sites that needed remedial measures were arising, in some cases, soon after new roads had been built. As early as 1980, UK guidelines included accident prevention alongside accident investigation. Knowledge from situations where accidents had occurred was used to identify potential dangers in existing designs that could be avoided by different initial design choices.

The traditional audit focuses on designs for new roads or major improvements. It is carried out at several stages, starting with the design concept, and ending with an inspection of the completed roadway before it is opened. In this way it is hoped to ensure that safety is fully taken into account in concept, outline and detailed design.

Examples of what goes wrong in highway design, that might be improved through better audit procedures, are well documented (e.g. TMS Consultancy for AA, 1999; Proctor, Belcher and Cook, 2001; give good examples for the United Kingdom). Typical problems identified include:

- Lack of deflection or too many entry lanes at roundabouts.
- Actual speeds greater than design speeds.
- Unprotected signs or columns.
- Signs obscured or poorly sited.
- Lack of continuity in provision for cyclists.
- Poorly sited pedestrian crossing facilities.
- Embankments unprotected.
- Short gaps in safety fencing.
- Poor design of nosing protection at exits.

In most audit guidelines the auditor is encouraged to use various checklists, taking the role of different road users, to identify features of the road environment that might encourage mistakes by road users, or where inadequate protection is provided. The auditor looks at sites in considerable detail, travelling through them from different directions. A key aim is to identify aspects where users might be confused or misled by the layout.

Safety audit procedures have also been considered in several other (mainly northern) European countries and In Australia, New Zealand, and North America. Safety audit manuals for new road schemes were published by Transit New Zealand (1993) and subsequently, covering both Australian and New Zealand experience, by Austroads (1994). At about the same time the Institute of Transport Engineers (1994) in the United States reviewed the status of road safety audit, considering it a potentially beneficial process for North America but noting that the audit's legal status would need to

be clearly defined in relation to US practice. Elsewhere in Europe, Denmark was at the forefront of adopting the practice, the Danish Ministry of Transport issuing its manual in 1997. Ireland also published recommended audit procedures in 2000, and several other countries are considering doing so.

At the same time several countries (New Zealand, France, USA) have investigated the use of inspection procedures, with some features common to safety audit practice, for assessing the safety performance of existing roads.

Transfund New Zealand produced draft procedures for safety audit of existing roads in 1996, and this work has been extended to considering the development of a safety performance index for audit of existing roads. In this they attempted to allocate a risk rating to every safety problem identified by an audit, and to use this risk rating to compare the audit results for different roads.

Machu (1996) described the French approach to safety checking of road infrastructure, and several French regions have used this to assess where their major road networks fail to comply with the standards proposed. This system is seen as complementing existing remedial programmes, and focused on junctions, bends and roadside obstacles that might lead to high injury severity.

During the 1980s, work for US Federal Highway Administration (Zegeer *et al.*, 1987) developed a pictorial roadside rating scale for two-lane roads. Separate seven point scales were developed for urban and rural areas. Comparison with accident statistics showed that on the rural roads the scale was reliable enough to be used as a variable in models developed to depict single vehicle accident rates.

2. Life cycle safety

Although audit at the design stage is important, it is just as important to develop processes that carry audit through the life of a road. Roads are in service for many years, and the original assumptions about usage, made at the design stage, can change substantially over that period. In many road networks, both the traffic demand and the more general function that a road needs to serve have changed since the road was built. The usual response is to deal with this through accident remedial programmes, treating sites where accidents are seen to concentrate.

A far more effective approach would be to plan the change in function of roads, and to modify their design and management in line with that planned change, not wait for the consequences of the mismatch to emerge in accident costs. For this a life cycle safety model is needed which is able to predict the changes in safety as the role of the road changes, and identify when and how to intervene most effectively. The EU has recently invited research proposals on this topic.

A process is needed which audits existing roads on a regular basis to confirm that they are still satisfactory for the demands they are facing, or to modify them to cope with these new demands. Such audits need to be able to assess how changes in road environment and traffic demand lead to changes in road user behaviour that might compromise safety. The process needs to be closely linked with both general accident investigation programmes, for single sites, routes and whole networks, and to maintenance management procedures which themselves include regular monitoring of the condition of the highway.

3. Self explaining roads

Different basic designs build different levels of safety into a road. Roads with divided carriageways and grade separated junctions, with no access to pedestrians and cyclists, exclude many of the conflicts occurring on roads that are used for more mixed functions. Users of the former roads experience relatively uniform driving conditions throughout the route, sometimes to the extent that measures are needed to maintain their alertness.

Ideally, roads that serve more mixed functions should also be designed so that road users are able to confidently and correctly anticipate the conflicts that they will need to deal with. This requires two key design principles. First that all roads serving a common function should be as similar as possible, with any variations along the route clearly indicated by minor changes within the same basic design. Second, that the design differences between roads serving different purposes should be sufficiently large to make them clearly different from the variations used to indicate minor changes within a common road category.

This differentiation exists in most countries between motorways and other roads, but not between different functions that the other roads serve. Different management strategies, for example speed limits, for traffic travelling on roads of different function can be used to reinforce the design differences. But road users need to accept that the speed limit is appropriate to the road function; adjustment of speed limits alone is unlikely to produce the desired behaviour for the road function, particularly if the road design appears to support a different function.

4. European Road Assessment Programme

The British AA Foundation for Road Safety Research, on behalf of the Euro Test group of European motoring organisations, commissioned TRL to develop and pilot a process for assessing the relative safety performance of European roads. It is intended that this should be developed into a regular programme monitoring the safety quality of roads in different countries.

The objectives of such a programme are to:

- Establish a programme of systematic testing of risk that identifies major safety shortcomings that can be addressed by practical road improvement measures.

- Ensure assessment of risk lies at the heart of strategic decisions on route improvements, crash protection and standards of route management.

Underlying the programme are objectives to ensure greater awareness and understanding by road-users, authorities and policy-makers and engineers alike of where fatal and serious road accidents occur and the successful practical actions that can be taken to provide protection.

One part of this programme has been to develop a process which can be used to “audit” existing roads on a regular basis to assess whether the road design and management is still appropriate to the function that the road is serving. The process proposed is different from standard safety audit because it does not attempt to assess all the individual risk sites along a road section.

The first phase of the process attempts to assess the general road standard along a route, by driving through the road network. This is most relevant to defining clearly different and consistent

standards for different road functions. Subsequent assessments may extend the analysis to more detailed recording of variations along these routes, to identify sites of particularly high risk.

The following sections describe how this approach has been used in the European Road Assessment Programme (EuroRAP).

4.1 Accident avoidance and mitigation of injury

Most countries set casualty reduction targets in terms of the more serious injuries. Assessment of road standard should thus reflect the capability of the road design to mitigate injuries where errors are made by road users, as well those aspects which reduce the chances of accidents occurring. The EuroRAP standards are therefore based on the changes in road design most likely to influence accidents resulting in fatal and serious injury.

4.2 Accident types

Accident analysis shows that a relatively high proportion of fatal and serious injury accidents occur on major roads outside built-up areas. A substantial proportion of these accidents relate to four circumstances (OECD 1999) – head on impacts with vehicle travelling in the opposite direction, single vehicle run off road, junction accidents, and accidents involving pedestrians.

Analyses of data from several European countries show that these four accident types are common, but the distribution of accidents between the four types varies, reflecting the different traffic levels and network density in the different countries. The definitions of accident types are not totally consistent between the countries, but the general picture is clear.

Country	Percentage of fatalities by accident type			
	Head on collisions	Single vehicle run off the road	Junction	Pedestrian
Denmark	26	25	27	11
France	20	40	18	6
Hungary	31	23	8	22
Switzerland	16	51	21	6
Sweden	34	30	12	13
Britain	30	20	20	13

Source: (OECD 1999 plus data from SNRA and GB).

The majority of the head-on collisions appear to be due to vehicles crossing unintentionally onto the opposite carriageway. Only a small proportion is attributable to overtaking manoeuvres.

Accidents in Great Britain in 1999 have been analysed in more detail and show that these four factors account for a high proportion of fatalities for each type of main interurban road, and also for both fatal and serious accidents. About 60% of all fatal accidents on motorways fall in these four groups, but the proportion rises to 79% on single carriageways and 89% on dual carriageways. The distribution of fatalities between the road types varies substantially, with head on collisions accounting

for over 40% of fatalities on single carriageway roads compared with 6-7% on divided roads, whereas single vehicle accidents account for 33% on motorways dropping to 17% on single carriageway roads. Fatalities at intersections account for 20-26% of fatalities on dual and single carriageways but only 8% on motorways. The highest proportion of fatal pedestrian accidents, compared with other types, occurs on dual carriageways.

The proportions for accidents involving killed and seriously injured casualties are broadly similar to those for fatal accidents, but with higher proportions of single vehicle and accidents at junctions, and a lower proportion involving pedestrians and head on collisions.

A large proportion of the junction accidents on A roads in Britain occur at minor junctions and private accesses; those on motorways are associated with slip roads and at-grade intersections. Accidents involving "pedestrians" on motorways are mainly associated with car occupants who have got out of vehicles that have stopped on the motorway hard shoulder.

Machu (1996), based on his experimental audit of roads in France, quotes 15% of fatalities associated with junctions, 30% with bends, and 20% resulting from impact with aggressive roadside obstacles. Wallen (1993), arguing for more effective roadside treatment, quotes data for USA showing 45% of all deaths occur on curves, 34% involve crashes on hills and 65% of all roadside deaths occur on rural roads.

ETSC (1998) in the briefing note on Forgiving Roadsides state:

- In Finland, collisions with "street furniture" accounted for 24% of all fatal accidents, the most frequently struck objects being trees.

- In France, collisions with street furniture accounted for 31% of all fatal accidents, with 56% of these being collisions with trees. Just over half of the accidents occurred on bends.

- In Germany, accidents involving "street furniture" contributed to 42% of deaths and 28% of seriously injured casualties. Two thirds of fatal casualties and 60% of serious casualties take place on rural roads with 71% and 55% of these respectively involving trees.

- In Sweden, 25% of car occupants killed collide with a fixed object, half of these being trees, 20% with barriers and 20% with poles or posts.

Armour (1989) showed that out of 155 crashes studied in Victoria, Australia, 110 involved either a tree, bridge or culvert.

In Britain (Department for Transport. Local Government and the Regions, 2001), 29% of fatal accidents involving single vehicles in the year 2000 resulted from collision with a tree, and another 24% with poles, posts or other permanent objects.

4.3 Road design elements relevant to safety

The road design elements that have been selected for attention in the EuroRAP project, address these accident situations. The following seven items are included:

- Median protection.
- Roadside protection.

- Treatment of space at edge of carriageway.
- Design of major intersections.
- Frequency of minor accesses.
- Frequency of bends and hills.
- Facilities for pedestrians and cyclists.

There is plenty of research evidence to support the choice of these items, notably from the OECD report on Rural Safety Strategies, ETSC briefing on Forgiving Roadsides, studies in the UK on accident risk on motorways, dual carriageways, and main rural single carriageway roads, and work in USA by Zegeer and others. Recommendations from the EU funded SAFESTAR project also highlight these features.

4.4 Road cross-sections and roadside protection

The most obvious way of ensuring protection of vehicles deviating from the highway is to provide safety barriers, on both near-side and off-side, along the whole length of the road. However this is expensive and at some sites does not necessarily provide much added benefit to the vehicle occupant. Studies by Elvik (1995, 1997) suggest that the addition of near-side barriers at sites previously unprotected generally reduce all injury accidents, but median barriers can at some sites increase total accident frequency despite reducing the most serious accidents. Most countries have design rules that require barriers at particularly aggressive sites – bridges, culverts, steep embankments. Barriers are also recommended when hard objects (poles) are placed near to the roadside, but the definition of such sites, the length over which the barrier should be installed, and the relevance of distance of the obstacle from the roadside are often not well established in design standards.

These items are closely linked with width of running lanes, and width of the clear zones at the edge of the roadway. Zegeer *et al.* (1994) related crash frequency on two lane highways to lane width, shoulder width and road side condition. They concluded that the greatest effect on accident risk could be achieved by widening shoulders on narrow roads. On low traffic roads, cross sections with total width (lanes plus shoulders) of 8.6 to 9.2m were associated with lower crash rates than narrower roads. There was less evidence of the importance of lane plus shoulder width on multilane roads. Frequency of crashes has also been related (Zegeer *et al.* 1992) to vertical and horizontal alignment.

Zegeer *et al.* (1998) suggested current "good" standards (lane width 3.4m, shoulder width >1.2m, with 2 or 4 lanes) for InterState highways might be improved to lane width 3.7m, shoulder width 2.4m, all shoulders paved, with roadway divided by a median strip.

Schoon (1994), based on a mixture of research results and good practice, suggests "obstacle-free zones" of at least 5m for rural non-motorway divided roads and rural undivided roads with a design speed of 100 km/h, and 3.5 m for undivided primary rural roads with a design speed of 80 km/h.

SAFESTAR recommendations include:

- Motorways should incorporate an obstacle free zone of 9m wide on each side of the carriageway.

- The median strip for motorways and express roads should have a width of at least 20m, except where an appropriate safety barrier is used.

- Frequency of entry and exit points for Express roads should be restricted.

- Lane width on both single and dual carriageways should be 3.5m.

- The cross section of the carriageway should include a continuation of the paved area beyond the edge of the traffic lanes.

- Shoulders on each side of traffic lanes should have a width of 1.3 to 1.5m, with a total carriageway width of 10m.

- Obstacle free zones should extend for at least 3m on each side of the carriageway.

- Situations in which a vehicle leaves the road should be prevented or ameliorated by the use of hard shoulders, safety barriers or high friction surfacing.

- Head on collisions should be reduced by the use of ghost islands and hard shoulders.

Studies by Walmsley and Summersgill (1998) of British motorways and main interurban roads show divided roads have accident rates 40% lower than undivided roads, roads with hard edge strips (1m wide) have accident rates 20% lower than those without, and wider roads (10m) have accident rates 25% lower than standard width roads (7.3m). Roads with twice the variation in horizontal alignment have 10% more accidents overall, but up to 60% more accidents involving vehicles leaving the carriageway. Twice the variation in vertical alignment results in 14% more accidents. Hughes and Amis (1996) show that, on British rural single carriageway roads, a 1m increase in carriageway width is associated with a 19% decrease in accidents, and that accident frequencies reduce as the proportion of double centre line marking (including central hatching) increases.

Beneficial experience has been reported (OECD 1999) from the use of 3 lane roads with middle lane road alternatively assigned (2 + 1). In Germany the accident rate per vehicle km on 2+1 roads, with total width of 14m, has been found to be two thirds of that on two lane roads of similar width. However studies in Finland have suggested overtaking lanes have a much smaller effect on injury accident reduction.

Recently several Scandinavian countries have experimented with installing safety barriers on narrow medians on three lane roads, with two and one lanes alternating on either side of the barrier. Dutch engineers are currently experimenting with much more marked physical delineation of a central strip in two lane roads, without actually dividing the roadway.

4.5 Intersections

For major junctions where the main road does not have priority, safety can be improved by reducing the number of conflicts and ensuring that they occur at relatively low speeds. Grade separated junctions are the safest type of intersection because the potential severity of any impact is minimised as flows merge. If at-grade crossings are used, accident severity is reduced if the speed of all traffic is reduced in the conflict area. In this context, roundabouts result in lower speed conflicts than traffic signals providing the former have sufficient deflection to slow traffic on the approach arms.

OECD (1999) quotes recent Danish and Dutch experience where accident risk has been reduced by the introduction of roundabouts. It also cites Norwegian evidence (Elvik, 1997) of the value of

channelling traffic for turning movements at four-way intersections. Hughes and Amis (1996) reported that turning lanes at junctions on British single carriageways were associated with decreasing numbers of shunt accidents but an increased number of vehicles entering the main carriageway being struck from the offside. Accident frequencies at side road junctions were influenced by traffic flows on the major and minor roads, but were reduced where carriageway widths were increased locally to the junction. US research also confirms that the presence of turning lanes at junctions reduces frequency of accidents.

On British single carriageway roads, a high proportion of accidents are associated with minor junctions and private accesses. Taylor *et al.* (2001) used data from two lane rural roads in Britain to assess speed accident relationships. Cluster analysis established four distinct road groups based on accident rate, mean speed, minor junction density, bend density, access road density and gradients of hills. Within these groups, two other factors – density of sharp bends, and density of minor cross roads, were found to influence total accident frequency.

4.6 Provision for vulnerable road users

Pedestrian and cyclist flows on main rural roads vary considerably between countries and between different parts of the road network. Where there is any substantial level of flow of either, there is a need to consider provision of special facilities - both alongside and crossing the roadway. In many countries the potential need for facilities is limited to a relatively small number of specific sites. Alternatively in countries such as Netherlands, provision of separate facilities for cyclists both alongside roads and at junctions is common.

Where substantial numbers of pedestrians are present, there is a strong argument for reducing speed limits to those compatible with urban areas. However in countries such as Britain, where the density of roadside development often does not allow simple separation between rural and urban areas, the selection of appropriate limits is less obvious. Standard safety audits often cite lack of provision for pedestrians and cyclists, on roads with relatively high speed limits, as a shortcoming in design. While it is sometimes not clear that accident savings would result from introducing such facilities, audits can often provide clues that pedestrians are still trying to make use of the road despite the lack of facilities.

To assess the relevance of this in relation to the other design features, in a more general road inspection, some evidence needs to be sought of the potential cyclist and pedestrian flows that are involved.

4.7 Road protection score

The European Road Assessment programme is developing a system of rating roads, with a road protection score based on information obtained from inspection drives through a sample of roads in different European countries. The scores are based on the elements listed in section 4.3 above. Such a system could provide the basis for a regular monitoring of the potential safety performance of roads within national and regional networks.

The effectiveness of different infrastructure designs, and particularly the protective systems, in providing a safe environment is strongly related to the speeds of traffic on those roads. The aim should be to operate the road at a speed consistent with its safety standard. Where this is not occurring, the

road would be given a worse score, to reflect the inconsistency between the road standard and the traffic speeds. To do this, the drive through needs to record an estimate of "free flow" traffic speeds.

5. Conclusions

1. Audit at the design stage of a road is not sufficient to maintain good safety performance from the road throughout its life.

2. It is necessary to develop a system of "auditing" throughout the life of the road in relation to the function it is required to perform.

3. To do this effectively it is important to plan ahead for changes in function and use, using a life cycle safety model to assess when best to intervene.

4. This approach is consistent with the "self explaining roads" philosophy that seeks to define clear standards and consistency within standards.

5. Inspection of existing roads should focus on four key accident types.

6. Road inspection should focus on design elements which mitigate the effect of road user errors as well as those designed to prevent accidents.

7. The European Road Assessment Programme is developing a Road Protection Score (RPS) using a common methodology for several European countries.

8. This Road Protection Score should be linked to traffic speed.

9. After the initial development of an RPS for main rural roads, EuroRAP needs to be extended to encompass a wide variety of road types.

10. In all countries, existing road networks should be re-assessed:

- To define road hierarchy and functions, now and in future.
- To modify road design and/or the management of traffic.
- To move towards a design which is optimum for the current function of the road.

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Public Transport Requirements: Public Transport in General

Contribution by Zdenek DOSEK
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Transport policy principles of the city of Prague and the role of public transport

Like virtually all cities in the formerly socialist countries of Central and Eastern Europe, Prague - as the capital of the Czech Republic - has seen a steep increase in car ownership and use in the last decade. Congestion, noise levels, air pollution, traffic accidents and the sheer number of parked cars have posed serious problems since as early as 1991.

According to statistics produced by the Prague Transport Engineering Institute, car ownership and use have grown dramatically since 1991; to levels unparalleled elsewhere in Europe, except for cities in the former East Germany. Car ownership figures for 1990 - 1999 are as follows:

- 1990: 336 000 private cars
- 1999: 621 000 private cars
- index 99/90 + 85%

By the end of 2000, the car ownership level in Prague was 1 car per 1.9 inhabitants. Prague has outpaced even the most motorised large cities in Western Europe where the current level is 1 private car per 2.1 – 2.3 inhabitants.

Motor vehicle use in Prague on an average working day (vehicle-km over the entire road network) amounted to:

- in 1990 7.293 million vehicle-km/day
- in 2000 16.6 million vehicle-km/day
- index 99/90 +119%

Generally, daily motor vehicle use increased by 8 686 million vehicle-km/day over the past 10 years (1990 - 1999). In other words, during this period car traffic in Prague grew more than in the previous 100 years of motor vehicle use from the end of the 19th century to 1990!

The steep increase in private car use in Prague in the 1990s was influenced by a number of factors. In the opinion of the Transport Engineering Institute, the most decisive factors were the following:

- Higher number of intra-city trips as a result of the increase in business activities and changes in life style.

- Higher number of local and foreign cars arriving daily in Prague as a political, economic and cultural centre.

– A significant shift from public transport to the private car for intra-city trips. Based on statistics produced by the Prague Public Transit Co. Inc., (PPT) over the period 1990 - 1999 the number of passengers using public transport (PT) in Prague decreased by more than 0.8 million a day, as illustrated by the following comparison of the number of passengers using public transport on an average working day, 0-24:

  - in 1990: 4.186 million passengers/day
  - in 1997: 3.393 million passengers/day
  - in 1998: 3.349 million passengers/day
  - in 1999: 3.343 million passengers/day

This amounts to a decline of 0.843 million passengers/day, or 20 per cent decrease in 1999 compared with 1990.

The current modal split of motorised transport is 58 per cent public transport (PT): 42 per cent private car transport (PCT).

Shifts in transport policy

The above changes are closely related to the change of political and economic system after 1989, which brought shifts in transport policy accompanied by changes in financing policy. As a result of ample subsidies from the central government, public transport services had been ubiquitous and very cheap until 1989. The central government funded all capital investment and operating subsidies. After 1989 most of this burden was transferred to the local municipal authorities. In spite of substantial fare increases, the level of operating costs covered by fare revenues has remained relatively low.

With regard to capital subsidies, the situation is more complicated and has changed over the period. Since 1994 a state financial aid programme has provided support subsidies for rolling stock renewal and urban transport construction. The state funds 30 per cent of the purchase price for capital investment in environmentally-friendly transport modes, i.e. electric-powered transport (trams, trolleybuses). Bus transport is less environmentally friendly is not subsidised to the same extent; state funding is only 20 per cent. This programme is contingent upon the co-participation of individual cities. Initially, the programme provided funding of CZK 1 billion but over the years funding was gradually cut to CZK 550 million in 1999 (of which CZK 40 million is intended for infrastructure only). In 2000, funding was further cut to approximately CZK 315 million (of which CZK 15 million is for infrastructure construction) and only CZK 150 million for 2001.

The above-mentioned programme is not applicable to the funding of infrastructure construction with a completion period of over one year since the financial resources are allocated for a calendar year only.

Prague metro clearly illustrates the trends in public transport funding policy. Since the metro opened in 1974, the state has provided abundant subsidies for extensions. However, state aid has been cut drastically in recent years: whereas in 1996 the subsidy amounted to CZK 1 billion, in 1997 it was slightly more than a half of this amount, i.e. CZK 570 million, and in 1998 the subsidy was suspended. It was partially renewed in 2000 with a state subsidy of CZK 370 million for a total capital construction cost of CZK 1 363 billion. With the extension of metro line C to the North of the City which started in autumn 2000, the state subsidy for 2001 will be close to CZK 1 billion (912.5 million) provided that the bulk of the funding is covered by a loan of CZK 1 191 billion from the European Investment Bank.

Improving the public transport system in Prague

Obviously, it has become more difficult for public transport in Prague to compete with private cars. With car ownership levels now twice as high and multiple fare increases, public transport has to offer better quality services.

Prague Public Transit Co. Inc. has been striving to improve these services in close co-operation with the City of Prague, its only shareholder, and other Prague institutions. Given the city's historical hilly and architecturally diverse character, such an effort will be successful only through the gradual implementation of a clearly defined, sophisticated transport policy.

The city of Prague outlined such a policy at the beginning of the second half of the 1990's in a brochure called "Transport Policy Principles of the City".

Eight of the nine key principles outlined in the city transport policy are closely related to the operation and development of the Prague public transport system. The implementation of these principles and the process of improving public transport are also a key tool in marketing the system. The concepts, development plans and data on the current status of the system outlined below are intended as a brief update on the implementation of urban transport policy and current trends.

A brief summary of the key principles of Prague's transport policy and their implementation:

Principle 1: The operation and development of transport infrastructure in Prague and the surrounding area are to be managed and planned as an integral whole

In 1999 a new area development plan for the city of Prague was completed. The "Urban Concept" section of the plan includes the following principles:

- Functional and qualitative redevelopment of the existing built-up area in addition to urban development of new land.

- In the peripheral zone, development has focused particularly on traditional urbanisation lines with **the emphasis on areas served by suburban rail transport.**

- In choosing particular areas, priority was given to those that **are easily accessible particularly by PT.**

Principle 2: To integrate transport system development and residential area development

- To aim at decreasing transport demand in the city through urban planning.

- To aim at serving densely populated areas and areas offering abundant job opportunities by rail transport.

The "Strategic Plan for the City of Prague" includes strategic priorities for 1999 - 2006. One of these priorities is the transition to a polycentric structure aimed at:

- A fundamental transformation of the existing monocentric city structure to a polycentric structure consisting of a city-wide centre with peripheral centres in the inner and outer city.

– A more balanced arrangement of residential areas and workplaces within the city that positively affects transport and technical infrastructure will result in the implementation of the plan designed to reduce pressure on the city-wide centre.

Results

– Prague has managed to link the majority of large residential estates to a reliable metro system, which is also capable of absorbing development.

– New district centres have emerged in areas located close to main metro stations (Smíchov, Karlín, Maniny, Pankrác, Bubny - Holešovice, Nové Butovice). New metro extensions are always planned with existing and future growth areas of the city in mind.

– Prague has succeeded in developing large "shopping parks" with connections to the metro system by locating them at metro terminuses (Zličín, Černý Most).

Principle 3: To design, develop and manage transport as an integrated system requiring intelligent co-operation from all transport modes

The development of the Prague integrated transport (PIT) system began in 1993 with the establishment of the Regional Prague Integrated Transport Agency (ROPID).

The current characteristics of the PIT system are as follows:

– Trunk roads and metro network

  The total length of the road network is 3 400 km, of which 10 km are motorways and 71 km other high-speed roads. Metro network length - 50 km, 50 stations.

– Metro, tram and railway network:

  - 50 km of metro network, 3 lines. Number of metro cars during peaks - 350;
  - 136.4 km of tram network, 24 day routes, 8 night routes. Number of tram cars during peaks - 672;
  - a bus network supplementary to the metro and tram networks: length – 797.5 km, 153 suburban day lines, 11 night lines. Number of buses during peaks - 962;
  - suburban rail transport is operated by the Czech Railways on all 10 railway tracks terminating in Prague.

– Fare zones and outline of regional routes of PIT:

  The Prague transport region includes Prague itself and parts of the Central Bohemian region. There are five fare zones extending up to 50 km outside the city centre boundaries. There are 93 regional bus lines, 22 of which are operated by Prague Public Transit Co. Inc. and 71 by private bus transport operators. Czech Railways operate on 10 railway tracks running an average of 396 train connections on working days (passenger and fast trains), which are covered by the PIT fare scheme.

– Park and Ride (P+R) facilities linking to metro and trams:

  From July 1, 1998 to date 11 P+R facilities have been put in service in Prague with a total capacity of 1 292 parking spaces.

Principle 4: To create conditions for city centre services that will satisfy a substantial share of passenger transport demand by public transport. To take measures to effectively regulate private car use in the city centre

In 1971 traffic in the historic centre of the city reached maximum levels. As early as 1972, systematic measures to restrict traffic were gradually implemented.

The most important traffic restrictions implemented in the historic centre in the 1970s and the 1980s were the following:

– Introduction of a wider inner-city zone with no entry for trucks in excess of 6 tonnes gross laden weight.

– Elimination of transit traffic from the road network along the entire right bank of Prague 1 and transfer of such traffic to peripheral roads.

– Introduction of restricted parking zones along the entire right bank of Prague 1 (the old town and part of the new town) (in 1974 – 1979). The main effect of this measure was to eliminate long-term on-street legal parking and thus substantially reduce car use for trips to the city centre, particularly for trips to work.

– Development of structurally modified pedestrian zones.

An important step in resolving traffic problems was taken in November 1985. The extension of Metro line B from Florenc to Smíchovské nádraží completed a triangle of three basic metro lines. At the same time, a new transport regime was introduced on the inner-city road network with the aim of stabilising transport conditions for a longer period.

The restrictions on the right bank of Prague 1 –zones A, B and C – achieved a 59% reduction in car traffic levels by 1986 compared with the maximum level in 1971, i.e. a return to 1959 levels.

From 1986 to 1990 car traffic in restricted zones A, B, C remained more or less level in spite of a steady increase (a further 25%) in the rest of the city centre.

Until the end of the 1980s, Prague managed to maintain car traffic in the city centre under control.

Trends after 1990

Increased business and commercial activities, the diversification of transport supply, increased tourism and a shift of some passengers from PT to private cars resulted in an increase in the pressure of car traffic on the city centre, particularly the historic centre of Prague.

Since 1990, the rate of increase in car traffic within the paid parking zone (+61%) was substantially higher than the rate of increase in the wider city centre (+44% inside the central cordon). This has resulted in a growing number of violations of road traffic regulations, particularly with respect to parking.

Traffic trends in the centre of Prague after 1990 show a deteriorating situation that the city will have to address if it is to prevent the total negation of the improvements achieved in the 1980s.

Principle 5: Improving transport system safety and quality as well as transport capacity

In the period between the 1960s and the 1980s, long-term accident rate trends were relatively positive, with the number of traffic accidents roughly mirroring the increase in transport supply. From 1990, the trend began to show the rate of traffic accidents rising more rapidly than the supply of transport services. Over the period 1991 – 1999 the total number of accidents increased by 145% while the supply of transport services grew only by 119%. One of the key factors in this negative trend was the decline in discipline of both drivers and pedestrians coupled with more ruthless behaviour.

On the other hand, the curve for trends in traffic accidents involving public transport modes grew far more moderately until 1996. In subsequent years, however this curve shows a significantly increasing trend, including accidents caused by tram and bus drivers (see the chart comparing the accident rate for Prague and Prague Public Transit Co. Inc.). The decline in the accident rate on the PT system in the second half of the 1990s is a result of the attention paid to drivers' training, including psychological training. This important programme was implemented on a scale appropriate for a crew of 1 100 drivers in the Tram Unit and 2 216 in the Bus Unit.

PPT Co. Inc. is participating in the PRISMATICA project (**Pr**oactive **I**ntegrated **S**ystems for Security **Ma**nagement by **T**echnological, **I**nstitutional and **C**ommunication **A**ssistance) in Key Action "Sustainable Mobility and Intermodality", Action Line 2.2.4/1; "Security in local and regional public transport". Within the framework of this project Prague Public Transit Co. Inc. is responsible for Task 3.5 "Legislative Issues", the aims of which are to clearly define the competencies of national police and metro employees under oath and to advertise penalties and enforce accompanying measures for assault victims.

Quality of transport

PPT's service quality programme falls within the framework of initiatives to develop the Citizens' Network, which acknowledges the need to improve the quality and accessibility of public transport services.

Four service quality standards have been measured from the beginning of 1998:

- Punctuality.
- Passenger information.
- Welcome (Customer Care).
- Uniform discipline.

In the spring of 2000 PPT added a fifth standard – Functioning of automatic vending machines.

The process so far has confirmed that the programme is an effective tool for a more customer-oriented corporate culture. Work on service as it is defined from the client's viewpoint, the measurement of results and the implementation of action plans to achieve set objectives will have a number of managerial implications.

Principle 6: To give priority to the operation and development of environmentally-friendly transport systems

The implementation of measures to support PT priority in traffic control in Prague was approved by the resolution of the Board of Representatives of Prague Municipal Council No. 747, dated June 25, 1996, on the "Public Transport Priority Programme in Prague". The implementation of these priority measures significantly contributes to improving the flow and regularity of public transport.

Priority traffic lights at crossroads have had a positive impact on tram operation. As of 31 December 2000, traffic lights at 59 crossroads were programmed to give priority to trams: absolute tram priority at 26 crossroads and conditional tram priority at 33 other crossroads. There are a total of 189 traffic lights in the entire tram network.

Concrete humps separating car lanes from the tram lane to prevent private cars from driving on the rails were installed on various segments and locations on the tram network, where the tram rails are at the same level as car lanes. Since 1998, humps have been installed on 14 segments over a total length of 2 800 m. The smoother flow of tram traffic has resulted in significant time savings as well as savings in electric power.

The introduction of bus lanes reserved for PIT system buses in 1998 has proved very effective in speeding up the flow of buses, particularly on very busy roads. To date, 17 individual segments of special bus lanes have been introduced over a total length of 6.9 km.

Future development of rail transport:

- Metro. Line C1 Nádraží Holešovice to Ládví

  Priority has been given to extending the Prague metro network, providing a solution to the supply of transport services to a densely populated area of housing estates in the north of the City. This will ensure a crucial improvement of radial links to the centre for approximately 90 000 residents of the area (improvement in time savings, safety and comfort for passengers) as well as related bus fleet savings. The operational segment has two stations (Kobylisy station and Ládví station) with a tunnel crossing under the Vltava river. The length of the extension is about 3.9 km.

  Investment costs – CZK 7.5bn; construction started in September 2000. Estimated opening: 2004, completion: 2005.

- Metro. Line C2 Ládví to Letňany

  The aim of the further extension of metro line C is to improve the supply of transport services to existing housing estates (Prosek, Letňany, etc.). The extension will provide a transport connection for the Letňany area, where extensive urban development projects are to be implemented (Prague Exhibition Grounds, Shopping Park, a high-capacity public transport interchange, including P+R). This operational segment has three stations (Prosek I, Prosek II, Letňany) and will be about 4.9 km long.

Investment costs amount to CZK 7.9bn. Development is planned for 2004-2006.

– Tram line Hlubočepy to Barrandov

This decisive investment in public surface transport provides a solution to the supply of transport services to the densely populated Barrandov housing estate (a catchment area of approximately 24 000 inhabitants). The housing estate is currently served by buses that use a single overloaded access road with a steep gradient. The route will be laid with segregated track, using two flyovers (304 m and 477 m long) to climb the Barrandov terrace.

The track will be 3.6 km long with costs amounting to approximately CZK 2.4bn. Following the initial preparatory works, the main implementation stage is to be started in 2001. Estimated opening: end of 2003, with completion in 2004.

Principle 7: To ensure safe pedestrian transport and provide a transport system suitable for people with mobility and visual impairments

PPT Co. Inc. consistently aims at making its services available to all groups of inhabitants and improving the accessibility of its PT system to persons with impaired mobility. PPT Co. Inc. continues in its effort to implement measures to provide Metro stations with barrier-free access. Twenty-two of a total of 50 stations were provided with barrier-free access (passenger lifts, freight lifts with an attendant, pavement level access ramps). The availability of passenger lifts at all stations is an integral part of new Metro line projects (IV.C1, IV.C2 and the completion of the IV.B segment).

On the metro, acoustic orientation beacons have been installed in as many as 40 metro stations to help the blind find their way. The gradual installation of receivers for the blind onboard surface transport vehicles is another important measure. This equipment, installed so far in all tram cars and in over 90% buses, enables remote-controlled activation of an external announcement which gives waiting passengers the route number and destination of the approaching vehicle and alerts drivers to the fact that a blind person wishes to board. All of the above equipment can be operated by a single universal command transmitter which is, at the moment, available to about 2 000 blind citizens in our country.

PPT's fleet is equipped with vehicles that enable barrier-free loading/unloading. At the end of 2000, the bus fleet included as many as 175 low-floor vehicles and another 50 low-floor buses are to be bought in 2001. These buses now operate on selected links of 27 routes on working days. Links served by low-floor vehicles are designated in timetables at stops for easier identification.

Principle 8: To provide as much information as possible

Accurate and current information about routes, timetables, fares and other services provided by Prague Integrated Transport is in great demand. Such quality information also helps enhance the image of PPT Co. Inc. in the eyes of the public.

Information leaflets are published for all events, permanent or temporary. Standard types of information material are produced for passengers: e.g. maps of the Prague PT network listing names of surface transport stops and a Guide to Prague Public Transport in three languages. Other materials include brochures promoting nostalgic tours by tram, the Public Transport Museum or the chairlift in the Prague Zoo.

Five information centres at metro stations provide further accurate and comprehensive information for passengers. The sixth PPT information centre is to be opened at the international Praha-Ruzyně airport by mid-2001. Information materials in lit display cases at metro stations are also an important passenger information tool. There is a total of 236 stands, mostly with two display cases (information boards).

In the daily METRO, distributed free of charge at metro stations, PPT has one page reserved for passenger information, entitled "PPT for You".

In July 1997, PPT launched its official web sites successfully on the Internet in three languages.

As a member of Subgroup 4 of the EU pilot project, "Benchmarking Local Passenger Transport Systems", the topic that Prague focused on was "How to improve integrated information in public transport". This European exchange of experience encouraged Prague to establish a "Mobility Centre", a multimodal information centre, preparation of which is already under way within the framework of the European MOST project.

Figure 1. **Traffic volumes on the central and outer cordon 1961 - 2000**
An average workday, both directions of traffic, 6-22 h

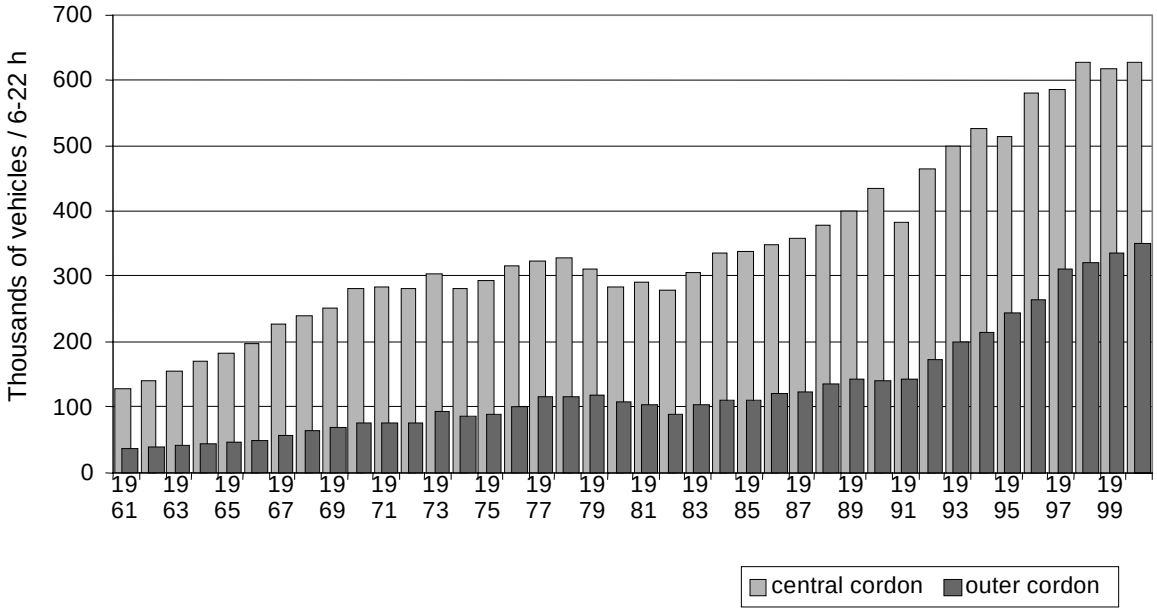
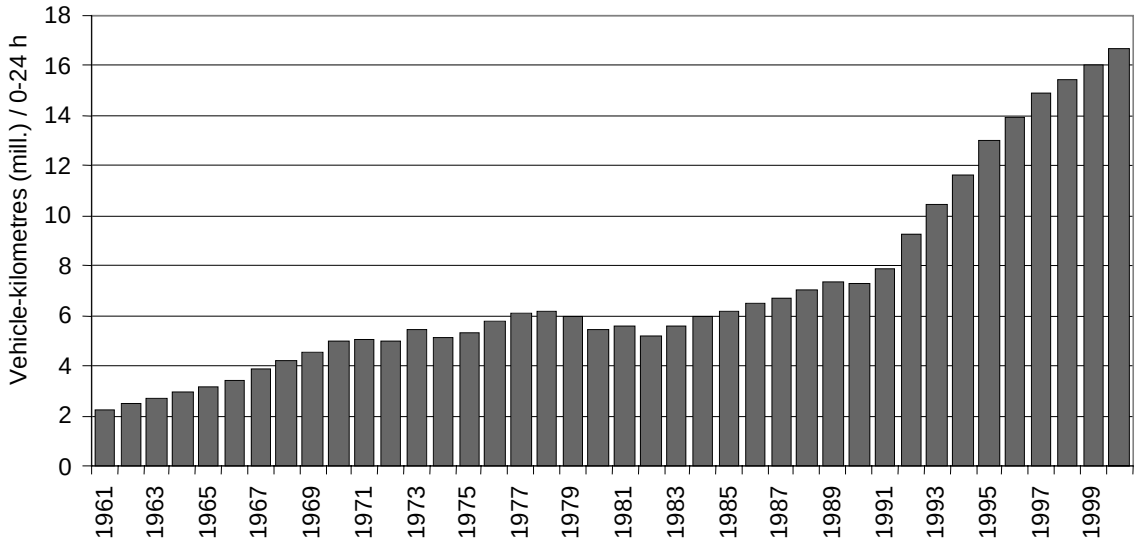


Figure 2. Motor-car traffic vehicle-kilometres development 1961 - 2000
The whole of the road network, an average workday, 0 - 24 h



Public transport requirements: School transport

Contribution by Jean-Louis FLAHAUT
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Paris - France

By way of introduction to the specific subject of youth transportation following the presentation on public transport in general, I should like to say a few words about the reality of school transport. Although what I shall be saying concerns only the European Union, I think some points will be made that are of general relevance. I shall be referring to a study conducted in 1998 by ANATEEP (*Association Nationale pour les Transports Educatifs de l'Enseignement Public*) for the European Commission (DGVII).

School transport situation in the EU

The concept of youth transportation is not homogeneous throughout Europe. School transport provision depends mainly on education policy (location of schools, enrolment ratios and duration of schooling, diversification of education options and pathways) and the rural space of the country concerned.

Youth transportation in the European Union is organised by local or more centralised agencies depending, of course, on the institutional history of each country.

In the EU an estimated ten million children use group transportation facilities (excluding urban transport) to go to school. In most countries, the number of children using these facilities represents between 10% and 30% of the school population.

Three types of country have been identified, in terms of the transport system prevalent in each: urban transport (tram, bus, underground railway), regular transport (bus, minibus), specific transport (coach, bus, minibus).

This differentiation, which necessarily is somewhat oversimplified, gives one an indication of the difficulty of developing an overall approach to school transport safety in Europe.

On the other hand, it is possible to think in terms of a European model for school transport based on multi-usage of vehicles, in contrast with the North American model comprising two mutually exclusive transport systems – mass transit and pupil transportation – with two very different types of facilities: traditional vehicles and school buses.

In conclusion, it can be said that the organisation of European school transport necessitates a harmonised approach.

SCHOOL TRANSPORT SAFETY

After this brief stock take, may I say how pleased I am to be able to speak to you, as a representative of AIST, on the subject of school transport requirements.

We consider the theme of this seminar to be eminently satisfactory for two key reasons:

1. Safety is being dealt with as a major component of transport policy. We well know that this is not always the case. Regrettably, the approach sometimes focuses too much on adaptability and efficiency of infrastructures or the relevance and cost-effectiveness of transport systems.

   Yet the safety of persons has become a crucial issue in our societies. Here I would refer you to the principle of precaution now being developed (epizootic…) in numerous countries. The general evolution of knowledge is such that everyone is now supposed to be aware of the implications of road risk. Road and rail disasters, often with excessive media coverage, are analysed down to the smallest detail and explained scientifically by experts.

   In this context the parents of schoolchildren tend to take a negative view of public transport, which they often wrongly regard as a dangerous mode of travel. It has to be acknowledged, of course, that the death of a child is particularly shocking and perceived as unacceptable when it occurs as the result of a public transport accident.

   However, statistical limitations notwithstanding, it can be said that school transport is safe overall.

   This brings me to the second reason for our satisfaction. We think that 'zero vision' in school transport is within reach.

2. Since its inception in 1994 AIST has been developing the idea of a logistical formula for school transport safety.

   The formula can be expressed as **zero anomaly, zero delay, zero lag, zero dead**. Safety is not only a moral imperative for those in charge of school transport, it is also a public service requirement. It is necessary to optimise the organisation and operation of school transport services so as to pass 'from the unforeseen to the unforeseeable' where harm to life and limb is concerned.

   This approach developed by AIST (and by ANATEEP in France) is in every way consistent with the thinking of our Swedish friends.

   I shall now describe, in very brief outline, the characteristics of this formula for safety. It naturally contains elements that have been mentioned earlier or will be later, maximum safety requiring a combination of procedures and not just a single action.

   Zero anomaly: This implies **good equipment** (up-to-date coach or bus with the most efficient safety devices and regular checking of the vehicle). It also implies a **qualified driver** (safety-aware and safety-trained →□ AIST has submitted to the European Commission an innovative programme named **SECOBUS** for the training of school bus drivers) and

scrupulous compliance with a transport contract between the organising authority and the carrier, worded in very precise terms and awarded to a company only of the highest quality.

Zero delay: This is a crucial indicator of service quality, since lack of punctuality is a direct cause of situations conducive to accidents (stress, waits at boarding areas, running behind schedule and hence increased speed, etc.).

Zero lag: In a situation of uncertainty, or even accident, the **relay of information** (on-board communication system) and the **application of ad hoc procedures** must be immediate.

These three requirements, about which much more could be said, should be a goal for school transport providers.

AIST is proposing 12 safety measures. If implemented, they will undoubtedly bring the target of '**zero dead**' much closer. I shall now present them briefly.

Twelve proposals by AIST for increasing youth transportation safety

1. Harmonized statistics database

   The establishment of a database of statistics recording information from each member country, with a common definition of an accident and a broadening of the idea of school transportation within the transportation of young people.

2. Directives for the transportation of young people

   The publication of a memorandum to member states which would contain minimal directives to be followed while transporting young people involving at least two member countries: organization in the case of an incident or an emergency.

3. Improvement in stop zones

   The setting up of a working group on stop zones. This group would assess the stop zones in each state, would define methods to improve decision-making, and would validate sound initiatives and experiences.

4. One adult seat per child in vehicles

   In Europe, except in Germany and in Austria, rules with regard to seating allow for the seating of three children per two adult seats. These measures must be repealed. AIST Europe fears that the "three for two rule" is applied despite European directives regarding the installation of safety belts.

5. Accessibility and safe transportation for the young handicapped

   Many young people are the victims of physical deficiencies (visual, reduced mobility, …) or mental deficiencies. This results in a disadvantageous situation for these young people in the use of public and school transportation. An ad hoc working group must be formed to study the organizational conditions, techniques and practices regarding safe and quality transportation for these young users.

6. Harmonization of security controls

   Harmonization among manufacturers of dashboards, emergency exits and security equipment for an effective evacuation of vehicles in the case of immediate danger.

7. Improvement of vehicle signalling

   The improvement signalling for vehicles which are used mainly for school transportation by:

   - illuminated pictograms with “leds” and reflective materials and where the format would be standardized;
   - reflective side strips on vehicles which transport children;
   - use of dipped headlights for all vehicles used for mass transportation.

8. Prohibition of longitudinal seats

   The prohibition of installing and using longitudinal seats in school transportation vehicles.

9. The installation, at construction time, of a communication system in all vehicles used for the transportation of passengers, which would allow for direct contact with emergency services.

10. Specific training of drivers

    The development of innovative programmes for the continual training of drivers, specifically in school transportation. This would not only improve safety, but also allow for the better integration of drivers who are insufficiently qualified and who have but a driving license for public transportation, as well as to allow for a better integration of females in the work force.

11. The education of youth regarding safety

    The development and distribution of information to sensitize young people about safe transportation and an evaluation of the educational programs regarding safety.

12. Alcoholism

    An alcohol level of 0 g/l for drivers of passenger vehicles and vehicles transporting young people.

Part IV.

SAFE AND SUSTAINABLE TRANSPORT MEANS A SAFE AND SUSTAINABLE VEHICLE

HOW CAN WE ENFORCE PASSIVE DEVICES?

Safety Enhancement by Intelligent Safety Transport Systems
The "ADVISORS" Project (5th Research Programme of the European Union)

Contribution by Marion WIETHOFF
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The Netherlands

Abstract

In Europe, many deaths and injured each years are the cost of today's road traffic. Therefore, it is wise to look for possible solutions for enhancing traffic safety. Some Advanced Driver Assistance Systems (ADAS) are expected to increase safety, but they may also evoke new safety hazards. Only empirical data on driver behaviour will justify claims of these ADAS. The ADVISORS project is aimed at development of a methodology for testing, devising implementation strategies and evaluating a number of ADAS which are promising on safety, road network efficiency and reducing environmental load.

It became clear from studies on identifying the causes of accidents that many accidents are a result of misjudgement of driver's actions and actions of other traffic participants. An analysis on theoretical approaches has shown that a few systems, in particular intelligent speed adaptation and vision enhancement systems and also navigation systems could have a beneficial effect on road safety. Some of these systems are in the process of testing in pilot tests: on the road and in driving simulators.

1. Introduction

Around 55 000 people are killed each year in accidents in the European Community, 1 700 000 are injured from which 150 000 people are left permanently disabled. The total cost of crashes in the EC is 50 billion Euros (Hutchinson, 1987). This is a particularly high number of deaths and injured in comparison to deaths from epidemics.

Intelligent transport systems, especially systems that may assist the driver are expected to increase road safety (ADAS: Advanced Driver Assistance Systems), road capacity as well as attenuating environmental load in traffic. However, car manufacturers are developing many of these systems essentially for commercial reasons.

On the one hand, it is worthwhile assessing which of these systems is potentially powerful in addressing these issues, on the other hand, it is worthwhile assessing whether they may generate safety hazards.

ADVISORS (**A**ction for advanced **D**river assistance and **V**ehicle control systems **I**mplementation, **S**tandardisation, **O**ptimum use of the **R**oad network and **S**afety), is a project co-funded by the European Commission (DGTREN), in which governmental and other research institutes, a transport company, insurance companies, and industry of ten different European countries participate.

In this paper, the ADVISORS approach will be based on the assessment of ADAS effects and implementation strategies, with the focus being on the theoretical approach and what safety effects can be expected of a few ADAS which are on the agenda of ADVISORS and other projects.

Previous pilot tests and modelling studies have indicated that ADA systems may make a significant contribution to increasing road safety. Some of the effects identified so far in a few promising systems are presented in this paper.

2. Considerations with regard to ADAS safety issues in traffic

With regard to safety, ADAS can be evaluated in several ways, according to the expectations of manufacturers, drivers or authorities. For some ADAS, there are some explicit expectations on positive safety implications of its use, but for other ADAS this may not be the case. Many ADAS are developed for commercial reasons. However, in all cases there may be unintended safety effects, either positive or negative.

- First of all, an ADAS may increase safety regarding some types of errors, because of *error correction features*. These are systems that maybe at the very last moment prevent the vehicle from obeying the driver's actions. For instance, anti-collision systems serve this purpose. In the case where the driver has made a misjudgement, the anti-collision system prevents the driver from actually causing or participating in an accident.

- Second, an ADAS may detect and/or influence *error-shaping conditions*. Error shaping conditions are those circumstances internal to the driver (e.g. sleepiness) or external to the vehicle (e.g. adverse weather conditions) which may increase the likelihood of the occurrence of errors. Driver state monitoring systems are an example of these types of systems, or road surface detection systems.

- Third, ADAS may increase *driver comfort* by offering new services. Navigation systems are an example of these or cruise control systems.

However, the perception of these systems may differ among individuals. For instance, Hoedemaeker (1999) found that drivers who usually tend to drive relatively slowly perceived an ACC system as a safety appliance, whilst drivers who tend to speeding perceive the same system as a comfort system. Also, some typical "comfort" systems may also have beneficial effects on safety.

- This brings us to the last ADAS issue, and that is that ADAS may incur particular safety effects because driver behaviour is changed. These changes may in the end have a very negative safety impact, for instance because of new errors occurring, whilst other errors have disappeared using the ADAS. These are the *unintended safety effects*.

ADVISORS focus lies especially on the latter safety issue, because theory can predict unintended safety effects, but only empirical data can prove what will actually happen.

3. ADVISORS step by step

ADVISORS attempts to resolve various issues regarding ADAS, especially regarding safety by undertaking the following actions:

- Firstly, ADVISORS will determine what safety problems, congestion problems and environmental problems are predominant, for which ADAS could provide a solution. This stage has already been finalised.

- Secondly, ADVISORS will develop a common framework for the evaluation of all types of ADAS, using an integrated traffic environment approach, considering impacts and benefits throughout the traffic chain and not localised only to one type of infrastructure for which a system might have been developed.

- Thirdly, the project focuses on the assessment of driver behaviour changes due to the implementation of various types of ADAS. It will use laboratory, driving simulator and on-road tests; performing in parallel a thorough cost-benefit assessment of each tested scenario, to allow the relevant authorities to select not only reliable but also affordable evaluation means for ADAS assessment.

- Fourthly, ADVISORS will conclude with recommendations for type approval and standardisation actions for ADAS marketing as well as legislative, organisational and institutional recommendations for their applications. This will bring the relevant technology one step further, to the service and benefit of the European citizen.

4. Theoretical Approach

4.1 Psychological theories - Structure

There are several classes of psychological theories from which one can derive predictions regarding the possible effects of fitting assistance systems in the car on driving behaviour and safety.

A model proposed by Rasmussen (1983) and Michon (1985) structures the regulation level of performance and also the level at which particular psychological theories focus upon.

The model proposes 3 levels of behaviour:

- The strategic level on which all knowledge based cognitive processes take place: regarding traffic behaviour this constitutes analysis of phenomena, learning, pre-trip selection of destination, modality etc. This level often involves the more time-consuming thought-processes.

- The tactical level, often described as the rule based level: important on this level are pattern recognition and selection and application of pre-established rules related to those patterns. The rules and patterns serve to reduce both task load and observation/decision/action times considerably and are considered to constitute an important part of our "internal representation" of traffic phenomena.

– The operational level or skill based level: on this level there is virtually no conscious analysis or action but largely automated sequences of actions (e.g. gear changing, observation routines, etc.). Actions on this level achieve the fastest responses that human are capable of and also serve to reduce task load by freeing mental capacity.

On all three levels we can distinguish input- processing-output of data as basic functional phases but at each level relationships between those three functions are different in character.

There are many theories of performance and traffic psychology developed. These theories stem from different scientific traditions and aim for different types of tasks.

Three of these categories of theories will be discussed here briefly.

4.2 Information processing theory and the theory of "Situation Awareness"

These are theories well established in the scientific community, applied in various field of human performance and operator performance. The first theory is particularly powerful in providing a structure for predicting and testing behavioural effects. Information processing theory is both a structural and an energetic approach of the cognitive processes. These theories predict that driver performance may easily increase if data limited processes (these are processes that can not be improved if one invests more effort; the limit to what one can do is reached) are supported by ADAS. (Wiethoff, 1997, Wickens, 1991, Norman and Bobrow, 1975) Furthermore, mental effort expenditure and therefore fatigue may decrease with ADAS which support resource driven processes (performance increases with effort investment), and this can be beneficial in situations were overload will occur, but maladaptive in situations of underload.

The theory of Situation Awareness (Endsley, 1995) is concerned about anticipatory behaviour of drivers, or operators or other human performers. This is crucial, since reactive behaviour, even when accelerated by well developed rules and skills, is often still too slow. Therefore, instead of *reacting to the immediate situation* we often react to a *predicted situation in the near future.* This prediction is thought to be made on the basis of an internal representation of the traffic also referred to as *situation awareness.* The theory predicts that ADAS will serve safety whenever situation awareness is increased. It involves helping recognising patterns in traffic, without having the additional effect of the driver losing his ability of judging traffic situations. On the other hand, systems that decrease situation awareness are expected to have negative impact on safety. For instance systems which will decide for the driver what to do, or systems which will make it more difficult for *other* traffic participants to understand and predict what the vehicle with an ADAS fitted is doing. Systems that will have the effect that the vehicle is behaving differently from other vehicles will deteriorate situation awareness by other traffic participants.

Both theories focus on *operational and tactical behaviour* of human performers.

4.3 Behavioural adaptation theories

There are various theories which predict behavioural changes whenever one perceives a change in the risk. These theories are particularly developed in the field of human performers who can choose their strategies in balancing inputs and expected outcomes. Wilde (1994) postulated in his Risk Homeostasis theory that individuals are comparing perceived level of risk that they are taking to an internal reference level of risk that they find acceptable. If the driving environment changes (e.g. by

fitting an ADAS in the car) and the perceived level of risk is reduced accordingly, drivers are willing to change their behaviour by more risk-taking actions (e.g. driving faster, performing secondary tasks) in order to return to their initial pre-set level of risk.

These theories focus on the *strategical behaviour* of human performers.

4.4 Error theories

In particular Reason's GEMS theory (Reason, 1987). This theory stems from the tradition of Theories of Regulation and Action theory, and is especially useful in predicting the type of errors one can expect depending on the level of regulation, which conditions evoke those errors and proposals for mitigation strategies. On skill based level, errors are mainly made because of inattention or because the wrong automated response was elicited. On rule based level, most errors are made as a result of convenience responses. On knowledge based level, most errors are made because of incorrect mental model or overload. When an ADAS interferes with the drivers' task, the driver may perform at a different regulation level, and new errors can occur.

GEMS focuses on what can go wrong on operational, tactical and strategical levels of performance.

4.5 Error shaping conditions

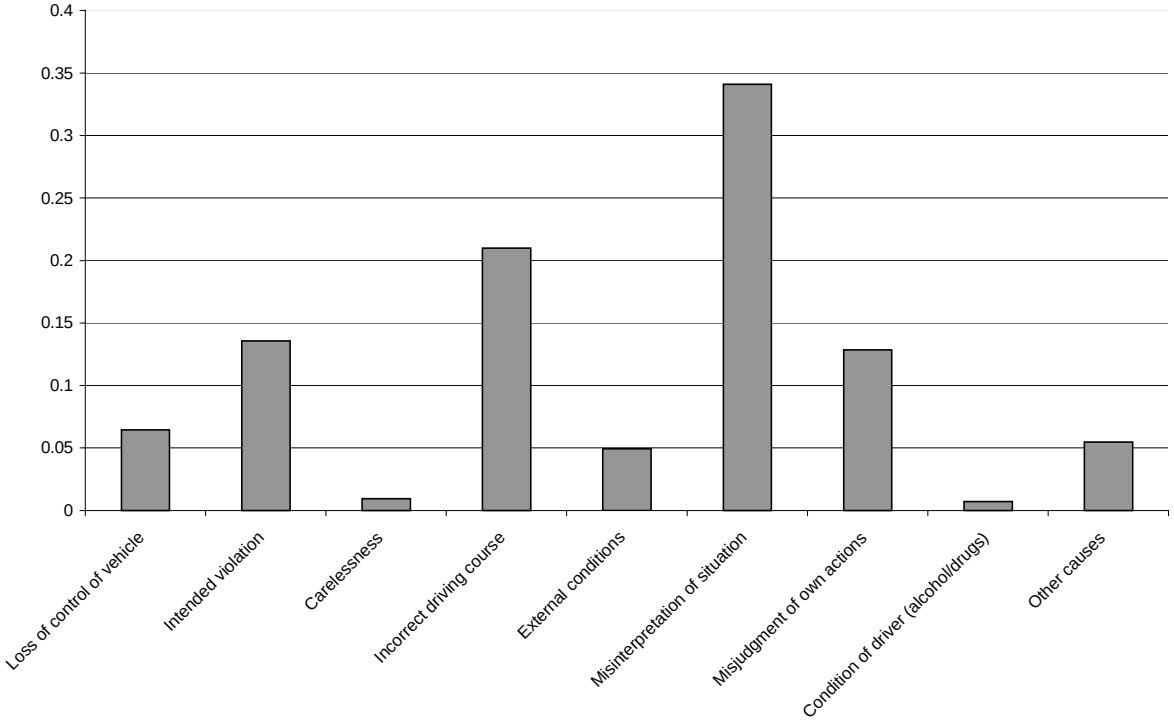
Literature (Heijer *et al*., 2000) shows further that the probability of human errors depends on certain general error shaping conditions:

- External conditions e.g. limitation of vision by obstructions or blinding, etc.
- Errors caused by distraction: the distraction may be external to the driving tasks (telephone conversation) or internal (too much attention for an alarm or display).
- Overload: too many tasks to be performed in a short time or too rapid changes in the traffic situation making it impossible to exert adequate control. A frequent cause for overload errors are too high relative speeds. A considerable volume of research (see References) consistently associates too high speeds with accident causation. Also when the traffic situation is complex and spatially widely distributed the observation time required to assess the situation may exceed the available time.
- Underload, caused by extended absence of sufficient stimuli ("highway hypnosis").
- Physical condition of the driver: fatigue, certain medical conditions or abuse of alcohol or drugs may severely impair the drivers abilities and cause all types of errors.

5. Problem identification

An analysis of accident databases in several European countries (The Netherlands, UK, Finland, Greece, Italy, Germany and the Czech Republic) has been performed (Heijer *et al*., 2000). The analyses of all these data sets would be too detailed for the present paper, therefore an overview is given of the Dutch accident data over the period 1983-1999 as an example.

Figure 1. **Causes of accidents in the Netherlands 1983-1999 (in percentages)**



For the whole set of analyses the following conclusions were drawn:

- There are considerable differences in the way the data are collected between the countries; this is a result of the fact that there is no common standard, but also because of differences in policy regarding what data collection are considered important.

- Accidents while crossing or turning, many of which are probably right-of-way accidents, is a significant category in all countries as well as head-to-tail collisions. In both the UK and in the Netherlands, collision with obstacles seems to be a major problem.

- Accidents related to the condition of the road surface are dominant in the Czech Republic

- Accidents related to driver condition (alcohol) are dominant in Finland.

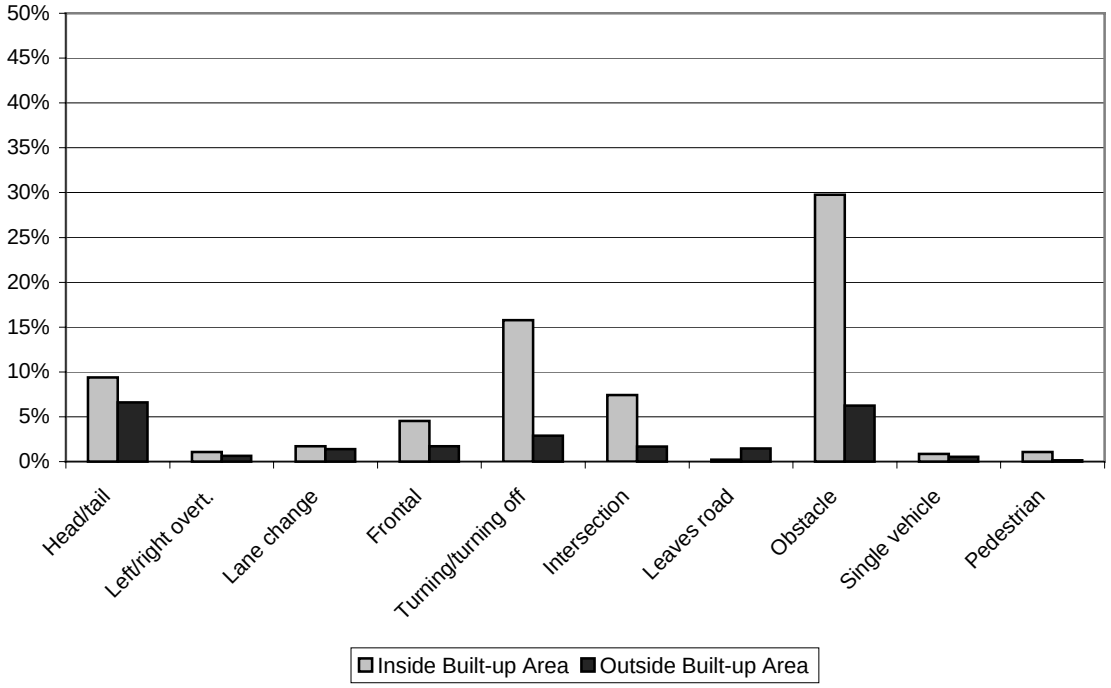
- In all highly motorised countries, accidents inside built-up areas account for the majority of accidents between vehicles.

For an overview of the Dutch accident data, please refer to Figures 1 and 2.

It was found that especially misinterpretation of the situation or other driver's intentions, incorrect driving course, intended violation of rules and misjudgement of own actions are main causes for accidents. Use of alcohol is grossly underestimated in the data, because it is very rarely recorded as

the only cause of accidents. When the manoeuvres are listed that cause accidents, it becomes clear that especially inside built up areas, obstacles, turning and head-to-tail collisions are very common.

Figure 2. **Manoeuvres associated with accidents in The Netherlands 1983-1999**



Therefore it is concluded that with regard to the Dutch situation attention should be drawn to ADAS which:

- Help with interpretation of situation or the behaviour of other drivers.
- Help with predicting the effect of own actions.
- Prevent incorrect driving course.
- Prevent intended violations.

Because main set of manoeuvres causing accidents (mainly inside built up-area) are:

- Head/tail collisions.
- Turning.
- Obstacle collisions.
- Frontal collisions and intersection collisions.

6. ADAS Shortlist

ADVISORS has defined a shortlist of ADAS that are well worth investigating. These ADAS will be tested, either on the road, or in driving simulators, or by use of simulation programmes or otherwise subject for study in the ADVISORS project. Some of the ADAS on the shortlist are presented here.

6.1 ISA (Intelligent Speed Adaptation)

This is a system that monitors speed limits (beacons on the road side) and transfers this information to vehicles with special appliances able to receive that information. Then, in case of reaching the speed limit, there are three options: (1) the system warns the driver by a signal, (2) it intervenes by giving haptic feedback (gas pedal) or (3) automatically slows down the car. In the latter option, the system is mandatory, however in some versions the driver has the initial option of switching the ISA on or off.

This system can be characterised by correcting an error shaping condition and correcting intentionally rule-violating behaviour. For some drivers it can also be regarded as a comfort system: the driver does not need to watch the speed limits, the system will slow down or indicate a warning whenever the vehicle goes too fast. Furthermore, in a complex traffic situation, it will relieve the driver of the burden of watching the speed, but that is usually not the highest attention demanding task. However, since speeding is associated with higher accident proneness, ISA would typically be a safety measure.

Different intelligent adaptation systems have been developed, ranging from informative to intervening systems. Intelligent speed adaptation has been estimated to reduce accidents by around 35 per cent as a compulsory and intervening system and fatalities by more than 50 per cent (Carsten and Fowkes, 1998).

- Information processing theories will predict that drivers will have more time because of reduced speed and reduced decision load, and therefore has more attention for judging the traffic situation.

- The theory of Situation Awareness predicts that the driver will probably have a better overview over traffic situations, because he has more time. Other traffic participants, however, may have a problem because cars fitted with ISA behave differently from other cars.

- Behaviour adaptation theories predict that probably some drivers may undertake more risks. Since speeding is not possible anymore in the mandatory ISA type, it is possible that risk taking is expressed in strategical choices: some drivers may decide to drive in circumstances when they would normally not have done so (unintended safety effect).

- GEMS does not make specific predictions.

In general, ISA is a powerful ADAS with regard to safety effects. Unintended safety effects (strategical choice, situation awareness of other traffic participants) are subject to empirical research. In a pilot study recently performed in Tilburg (AVV Report, 2001), there were records of other traffic participants complaining and also interacting with the ISA vehicles in an unpleasant manner. Because there are several large pilots performed (The Netherlands, Sweden), ADVISORS has not planned a pilot in the current project.

6.2 ACC (Advanced Cruise Control)

In an ordinary Cruise Control System, as they are already on the market for several years, the driver selects pre-set speed, and the system will make sure that the vehicle will not override that speed

level. In the ACC, the additional feature is that when approaching a vehicle in front, the system will not allow the headway to become smaller than a particular predefined distance.

The system will therefore prevent the driver from approaching a car in motion in front too close. Currently, the ACC systems (if combined with Stop and Go) will be operational at low and high speeds of the vehicle and of the vehicle in front.

This system is also a functionality which is active as an error shaping condition and as an error correction functionality, correcting dangerous approaches within the same lane. As Hoedemaeker (1999) has pointed out, the system is perceived as a comfort system for some drivers. Drivers do not need to watch time headway and may tend to either divert attention or diminish effort investment. The system is developed in the expectation that it will be a safety measure.

Cruise Control systems reduce driver stress and increases safety somewhat but can also cause safety problems in critical situations, if not properly designed (Gustafsson, 1997). To ensure safety, cruise control systems should be accompanied by actual collision avoidance systems. Perrett and Stevens (1996) predict a 80 per cent reduction in fatalities due to anti-collision systems. However, these predictions need to be treated with caution: the technologies required to make collision avoidance feasible are not yet mature; the systems are only relevant to some kinds of crashes; and driver behaviour in vehicles fitted with such systems is not known.

- In general, it is expected that on rural roads and motorways head-tail collisions will be reduced substantially, but it is as yet questionable whether the same will hold in slow traffic and urban areas.

- Information processing theories will predict that drivers will cease watching the distance to the car in front, and also will cease watching other traffic participants and obstacles. This can be very dangerous because other accidents will occur more often. Especially in situations where decision load is higher (urban areas), ACC does not help very much (unintended safety effect).

- The theory of Situation Awareness predicts that the driver will, because of not watching distances of the car in front lose overview over situations when they become critical. No situation awareness changes are expected with regard to other traffic participants when the ACC minimal distance is close to the distance drivers in general adhere to. If, however the ACC distance is considerably smaller, there will be a problem. The driver of the car in front may interpret the behaviour of the ACC car as “pushy” and react accordingly (unintended safety effect).

- Behaviour adaptation theories predict that some drivers may undertake more risks. As Hoedemaeker (1999) already found, speed is usually a bit higher in cars with an ACC fitted, and drivers tend to drive more often on the left lane. (unintended safety effect).

- GEMS predicts that it is possible that drivers forget under some error shaping factors that the ACC does not work for other obstacles and the more vulnerable traffic participants. This is more likely to occur in situations of inattention (driver doing other things at the same time), and rural or urban traffic situations that look very much like motorways, but still involving vulnerable traffic participants (unintended safety effect).

Two pilots are scheduled for testing the ACC. One pilot is to be conducted in the VTI moving base driving simulator on rural roads and highways. Twenty-four to forty average drivers will be

included in the pilot. The participants will drive a route consisting of rural road sections and highway sections. Along the route, "normal driving" as well as "more critical" situations will occur. The simulated environmental conditions will be high friction and good visibility. The participants will be exposed to other traffic representing different penetration levels. The purpose of the pilot is to investigate possible effects of ACC on traffic safety related variables, like behavioural impact, workload, acceptance and usability. Another aim is to try to identify variation in effects from various levels of penetration and headway set by other ACC equipped vehicles.

TRL will focus on ACC and Stop & Go. This requires the trial to focus on a system designed for urban use, and which potential manufacturers promote as a comfort system, removing some of the physical effort and some of the stress of continual accelerations and decelerations. Responsibility for headway monitoring is supposed to remain with the driver, so that in the case of system failure, unexpected obstacles, or the need for deceleration beyond the capability of the system, the driver would intervene. The TRL trial will seek to explore not only possible changes in driving style, but also changes in effort, mental workload and situation awareness. The range of data captured will reflect this need to develop a rich picture of the safety, acceptability and comfort issues surrounding the system implementation.. The trial will compare drivers with and without the system, and explore the effect of different operational characteristics, in particular different mean time headway settings. Because previous research has revealed a difference in performance and attitudes between young and old drivers, this trial will directly compare these two groups, rather than having participants from the middle age band.

6.3 Blind Spot: electronic mirror or warning system

This system allows the driver to extent the view to that part that is usually invisible by the driver (blind spot). It can be on the side or behind the vehicle, when low obstacles cannot be seen by the rear view mirror.

The system gives a warning when turning or changing lanes in the presence of other vehicles, cyclists, pedestrians in the driver's blind spot. A passive sensor senses thermal energy as radiated from the tyres of a moving vehicle or bodily heat from persons. This temperature is compared to the temperature of a reference part of the road, e.g. directly behind the vehicle. If no vehicle is in the blind spot, then the two temperatures will be almost the same and no warning is given. Otherwise a flashing LED warns the driver of the presence of a vehicle on the adjacent lane. Active systems are more expensive.

This feature is also concerned with electronic rear view mirror (based on multiple video sensors or a digital image processing feature).

Such system should provide to the driver a better field of view without being obstructed by pillars, passengers and so. However the camera image present their own problems to human eye and how the driver perceives those images. i.e. the camera doesn't provide the depth of focus of a mirror and forces the driver to determine distances by the relative size of the objects viewed.

The blind spot on the side of the vehicle is one of the most frequent causes of accidents especially when overtaking or changing lanes. In contrast to an electronic mirror there is no danger that distances are misjudged as with an electronic mirror, because the blind spot is only a part of the whole view. The main advantage of the blind spot detection is its combination with normal mirrors.

So it seems to be useful to combine the usage of blind spot detection with automatically keeping the lane at the same time.

The system has a functionality for adjusting error shaping conditions. No negative side effects are expected.

- Information processing theories will predict that driver performance will increase. Limited sight is a data limited problem.

- The theory of Situation Awareness predicts that driver performance will increase. The driver's situation awareness will improve.

- Behaviour adaptation theories would not predict that drivers may undertake more risks, since these systems only support perception but not decision making or motor response.

- GEMS would not predict that new errors would appear.

Concluding: These vision enhancement systems would increase driver performance; theories would not predict any new problems.

The ADVISORS pilot (conducted by CRF and BASt) is expected to yield data, which allow assessing of *combined* safety benefits resulting from blind-spot warning and lane-warning support when driving on highways and interurban roads. Unsupported driving is taken as a reference point. The measurement approach can be characterised as indirect since the conclusions are derived from data which can be seen as linked to direct measures of safety, i.e. different kind of accident measures. The tests are conducted using ordinary drivers. They will drive the CRF prototype vehicle, which is the same already used inside the LACOS project. Necessary modifications and specific devices for the data-logging in the ADVISORS project have been envisaged and will be added. The demonstrator is a "LANCIA K 3.0 V6", with the LS system implemented on-board.

6.4 Enhanced navigation – navigation routing

This feature will provide location and route guidance input to the driver and will support the various collision avoidance capabilities with road geometry and location data. It will also provide the necessary capability to filter traffic information RDS-TMC (Radio Data System – Traffic Message Channel) to select those messages that are applicable to the vehicle location and route of travel. It will also offer the capability to recommend optimal routing based on driver preferences. More advanced versions of this service may integrate real-time traffic conditions into the calculations of optimal routes. An extra module will enable the receipt of information sent via GSM. The navigation display can also be used helping the driver when parking, using a camera viewing backwards.

This system is mainly to be regarded as a comfort system. It provides a service that supports the driver. However, in some circumstances (e.g. when the driver would otherwise get lost or give most of his attention to the map) it can be regarded as a correction of an error shaping condition. In complex traffic situations, finding the way is also mainly a knowledge-based task and therefore it will involve interference with handling the traffic situation.

- Information processing theories will predict that driver performance may increase in complex traffic situations where finding the way is also a problem. Attention can be directed towards the complex traffic situation. However, it is very dependent on the quality of the

interface whether drivers will be able to control the direction of their attention to the traffic situation. Auditive rather then visual systems are to be preferred.

- For the same reason, the theory of Situation Awareness predicts that driver performance will increase in those complex situations. The driver's situation awareness will improve. However, collision avoidance systems may decrease driver's situation awareness in the long run, because drivers will be counting on the system and possibly relinquish watching.

- Behaviour adaptation theories would predict that drivers might undertake more risks for the collision avoidance systems. For the navigation functionality, drivers will tend to rely on the navigation system and not think beforehand about the route.

- GEMS would predict overconfidence in the system. For the navigation functionality, temporary roadblocks etc. could be a problem, for the collision avoidance functionality, this could be a serious safety hazard.

Concluding, the navigation functionality this system could improve driver performance in complex traffic situations, if the user interface is optimal. For collision avoidance systems, there are some serious safety hazards.

In the ADVISORS pilot a travel accountancy system is implemented for a large transport company. In the test, especially interface characteristics will be tested for communication between the driver and the route-planner. The system could offer a positive influence on decreasing travel times and distances and on increasing the mean load rates. The system used is a route planning and fleet management system, which could make use of external information to optimise routes and use of the fleet. Traffic information, which could have a huge influence on the transport efficiency, is information about delays to expect, caused by congestion or roads under construction. The Traffic Information Centre (TIC) in Driebergen can deliver this information.

7. Conclusions

In the problem identification, it is found that violating the rules is a serious problem associated with accidents. Furthermore, in various studies it has repeatedly been found that speeding and accident proneness coincide. Therefore, ISA is an interesting possibility, and there is a good chance of its success as a safety measure. However, drivers' attitudes towards ISA are not very favourable, and the car manufacturing industry is not very keen.

ACC is a system that, in combination with the Stop and Go system (for slow driving) can help in preventing head-tail collisions which may be partly a result of misjudgement of own actions or misinterpretation of the other drivers' actions. However there are some serious situation awareness problems and error problems to be expected in particular with respect to vulnerable traffic participants and obstacles. Behavioural effects of this system must be tested thoroughly.

Electronic mirror or warning systems may help increase driver performance. Warning systems may decrease situation awareness or increase risk taking.

Enhanced navigation systems may help in complex traffic situations, e.g. some intersections which could prevent incorrect driving course, misinterpretation of own and other drivers actions.

To conclude, there are a number of systems on the ADVISORS shortlist, and indeed elsewhere, worth testing in order to increase traffic safety.

For ADVISORS, however, not only traffic safety, but also road network efficiency and relief of environmental load are important.

It is evidently clear that actual testing is necessary to find evidence for the behavioural effects (and therefore safety effects) and the other effects.

Each of the theories presented here give a foothold in predicting possible effects.

Furthermore, the differences in safety between different countries and certain traffic conditions (e.g. icy roads) and driver behaviour (driver attitudes towards ISA are expected to be more negative in southern European nations and Germany) may direct public authorities' decisions towards focusing on implementation or allowing a different subset of ADAS. However, some systems require both infrastructure changes and implementations in car manufacturing. Differential effects of penetration rates also need to be taken into account in selecting the best solution.

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The European New Car Assessment Programme - an experiment to broaden?

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Introduction

The European New Car Assessment Programme unveiled the first set of crash test results in February 1997. Of the seven "supermini" class cars tested, only two received three out of the four available stars, four cars received two stars and one, the unfortunate Rover 100, received only one star. The launch of the results was accompanied by protest from some sections of the motor industry, attacking the results as simplistic and unrepresentative of real life crashes and unfair to the huge amount of research work and crash testing that the industry was conducting. Five years later much has changed. The Renault Laguna became the first car to achieve the new five star rating that includes a pole test measuring side-impact head protection. The second round of testing of super minis produced greatly improved results, with two four star cars and four three star cars. Both Renault and Fiat have used the Euro-NCAP crash test results as the basis for Pan-European advertising campaigns, featuring their NCAP star ratings and the Euro-NCAP web site in television and printed advertisements. The European Commission, in its 2000 Communication on road safety, credited the Euro-NCAP programme with accelerating passive safety design by six years and saving an estimated 2 000 lives each year.

The *Federation Internationale de l'Automobile* (FIA) is proud to have been involved from the outset in creating Euro-NCAP. Together with the United Kingdom and Swedish governments, the automobile clubs RAC and AA and the European Commission, the FIA funded the development of the programme and the first set of tests by the UK Transport Research Laboratory. Today, the Programme's supporters number five European governments, consumers' groups and the FIA Foundation.

FIA Foundation

The FIA Foundation for the Automobile and Society is a new organisation established as a charity last year by the FIA with an endowment of $300 million. We are a grant making body, focusing on road safety and environmental research and education. Armed with an annual budget that we anticipate will be close to the European Commission transport DG's safety budget of 8 million Euros we expect to contribute to making a difference in road safety. And one of the projects that the FIA Foundation is committed to is membership of Euro-NCAP, because we believe that Euro-NCAP is an experiment that has demonstrably delivered, harnessing together the consumer's desire for information and the competitive instincts of the motor industry.

Five Star Cars - Why has Euro NCAP worked?

Before Euro-NCAP there was nowhere that a European consumer could go for independent, comparative information about the passive safety performance of the cars on sale in local showrooms. Some governments and insurance companies published information about the quantity of makes and models of car that had been involved in accidents but this was of limited usefulness. Euro-NCAP was a fairly unique creation, a public/private partnership entering an area that was previously the sole preserve of regulatory authorities developing type approval standards. The new dynamic provided by Euro-NCAP stretched performance further than regulation alone. How was this achieved? What Euro-NCAP did was to take passive safety design performance from being a concern solely of regulators and legislators -- and the first Euro NCAP launch followed only a year or so after the first updating of EU crash test regulations for twenty years -- to being a direct public concern.

With Euro-NCAP, a consumer can, for the first time, directly examine the crash test performance of two cars that he is considering buying and, thus informed, has an important piece of new information to add to his final decision over which car to buy. It could be argued that it was this direct, comparable choice based on star ratings that provided the dynamic that has brought us to the first five star car. Since one car manufacturer began to perform well in the crash tests, and to advertise cars on the strength of that performance, competition and market forces dictated that other manufacturers would have to follow suit. Vehicle occupant safety was something that car buyers cared about, and access to crash test information swung sales. This is worth remembering when considering the extension or broadening of the Euro-NCAP experiment. The relatively poor progress in pedestrian impact performance in the Euro-NCAP crash tests -- only one manufacturer, Honda, has deliberately set out to address both occupant and pedestrian -- could be seen as a result of the relative lack of consumer interest in pedestrian impact performance. We may be concerned about pedestrian protection when we are crossing the road or walking with our children. But the many large 4x4 jeeps with steel bull bars being driven by mothers with small children are testament to the limits of our altruism or our imagination. Stated brutally, pedestrian impact stars do not sell cars. This does not mean that Euro-NCAP should not continue to test pedestrian impacts or publicise the results. But if pedestrian protection does not have a competitive dynamic attached to it, we need to find other ways of bringing pressure to bear for improvements.

Five Star Formula: The 'systems' approach to road safety

We heard during this meeting about the "vision zero" approach developed by the Swedish Government as its guiding philosophy to road safety. The FIA uses a similar approach in the rather more controlled environment of Formula One, as well as in other motor sport, examining every aspect of the way racing cars are designed and driven, and the tracks they are driven on. Accidents will inevitably happen, what we attempt to do is to build survivability into the inevitable.

For the FIA and the FIA Foundation, Euro-NCAP has been an important part of what we see as this comprehensive systems approach to safety on the roads. Today's Euro-NCAP four-star cars should protect their occupants against fatal injury at speeds of around 65 kilometres per hour in a head on collision. This is the systems target that has been factored in for the vehicle's passive safety. But to make the systems approach a reality, and to achieve the "vision zero", similar targets should be introduced for the road infrastructure, for driver behaviour and, eventually for technological accident avoidance systems. And, slowly, this is what is beginning to happen.

Five Star Roads

We have already heard today about the European Road Assessment Programme, the aim of which is to identify and assess those European roads that pose an unacceptable safety risk. The Euro RAP programme was established by European motoring organisations, under the leadership of the AA Foundation for road safety and with the technical expertise of the UK's Transport Research Laboratory. The FIA Foundation is pleased to be a funding supporter of the second phase of the programme, because we see the aims of Euro RAP as entirely complementary to the Euro NCAP programme. Four or five star cars should be driving on four and five star roads. Roads should be identified and assessed according to transparent protocols including accident rates. Different roads, different road authorities and roads in different countries and regions should be comparable according to both star-rating systems and more detailed technical data. The results should be released to the public. All of these things are necessary for the public to have the information necessary to hold road owners or managers accountable.

But the question then arises: what will we do with the information when we have it? I have already argued that the Euro NCAP programme has been successful because the release of information about crash test performance fed into the already existing competitive force of the new car market and that pedestrian protection has been less successful in part because the same level of potential interest from the public is not present. Using Euro RAP as a way to force change will present new challenges and obstacles, but lack of public interest will not be one of them. We already know that local communities will lobby furiously for improvements on dangerous sections of roads that have claimed the lives of family and friends. The information provided by Euro RAP should create public pressure for road improvements on a much larger scale, particularly when poorly performing roads and high levels of road user taxation are linked in the public imagination. The barrier to change will be the extent to which finance ministries can withstand the pressure for prioritising infrastructure improvements that comes from a public empowered for the first time with the information to hold government truly accountable and the pressure that comes from road authorities willing to harness that public interest.

Five Star Drivers

More than 90 % of road traffic accidents involve human error. A minority of drivers will always manage to evade the best effects of driver training or police enforcement. But the truth is that all of us are capable, no matter how advanced our training or how effective the enforcement, of causing an accident in the split second of a concentration lapse. This fact is of course at the heart of the systems approach to road safety, because short of engineering perfect human drivers there is currently no way of preventing all accidents from occurring, so mitigation of the consequences becomes the front line in reducing fatalities and serious injuries. But the systems approach to injury mitigation should also involve the vehicle driver and passengers. Wearing a seatbelt is the simplest and one of the most effective and low cost ways of reducing the severity of injuries. Yet seatbelt wearing rates differ wildly here within Europe, let alone when compared with some other parts of the world. The FIA Foundation is beginning this year a study of the effectiveness of seatbelt legislation, awareness campaigns and enforcement, to identify best -- and worst -- practice and to try to rate the progress made by different countries.

The way technology in the car interacts with the driver -- the human machine interface -- is also important for injury mitigation. There are compelling arguments for audible seatbelt reminders to be fitted as standard. Airbags are becoming much more widely available, and particularly in the case of side air bags Euro NCAP has played an influential role, in combination with legislation, in ensuring

this is so. Surveys suggest that at least half of parents who use a child seat are fitting it incorrectly, and the performance of child seats varies, sometimes quite dramatically. A testing regime for child seats is a logical next step for the Euro NCAP model approach, and testing houses and motoring organisations are currently developing plans for such a programme. But looking into the future, the most exciting potential for a Euro NCAP model approach may be in the area of vehicle active safety and in-car intelligent systems.

Five Star Accident Prevention

Active safety -- from ABS to collision avoidance systems -- must be the way ahead for road safety. A two star pedestrian protection design rating would be less important if a car was equipped with radar warning equipment and intelligent speed adaptation. The safest car will not be the car that has achieved top scores in Euro NCAP for occupant and pedestrian protection. The safest car will be the car that has achieved a five star rating for its accident avoidance technology.

We should not be under any illusions as to the difficulty and time it may take to bring some of these technological solutions to market. Some of the experts are talking in decades rather than years. And introducing a Euro NCAP model assessment programme may not be straightforward once products are available for testing. A working group within Euro NCAP has been looking at establishing test protocols for active safety. They are, for example, finding that it is very difficult to guarantee identical testing conditions when brakes or steering are being examined. A tiny change in temperature or the slightest alteration in human behaviour can prevent compatibility between tests.

Despite these difficulties and the huge technical challenge that is presented by intelligent transport systems, greater emphasis on active safety will surely reap dividends in the future. Securing the political and financial support for research and development and creating a regulatory framework for such innovation now is of huge importance.

Conclusion

Euro CAP has generated huge public interest and, through co-operation between the Programme and car manufacturers, substantial safety improvements in the cars we drive today. There is still progress that could be made in passive safety design, with work on crash compatibility and on pedestrian impact design. But the future will be electronic. There are great many issues -- legal, operational, behavioural and technical -- to surmount before a new system such as intelligent speed adaptation can be introduced. But once the technology is mastered and products do begin to appear, there should be a role for an e-safety assessment programme to inform consumers, accelerate the introduction of safer technology and to contribute to the vision of a road network that delivers five star safety.

Intelligent Speed Adaptation (ISA)

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Introduction

Intelligent Speed Adaptation (ISA) is gaining more and more attention. It is one of the promising new developments in the world of intelligent transport systems (ITS) which has the potential to considerably enhance traffic safety and driver comfort. Car manufacturers already offer (simple) ISA systems as an option and countries are seriously studying the possibility of the introduction of such systems as part of their traffic safety policy. Currently it is discussed in different (European) forums and several pilots and research projects are carried out which will deliver more insight into its prospects and technical requirements. In the next years the possibilities of (large-scale) introduction have to be discussed. Due to the globalisation of industry, the harmonisation of vehicle requirements and cross-border traffic, implementation clearly has an international (European) dimension. In this paper, after a brief status summary of ISA, a possible path to implementation is set out that tries to accommodate the different views on ISA. This will have to be detailed further in the coming years.

ISA in Europe

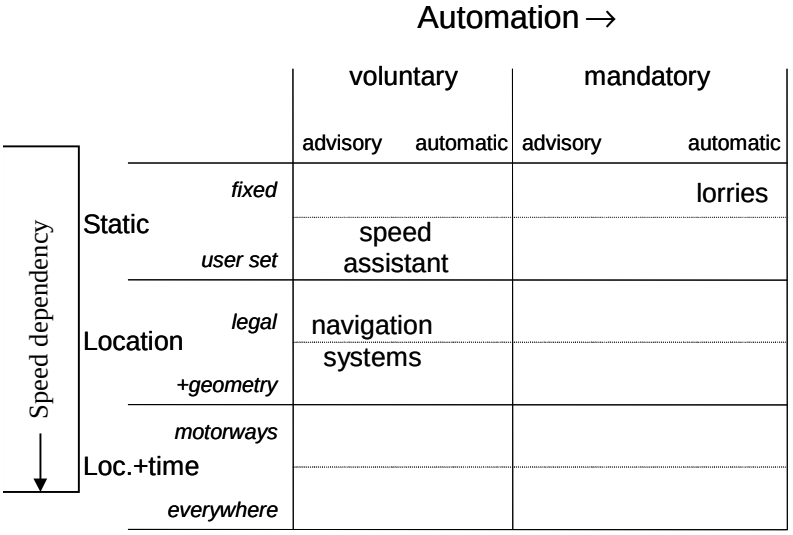
In several countries pilot studies have been, or are, carried out: United Kingdom, Sweden, the Netherlands, Finland, Denmark, France and Belgium. In the European research programmes DUMAS and MASTER knowledge has been compiled about road safety and speed. The coming programme PROSPER (2002-2004) will be entirely focused on ISA; from technical aspects to implementation strategies.

ISA is also discussed in other forums, e.g. in the ECE (WP.1 and WP.29), the Forum for the Automobile and Society, ERTICO and the EU High Level Group on Road Safety. The latter has a dedicated ISA subgroup which will probably be continued for the coming years. Both in the eEurope 2002 Action Plan and in the Third Road Safety Action Plan Intelligent Transport Systems (ITS), of which ISA is part, are mentioned for their potential for the improvement of road safety.

Typology

Many different ISA systems are possible, they are summarised in the figure below. The two main dimensions are the nature of the speed limit (vertical) and the degree of intervention of the system (horizontal). The simplest systems have only one, fixed speed, like the speed delimiter for trucks. On some new passenger cars a user set ISA is available as an option. For ISA systems with place dependent speed advice a database with speeds is required. This can be integrated in the future with the digital map of the navigation system. For the most advanced form of ISA the speed advice is transmitted to the car by road side infrastructure. This avoids the requirement of an up-to-date database in the car and makes dynamic speed advice possible, e.g. related to congestion, weather conditions or accidents.

The second dimension is the degree of intervention, both in the sense of installation of the equipment (voluntary, available as an option, or mandatory by law) and in the feed-back to the driver (from speed advise to speed delimiter). The border between 'advisory' and 'automatic' is vague and depends on the perception of the user (e.g. in a system with a haptic feedback the maximum speed can be exceeded but this is not very comfortable).



ISA potential

Speeding is widespread in Europe and is one of the major causes of traffic accidents. It is estimated that speed plays a role in about a third of the fatal accidents[1]. The safety of drivers and passengers of motor vehicles has been greatly enhanced in the last decade by the progress in passive safety and much is expected from the upcoming active safety systems. But every year about 10 000 vulnerable road users (pedestrians, cyclists and mopeds) are killed in the EU who don't have the benefits of such systems. The reduction of the speed of motor vehicles in urban areas could reduce their toll significantly: the risk of fatal injuries for a pedestrian hit by a car is virtually zero for 30 km/h, about 50% for 50km/h and almost 100% for 70 km/h.[2].

The observation of maximum speeds can be achieved by means of police or electronic surveillance, education and road design. ISA adds a vehicle based technology to this spectrum. The advantage of ISA is that it is always available, can be made flexible to reflect local road conditions (weather, congestion, curves) and is very cost effective; virtually no additional infrastructure has to be installed by the public authorities, depending on the type of vehicle-road communication used. In contrast to that, surveillance can only be limited in time and location and infrastuctural measures are

1. 3rd Road Safety Action Plan 2002-2010, DG-TREN; ECMT studies 'Safety in road traffic for vulnerable users' (2000) and 'Speed moderation' (1996).

2. MASTER Final Report (1998).

very costly and have undesirable side effects. On the other hand, ISA might be perceived as too intrusive in the liberty of the driver if the maximum speed can not be exceeded anywhere.

Apart from traffic safety, ISA offers enhanced driving comfort by alleviating the driver from the task to continuously monitor its speed. This makes driving more relaxed, more attention can be paid to the road and other road users and speeding tickets are avoided. In the case of dynamic ISA road congestion can be reduced by speed optimising and intelligent speed limits can be implemented, tailored to the local actual road and traffic conditions.

By several studies[3] it is estimated that a full deployment of ISA will reduce the traffic death toll by 10-50%, depending on the type of ISA used. Generally speaking, the systems in the upper left of the figure above are the least effective, those in the lower right the most.

Implementation

Full deployment of a mandatory, automatic ISA would be one of the most effective single measures imaginable for the improvement of traffic safety. However, this will not be reality in the near future. Acceptance for such a measure is still too low, standards have to be developed and issues such as liability and maintenance of the data base with maximum speeds have to be resolved. But more and more car manufacturers already offer voluntary, advisory ISA in some of their models. In the coming years manufacturers and governments should work together to increase market penetration and functionality of such voluntary systems.

For all types of ISA technical standards will be necessary to avoid incompatible equipment and user interfaces and facilitate market introduction. Governments interested in ISA could pursue a national implementation. But this would create problems with cross-border traffic and is expensive due to a higher unit cost. Therefore a European standard for ISA systems is the best option for an effective and cost efficient introduction of ISA.

Ultimately this could lead to a fitting of ISA equipment in all new vehicle types. But such a standard has to accommodate the different views of the member states about ISA. A regime that requires the speed management technology to be fitted on the vehicle but leaves its activation to the individual member states could satisfy all member countries, provided the technology is not too expensive but complete enough to make an advanced ISA possible. In this way, ISA can be activated 'where, when and how' the national authorities see fit for the specific local situation. This guarantees maximum flexibility, an optimal integration of ISA with local traffic safety policy and better acceptance by the general public. This end view can be summarised as *fitting of ISA equipment in all European vehicles - Activation by national authorities (how/when/where).* For example, flexibility in time would make it feasible to have intelligent speed limits, dependent on traffic and weather conditions. The flexibility in feedback (advisory-automatic) would make a policy possible where the system is always advisory for special areas or circumstances: near schools, playgrounds and accidents, for access to pedestrian areas, in residential areas, etc.

3. E.g. 'External Vehicle Speed Control', University of Leeds and The Motor Industry Research Organisation (2000).

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