

SUNflower:

A comparative study of the development of road safety in Sweden, the United Kingdom, and the Netherlands

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Foreword

Although the traffic safety records of Sweden, the United Kingdom and the Netherlands are the best among the countries of the European Union, their accident toll is still unacceptably high. New ways for further improvement have to be, and are being sought, to further reduce casualties in these countries. Interestingly, the strategies, which have produced the relatively good results, are quite different in these three countries. So, the question arose as to what exactly made them work in coping with the traffic safety problem. And further, if specific beneficial patterns or underlying concepts can be determined, is it then possible to interchange them.

A better insight into the development of policies and programmes in these countries might conceivably identify key factors, which could further improve current safety practice in each of them. Moreover, it might offer guidance for remedial action in other countries of the European Union, applicant states, and other countries as well. Learning from each other and putting that learning into practice, is an indispensable part of gaining maximum improvement in safety. Such improvement should be given high priority, considering that each year more than 40,000 citizens of the European Union continue to meet premature deaths on our roads. Moreover, ideas are in progress to come up with a quantitative target to reduce the number of fatalities by 50% in the European Union in ten years time.

In this context, a study was carried out to assess the background to the safety strategies of Sweden, the United Kingdom and the Netherlands: the SUN countries. The results of this study are of special value in the progress of development of the safety programmes of the three countries. The methodology of the study has been designed in such a way that it can be used as a basis for comparative studies among other Member States.

The study was performed by a team of researchers from three institutes: respectively the Swedish Road and Transport Research Institute (VTI), the Transport Research Laboratory (TRL) from the United Kingdom, and the SWOV Institute for Road Safety Research in the Netherlands. All three institutes are well-known and have an outstanding reputation in the field of road safety research. This is the place to thank all my co-authors of this report: Göran Nilsson and Hans-Erik Petterson from Sweden, David Lynam and Jeremy Broughton from the United Kingdom and Matthijs Koornstra, Piet Noordzij and Peter Wouters from the Netherlands. Their task to compile this report was a very challenging one and turned out to be a complicated one. But their craftsmanship, their deep knowledge and understanding of the road safety problem, their dedication and motivation, their endless efforts to draft and redraft texts and to respond to critical comments from the other group members, resulted in this groundbreaking report. I would like to thank especially my former SWOV colleagues Matthijs Koornstra and Piet Noordzij, who carried out a part of the difficult task of our group. I gratefully acknowledge the contributions of the members of our Advisory Panel (Appendix D). From a distance they gave valuable reactions on drafts of this text and, without any doubts, their insight and support improved the quality of the final report. I am grateful for the financial support provided by DG TREN of the European Commission and of the Swedish National Road Administration, the Department of Transport, Local Government and the Regions from the UK and the Ministry of Transport, Public Works and Water Management from the Netherlands.

May I express my wish that this report will be used as a model and trigger for further comparable studies in this field and in this way contribute to a further reduction of the number of casualties on our roads.

Fred Wegman

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Executive summary

The road safety performance of different countries within Europe varies substantially. The three countries with the lowest accident levels are Sweden, United Kingdom, and the Netherlands (described here as the SUN countries). The aim of the study is to determine the underlying elements in the current policies and programmes of the SUN countries, which make them particularly effective in coping with the traffic safety problem, and thereby identify policy improvements most likely to produce casualty reductions in both SUN countries and other (European) countries.

Research method

A methodology for the meaningful comparisons of countries has been developed and applied in analyses of

- national road safety strategies, mainly over the last two decades;
- fatality risks of comparable road types, road user modes and collisions between modes;
- four case study subjects: drinking and driving, seat belt and child restraint use, local infrastructural improvements on urban and minor rural roads, and safety on main inter-urban roads;
- changes in overall national risk and several more specific risk trends between 1980 and 2000.
- Based on these analyses, the fatality reductions between 1980-2000 are attributed to road safety measures and discussed in the context of the targeted fatality reductions up to 2010.
- Within the study it has not been possible to look at all policy areas in detail, so it is not possible to provide a full explanation of the effects of all policies on national risk levels. Nevertheless the case studies provide an indication of the way in which the more detailed information provides more scope to understand the effect of specific policy changes.

General conclusions

- all three countries have achieved similar levels of safety through continuing planned improvements in these levels over recent decades
- policy areas targeted have been similar
- but policies implemented have differed at a detailed level
- differences in focus for safety programmes result from both different relative sizes of accident groups and differences in the structure of road safety capability which influences its ability to deliver different types of policy
- progress has been achieved through directing improved policies to all three areas – vehicle, road and road users
- there is room for further improvement in well-established safety fields in all three countries, and scope to learn from each other to ensure collective experience is used effectively
- risk factors are provided throughout the report, for the SUN countries, which can be used by other countries as indicators of the levels of safety that are achievable in relation to different aspects of the road safety problem. Differences in these factors between the three SUN countries indicate how these indicators need to be tailored to national situations

- the casualty reduction target set by the EU is ambitious and will require substantial additional actions if it is to be achieved. The current plans of the SUN countries fall below this target. Additional action is therefore required (by the EU)
 - either to encourage greater national activity,
 - or through pan-European activities – to make up this shortfall.

Main conclusions with respect to differences between the SUN countries

- The total risks (i.e. death rates) of the SUN countries are the lowest in the world and similar, although just significantly lower in Britain (7.28 fatalities per billion motor vehicle kilometres, versus 8.44 and 8.48 in Sweden and the Netherlands).
- Traffic growth during 1980-2000 was largest in Britain and lowest in Sweden, and traffic densities on main roads in 2000 are also highest in Britain and lowest in Sweden. However, the motorway length per capita, area, and per number of motor vehicles is shortest in Britain and largest in Sweden.
- British risks are highest for pedestrians and for motorcyclists, but lowest for car occupants, compared to the other countries. Factors, which may explain these risk differences include the higher traffic density on British roads, the greater use of roundabouts at junctions, and the lower average speed on main inter urban roads.
- Car occupant risk is highest in Sweden. Factors that may explain this are the higher Swedish average speed on main roads, despite lower speed limits, and the lower traffic density and lower speed limit enforcement level.
- Dutch mopedists have almost twice the risk of mopedists in the other countries, and drive many more kilometres. Dutch cyclist risk is lowest, but is still higher than car risk even when the risk that cars inflict on other road users is included, and Dutch citizens cycle by far the most. Factors that may explain the low cyclist risk include the presence of large numbers of cyclists and the extensive implementation of cycle facilities.
- Sweden has 14% driver fatalities over 0.1% BAC in 2000 versus an estimated 17% in the Netherlands and a reported 20% in Britain. This may be explained by the differences in legal blood alcohol limit, enforcement policies, and penalties for offending in the three countries.
- Levels of child restraint use and seat belt use in front and back seats are high, but lowest in the Netherlands.
- The risk on motorways is almost five times lower than on other roads; this risk differs slightly in the three countries (2.0 per billion vehicle kilometres in Britain versus 2.3 in the Netherlands and 2.5 in Sweden).
- The risk on Dutch roads other than motorways is about a third higher than the risk on these roads in the other countries. Factors, which might explain this, include higher exposure and risk to mopedists, higher cyclist exposure, lower belt use, and higher junction density.

Main recommendations for future road safety improvements in the SUN countries

- Car drivers have a higher risk in Sweden than in the other two countries; traffic safety effort in Sweden should concentrate on car drivers and their speed behaviour.
- Britain would benefit from a lower blood alcohol limit for drinking and driving, more intensively enforced, but with some relaxation of penalties for the new lower limit offences.
- Britain needs to find an infrastructure solution that will enable pedestrian and vehicular traffic to co-exist at lower fatality levels, for example by extending the length of urban roads with 20mph (30kph) speed limits.

- Britain should also give greater emphasis to developing a more extensive high quality road network of similar density to that in the other countries; this could encourage greater acceptance of lower speeds on other roads.
- The Netherlands needs to understand why its moped rider risk is so high, in order to identify an appropriate solution.
- The Netherlands also needs to review its drink-driving problem to identify how best to make further reductions in alcohol related fatalities.
- The Netherlands needs to identify an effective strategy to increase seat belt wearing rates to a similar level as the other two countries.

Main conclusion for the Commission of the EU (and member states)

- The total fatality saving of the SUN country targets for 2010 is expected to be about one third compared to 2000, while the total fatality reduction of other EU member states derived from trend extrapolations of risk reduction and traffic growth is less than 40% in that period. Therefore, the EU target of 50% fatality reduction between 2000 and 2010 seems very ambitious and its achievement requires additional actions.

Main recommendations for the Commission of the EU (and member states)

- Create an EU fund for subsidies assigned conditionally to enlarged national investments on large-scale implementations of infrastructural road safety measures and substantially intensified enforcement on speeding, drink driving, and seat belt or child restraint use.
- Give high priority to new vehicle safety directives in order to give greater fatality reduction than the estimated average 10% reduction in 2010 compared to 2000 in the EU.
- Find suitable EU actions to encourage greater application of effective road safety measures in all EU member states. This could realistically be achieved by large-scale national implementations of infrastructural road safety measures and intensified enforcement on speeding, drink driving, and use of a seat belt or child restraint in all EU member states. The latter measures are mainly the competence of EU member states, but their investments on these highly effective measures are too low for their required large-scale application.

Main recommendations with respect to further (EU sponsored) studies

- Other countries may wish to develop similar analyses in relation to their own national safety problems and policies. The risk indicators for the SUN countries can be used as comparators against which to benchmark their performance in different aspects of road safety, taking into account the characteristics of the different national problems.
- Organising and supporting projects on road safety comparison between the SUN and other EU countries in order to understand the problems in each country and enable them to choose the best measures to improve road safety;
- Supporting a second phase of the SUNflower project for an extended study:
 - on pedestrian and motorised two-wheeler safety
 - on managing speeds
 - on novice driver risk and training,
 - on safety comparisons of some similar cities and regions
 - on influences of cultural differences on road safety policies and road traffic behaviour

- on institutional and organisational matters and funding mechanisms in and for road safety policies and programmes
- To investigate and understand the differences in national accident reporting, methodology for collecting exposure data, and the development of performance indicators to compare between countries, in order to confirm the robustness of the methodology proposed.

1. Objectives and methodology of the study

1.1. The objectives of the comparative study

The road safety records of Sweden, the United Kingdom, and the Netherlands (the SUN countries) are the best among the countries of the European Union (and in the world). Although road safety levels are good in the SUN countries, the toll of road crashes is still judged unacceptably high in each of these countries. Each country is searching for ways to further improve their road safety in order to reduce the burden of road traffic casualties in their countries. Despite macroscopic similarities (for example: target setting), their road safety strategies and actual activities seem to differ. So, the question arises what exactly made road safety improve in the SUN countries and, if specific beneficial aspects of measures, operational practices, or underlying concepts can be determined, what is the possibility for transfer of these aspects to another SUN country or other countries? A better insight into the relationship between the developments of road risks and road safety policies, programmes, and measures in these countries might conceivably identify key factors, which could further improve the current road safety practice in each of the SUN countries. This is the first objective of the SUNflower project, as the comparative study of the SUN countries is called.

Moreover, the methodology and findings of such a comparative study might also offer guidance for remedial action in other countries of the European Union as well. Learning from each other and putting learning into practice, is an indispensable part of gaining maximum improvement in road safety. Such improvements should be given high priority, considering that each year more than 40,000 citizens of the European Union continue to meet premature deaths on its roads. These fatalities, combined with the injury and damage accidents, also cause an annual economic loss of a few percent of the GNP in the European Union. The broader application of many effective road safety measures may not only reduce the burden of road fatalities and lost health and relief of grief and pain, but also represents cost beneficial investment of resources leading to an increase of economical welfare.

The comparative study of the effectiveness of road safety strategies in Sweden, the United Kingdom (or rather Great Britain, because often North Ireland is excluded in the reported data), and the Netherlands, is intended to contribute to outcomes that might be used in the Road Safety Action Plan for the period to 2010, which the European Commission is drawing up. The SUNflower project, therefore, has been partially subsidised by the European Commission, and the methodology of the study is designed in such a way that comparisons can be made by other member states. Thus the dissemination of the outcome of the study to all member states of the European Union is important; this has already been partially achieved by an international congress in April 2002. The closing address of that congress (Appendix A) and some of the points raised in discussion at the congress are included in this report.

The study was performed collaboratively by the central institutes for road safety research in the three SUN countries, respectively

- the National Road and Transport Research Institute (VTI) in Sweden
- the Transport Research Laboratory (TRL) in the United Kingdom
- the SWOV Institute for Road Safety Research in the Netherlands,

where the SWOV acted as main contractor for the SUNflower research project with respect to the European Commission. An Advisory Group (Appendix D), consisting of policy makers in the three countries, as well as delegates from the Commission of

the European Union, the European Transport Safety Council, and the OECD (Organisation of Economic Co-operation and Development), has supported the investigation, especially with regard to the search of policy-relevant study outcomes and their usefulness for other countries.

1.2. The methodological approach

The task is to describe and analyse differences in the national road safety policies and strategies, as well the different ways the road safety levels in Sweden, UK and the Netherlands have been achieved, in order to learn how we can benefit from each other. For the most part the data given for “UK” represent Great Britain, shown as “UK(GB)”. This is because the data for Northern Ireland is collected and held separately from that for the rest of Britain. However Northern Ireland has less than 5% of all UK fatalities, and their policies and practices are relatively similar, so the data for Great Britain give a good indication of the situation for the whole of UK. Special attention is given to

- Characteristics of each country:
 - o past, present and planned road safety policies as well as the relevant traffic background and the structure of the organisations involved in road safety,
 - o quantitative developments in growth of road traffic and reduction in risk, particularly since 1980.
- Specific problem areas:
 - o drinking and driving
 - o seat belts
 - o road safety aspects of infrastructure
 - low cost infrastructure improvements on urban and minor rural areas
 - main inter-urban roads (including motorways).

In the framework of this study it was not possible to cover all relevant and interesting road safety topics to be included in SUNflower as a case study. A selection had to be made which meant that some very interesting ones (speed and novice drivers, to mention just two) were excluded.

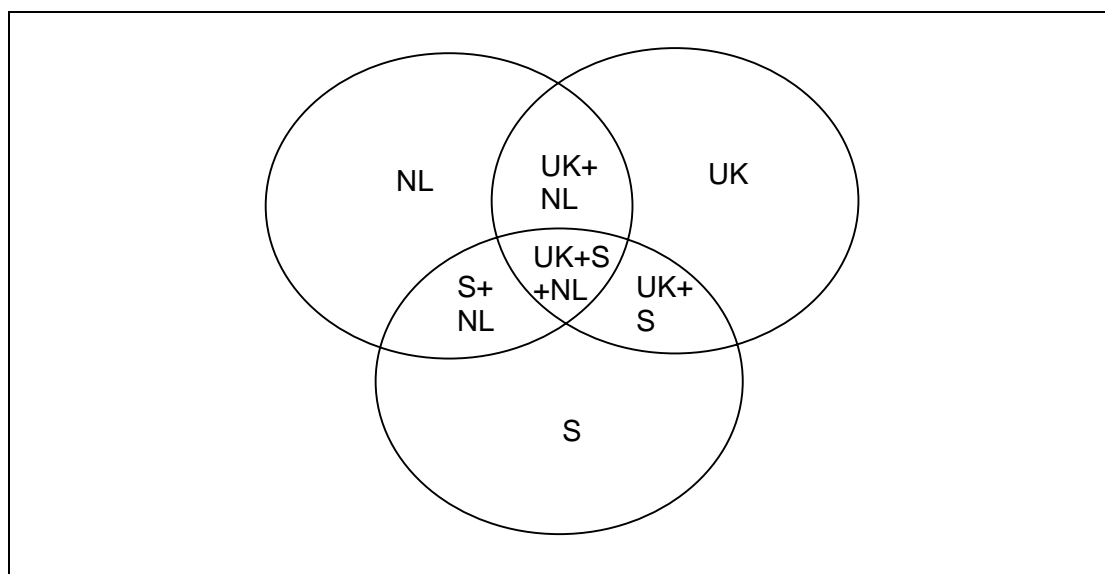


Figure 1.1. Differences and similarities in road safety aspects in the SUN countries

The quantities of areas in this figure are unimportant. The point is that there are trilateral and bilateral overlaps as well as unique aspects on all the topics that are to be described and analysed in the SUN project, with some factors comparable between all three countries, and some unique to only one. Examples that fall into each picture area can be given, prompting questions about the causes of differences. Quantitative target setting with respect to the reduction of fatalities is a common aspect to the three SUN countries, but there are also differences in specifying the target with respect to regions or class of roads (fatalities per province in the Netherlands) or per road user group (fatal and serious child casualties in the the United Kingdom). It might be that there are bilateral common aspects as well. All three SUN countries have an explicit policy plan on national road safety, which is discussed in or approved by parliament (a common SUN aspect), but the way it is executed may be quite different. The Vision Zero policy of Sweden and the Sustainable Safety policy in the Netherlands have much in common, but what about the infrastructural improvement aspects of these two policies? Are they common in Sweden and the Netherlands, or is that infrastructure aspect better covered by the good practice and road safety audits of the UK?

Each SUN country shows a trend of more or less regular decay of fatality risk (road fatalities per motor vehicle kilometrage), which thus is a common aspect. However, the slopes of the risk reduction differ for different periods in the SUN countries. On the one hand, in 1970 the risk levels of the UK and Sweden (to some extent) were already much lower than in the Netherlands, while the risk reduction after 1970 up to 1990 is steeper in the Netherlands. The questions are: (1) the reason for this initially higher risk level in the Netherlands and (2) the reason for the later observed, steeper risk reduction in the Netherlands? On the other hand, in the UK(GB) after 1985, a larger annual risk reduction than before has been achieved, despite its lowest risk level (illustrating that there is not yet diminishing effectiveness in even the safest countries). The annual risk reduction stagnated somewhat in the Netherlands between 1985 and 1995. How can these differences be understood by policy and/or action-related differences? After 1994 the annual risk reduction in the Netherlands improved again, while in Sweden the risk reduction seems to stagnate somewhat in the last decade. The question again arises whether this can be explained.

Drinking and driving and seat belt use are regulated by law, as a common SUN countries aspect. However, the legal limits of blood alcohol (BAC) for the drivers are different (0.2% BAC in Sweden, 0.5% in the Netherlands and 0.8% in UK), while the belt wearing rates differ (being lowest in NL). Also the enforcement policies for both road behaviour types have common and different aspects that need to be studied more in depth.

Although this descriptive scheme is mainly qualitative in nature, the specific analyses of the SUN project try to entangle the common, bilateral common and unique parts by some quantitative analysis, at least for the effectiveness of the main road safety measures taken and the effects of the known differences in the national transport systems. The main aim, then, is the estimation of the road safety benefits from each measure. If a potentially effective measure is not applied or not fully applied in a country, then the road safety in that country might be further improved by full application of that measure. But national differences in transport structure and/or culture can be a problem for the transfer of effective measures from one country to another.

The study uses a kind of benchmarking approach with respect to road safety for the SUN countries, which could be followed by other countries comparing themselves with the SUN countries. The relevant benchmarks that initially have been chosen for the comparative study are:

(1) the nature and content of the national road safety plans and action programmes,
(2) performance indicators (belt wearing rates, drink driving violations) – see for example ETSC, 2001 - and
(3) the final outcomes of road traffic fatalities in comparable terms of mortality (road deaths per inhabitant) and death rate per amount of exposure (amount of motor vehicle kilometres or travel kilometres of a road user type). The use of casualty data (deaths + injured) as final outcomes, although relevant, is problematic due to the different levels of under-reporting of road traffic injuries and is, therefore, hardly used. The description and analyses of each topic studied in the next chapters more or less follow the quantitative bench marking approach.

The thinking beyond the methodological approach is based on a road safety target hierarchy of “social costs .-final outcomes (number killed or injured) .-intermediate outcomes (performance indicators) .-programmes/measures .- structure/culture” as shown in the next diagrams that are adapted from the consultation document on the Road Safety Strategy 2010 of New Zealand (LTSA,2000).

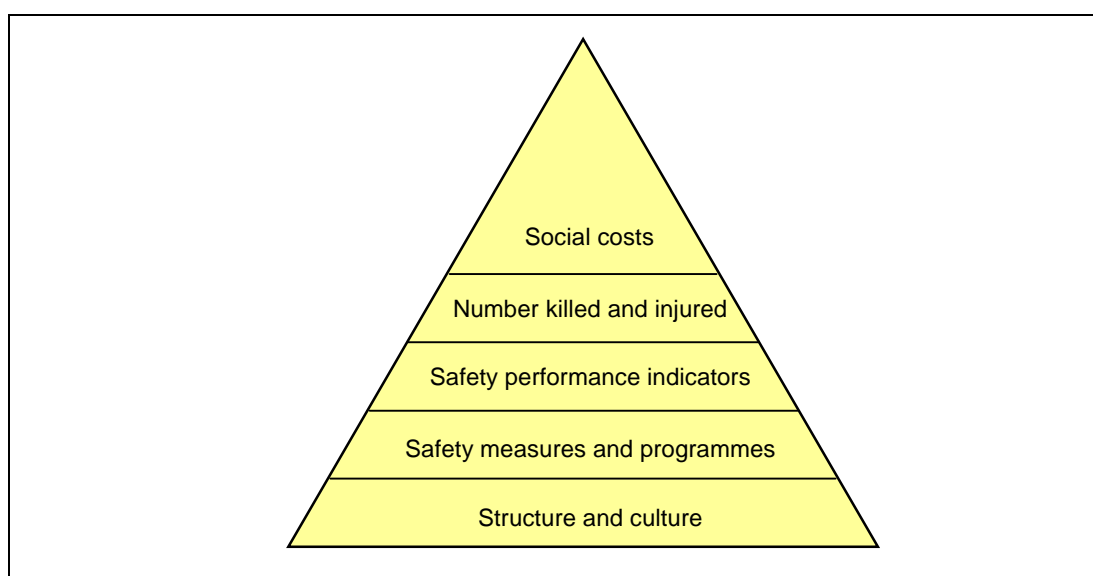


Figure 1.2. *A target hierarchy for road safety*

Each level in this hierarchy may be influenced by external factors. For example, demographic differences, or differences such as dark and snowy winters with elks crossing the roads in Sweden, drowning accidents in The Netherlands with its many canals, or the left-hand driving and longstanding use of roundabouts in the UK. Also, reporting practices can be different for each of the SUN countries. Injuries are differently under-reported by the police and crashes are categorised in different ways. For example, crashes with more than two vehicles involved are a category in the UK(GB), but they are categorised by the two vehicle types primarily involved in Sweden and the Netherlands, while fatalities on railroad crossings are not separately reported in the UK(GB).

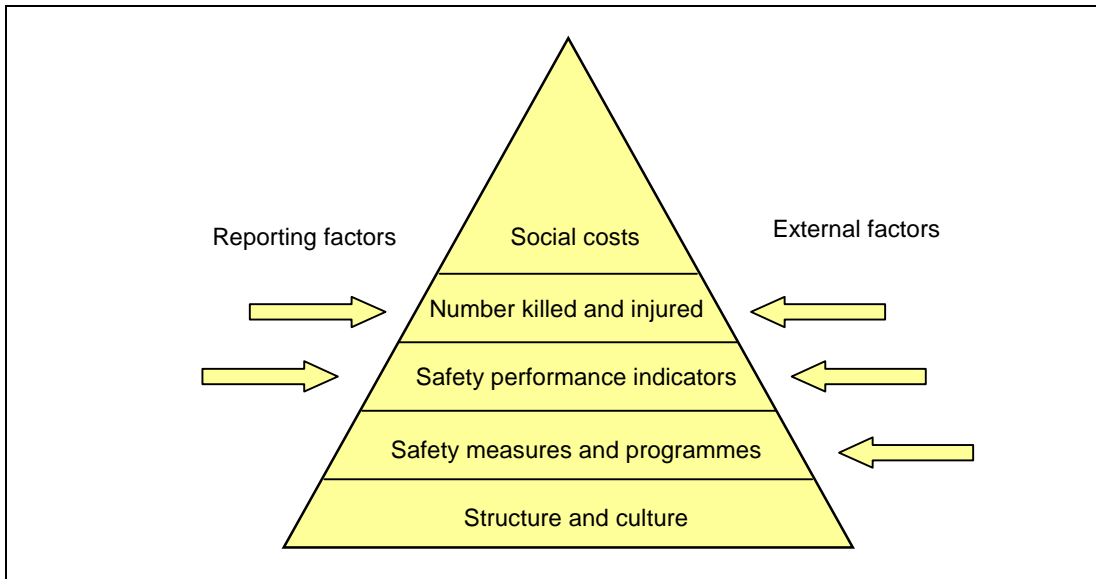


Figure 1.3. *A target hierarchy for road safety influenced by external factors*

These external factors together with reporting differences can make comparisons difficult or even invalid and, therefore, special attention must be given to the possibilities of such external factors and differential reporting practices. The system components and their developments over time of the SUN countries must be compared, which implies the three-dimensional comparison of the pyramidal outcome hierarchy (vertical dimension) of the system components in each of the three countries (horizontal dimension) over time (time dimension).

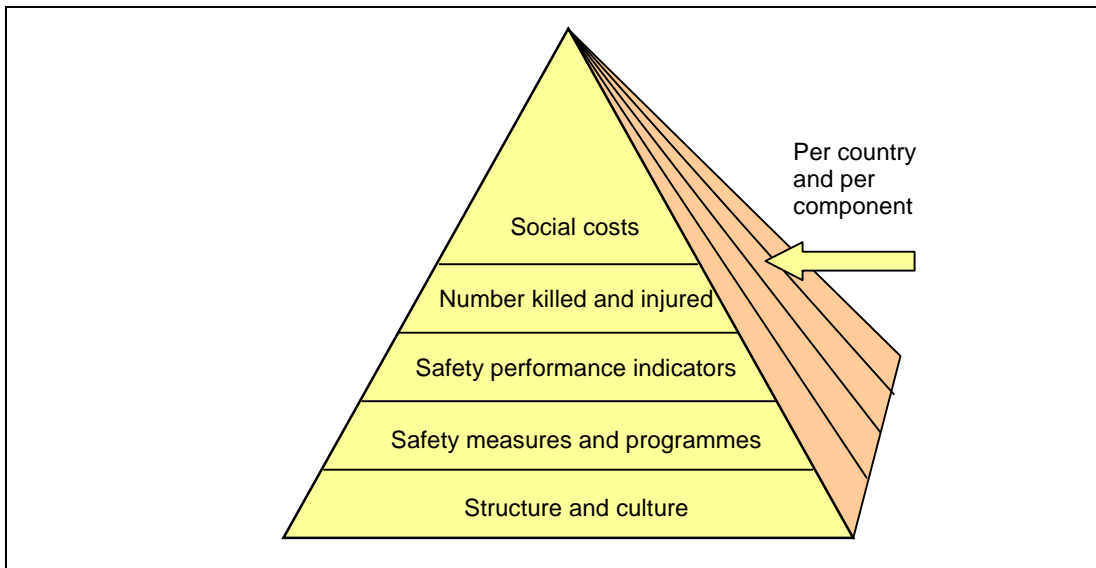


Figure 1.4. *A target pyramid: target hierarchy for road safety at a disaggregate level*

These comparisons are in the first place needed in order to understand the influence of differences on the level of programmes and/or measures. Secondly, the four case studies selected (belt wearing, drinking and driving, “small” and “large” infrastructure improvements) with their performance indicators on the level of intermediate outcomes

are needed to understand the differential effects on the level of the final outcomes for the SUN countries. Thereby the national differences in the development (time dimension) of the road fatality risks may be explained. The success of component comparisons between the SUN countries (with possible further component comparisons in a second study phase) and the feasibility of similar comparisons for other countries will be the basis for the methodology recommended for comparisons of other countries with the SUN countries.

1.3. Overview of chapter contents

Chapter 2 contains the topics of *Policy and organisation of road safety and the traffic background* in the SUN countries. It gives a historical overview of main national policies from 1970 to 1990, between 1990-2000, present, and future policies in Sweden, the UK, and the Netherlands. Also the national organisations for road safety and their tasks in the three countries are described, while the common and different policy and organisational features are investigated. The different backgrounds with respect to the (road) traffic systems in the three countries are also described and their relevance for the understanding of road safety differences is discussed.

Chapter 3 describes, analyses and compares the *Road safety situation in 2000 for the SUN countries*. For that year it contains the safety and exposure data and gives a general comparison of fatality risks for the different road user types and the different collision types. It contains more specifically relations between national transport exposure and safety differences and comparisons of fatalities per collision type and of fatality risks per transport mode and road type. Thereby, it describes and summarises the current common aspects and main differences of the road safety in the SUN countries.

Chapter 4 contains the case study on *Drinking and driving*. It gives a historical overview of policies on driving while intoxicated (DWI) in Sweden, the UK, and the Netherlands and describes the common and different aspects of the DWI policies as well as of their tactics and operational activities for compliance to their (different) DWI laws. The development of the numbers of DWI fatalities and casualties, where trends and deviations between Sweden, UK, and the Netherlands are described, are related to policy, tactics and operational differences with respect to drinking and driving.

Chapter 5 covers the case study on the *Use of seat belts and other protection devices in cars*. It contains an overview of policies on seat belt wearing in each of the three SUN countries and describes the common and different aspects. Also, the tactics and operational activities for the promotion of seat belt wearing are discussed. The present level and developments of seat belt wearing rates, its common trend and the deviations between Sweden, UK, and the Netherlands are related to policy, tactics and operational differences.

Chapter 6 describes the case study of *Low cost infrastructure improvements in urban areas and on minor rural roads* (including 30 km/h area treatments, roundabouts, black spots, pedestrian/cyclist measures etc.). Again an overview of infrastructure improvement policies in Sweden, the UK, and the Netherlands is given and the common and different policy aspects are discussed. Where relevant data are available, also the tactics, funding, and operational activities for infrastructure improvements are considered. The quantitative information on effects of measures on road safety improvement is researched and their influence on fatalities analysed for each country. The analyses are mainly based on the developments of fatalities and fatality risks, and

the local road engineering measures on minor rural roads and on urban area roads between 1980 and 2000. Common trends and differences in Sweden, UK, and the Netherlands are related to strategic and operational differences, describing and trying to explain common and different effects of infrastructural measures in residential areas and main urban roads on national safety developments.

Chapter 7 contains the case study on *Infrastructure of high quality inter-urban road network*. It describes a historical overview of national policies on the inter-urban road network in the three SUN countries. The common and different aspects of the road safety on their inter-urban road networks are highlighted. Quantitative information on the comparable road types per country are analysed and the differences in level and developments of fatalities or fatality risk on the inter-urban networks (for example by roads with different speed limits) are related to differences in average speed, traffic flow density, and speed enforcement levels.

Chapter 8 on *Using past trends to inform future policies* contains an explanatory analysis of the road safety developments in the three SUN countries. It presents a quantitative description and analysis of developments in fatalities, related to details of road safety measures for road user modes and road types (motorway, rural roads, built-up area roads), growth of exposure (motor vehicle kilometres or kilometres travelled by road user types). Thereby an explanation of the risk developments is presented. Notably the effectiveness of road safety measures on risk reduction is discussed for the effects of vehicle safety improvements, seat belt wearing, drink driving policies, small and large infrastructure measures, as well as effects of other measures. It further discusses what can be learnt from recent risk trend comparisons for road user and road types and what this may imply for the explanation of different past performances and for strategies and future potential. Appendix B contains information to discuss priorities for future measures or strategies in the SUN countries.

The last chapter 9 contains *Conclusions and recommendations*. It summarises the main findings for the SUN countries from the previous chapters, draws conclusions on the usefulness and limitations of the methodology and research design used, and formulates recommendations for:

- wider and other comparative studies,
- further improvements of road safety in the three SUN countries,
- a European road safety policy.

1.4. The potential usefulness of the study

The study relies strongly on the use of high quality data that must be comparable. It is thus implicitly and firstly an attempt to get insight in the reliability of the use of national data for international comparisons and, as such, is a preliminary test for the use of other national data in the CARE-database for national road safety purposes. Secondly, it is an attempt to define the relevant benchmarks (size and nature of programmes/action plans/measures, intermediate and final outcomes) for a road safety comparison. Thirdly the study aims to contribute to the science-based understanding of differences between benchmark values. Fourthly the study tries to customise the findings into “good practices” for road safety comparisons. Finally, it is aimed to learn how road safety policies and/or actions can be optimised in the SUN countries and to learn how further comparisons of other countries with the SUN countries can be performed. Thereby it is meant to contribute to the improvement of road safety programmes and/or actions of the countries in the EU and of the EU itself.

Thus, by determining the underlying effective elements in policies and programmes of the SUN countries and the assessment of their impacts on the improvement of road safety, the results support

- the optimisation of the future road safety strategies for each SUN country.
- The further results are:
- a proven methodology for
 - o road safety comparisons of countries
 - o bench marking of road safety measures and their effect evaluation.
- study outcomes that can be used by
 - o the European Commission for their future road safety policy,
 - o other EU member states EU applicants states and other countries for their road safety plans and advice on effective measures.

2. Road safety policy and organisation and the traffic background

2.1. Historical overview of main national policies

2.1.1. Sweden

Traffic safety in Sweden has been highly influenced by the change from left to right hand traffic in September 1967. The period around the change meant a re-education of the population, a re-construction of the road network and new vehicles for public transport. Traffic safety had a high priority. The change was combined with very low speed limits and afterwards a lot of trials with different speed limit systems were tested and resulted in the speed limits of 50, 70, 90, and 110 km/h in 1972. The differentiated speed limit system has been about the same up to today. A new authority, the Road Safety Office, was established in 1968. Motor vehicle inspection has been mandatory since 1965, originally required annually for every car over 2 years old.

A list of specific road safety activities in Sweden for the period of 1970-2000 can be found in Appendix C. A more general description follows here. As the acceptance of traffic safety measures was high during the 1970s, seat belt use in the front seat of passenger cars became mandatory in 1975, together with a helmet law for motorcyclists in 1975 and for moped riders in 1978. Daytime running lights was introduced in the autumn 1977. The annual number of fatalities was reduced from 1200 to 700 between 1975 and 1983 and Sweden became the safest country in the world up to the mid 1980s. In the rest of the eighties the traffic safety situation was mainly influenced by the good national economy leading to increased traffic, and the number of fatalities in 1989 increased to 900. The mandatory use of seat belts was introduced for children in 1988 and for adults in the back seat in 1996. The high number of fatalities in 1989 resulted in the speed limit of 110 being replaced with 90 km/h during the summer of 1989 including on motorways in the region of the big cities until the spring of 1992. Since 1993, young drivers could get a learner's permit for driving under supervision in real traffic from the age of 16. In 1999, motor vehicle inspection requirements were modified to start with 3 year old cars and then annually after cars were 5 year old cars.

In the National Traffic Safety Programme of 1990, a quantitative target was set for traffic safety work: less than 600 fatalities in the year of 2000. In 1993, the Road Safety Office merged into the Swedish National Road Administration (SNRA) or Vägverket. The SNRA, now responsible for national traffic safety work, presented in 1994 a National Traffic Safety Programme for the years 1995 to 2000. A new or revised target of 400 fatalities for the year 2000 was set as the old target was reached in 1994. The intentions of that programme, with ten sub-targets for traffic behaviour, have not been reached but have vanished with the discussion of the concept of the Vision Zero. The annual number of fatalities has been constant during the period 1994 to 2001. In 2000, there were 591 deaths and 4,103 serious injuries in traffic.

Vision Zero is the philosophy and long-term guideline for traffic safety actions in Sweden after 1997 when it was approved by the Swedish Parliament. It aims at a future traffic structure in which measures have been taken so that no one is killed or seriously injured as a result of a traffic accident. In the Vision Zero approach, the emphasis is moved away from enhancing the ability of road users to cope with an imperfect system. Instead, it is acknowledged that traffic accidents cannot always be avoided, since

people sometimes make mistakes. Therefore, these accidents have to be prevented from leading to fatalities and serious injuries by designing roads, vehicles and transport services in a way that someone can tolerate the violence of an accident without being killed or seriously injured. Roads and vehicles have to be made much safer. People have to be made much more aware of the importance of safe behaviour in traffic. According to Vision Zero, everyone shares responsibility for making traffic safer: politicians, planners, road maintenance organisations such as the SNRA and municipalities, transport service providers, vehicle manufacturers, and road users. The operational translation of the Vision Zero philosophy was not yet specified in 1997, nor was the deadline to meet the ultimate objective set, but an interim target was specified. The target for 2007 is a 50% reduction in fatalities, compared with the 1996 level. In 1999, a short-term action plan was launched by the Swedish government, containing 11 points aimed at strengthening and stimulating traffic safety work in accordance with the Vision Zero principles:

- A focus on the most dangerous roads (e.g. priority for installing centre-guardrails for eliminating head-on collisions, removing obstacles next to roads, etc.)
- Safer traffic in built-up areas (e.g. a safety analysis of street networks in 102 municipalities led to reconstruction of streets; the efforts are continuing.)
- Emphasis on the responsibilities of road users (e.g. creating more respect for traffic rules in particular with regard to speed limits, seat belt use, and intoxicated driving.)
- Safe bicycle traffic (e.g. campaign for using bicycle helmets, a voluntary bicycle safety standard.)
- Quality assurance in transport work (e.g. public agencies with large transportation needs will receive traffic safety (and environmental impact) instructions on how to assure the quality of their own transportation services and those procured from outside firms.)
- Winter tyre requirement (e.g. a new law mandating specific tyres under winter road conditions.)
- Making better use of Swedish technology (e.g. promoting the introduction of technology - available or to be developed - that relatively soon can be applied, like seat belt reminders, in-car speed adaptation systems (ISA), alcohol ignition interlocks for preventing drinking and driving, and electronic driver licenses.)
- Responsibilities of road transport system designers (e.g. establishment of an independent organisation for road traffic inspection is proposed by a commission of inquiry on the responsibilities of the public sector and the business community for safe road traffic.)
- Public responses to traffic violations (e.g. a commission of inquiry is reviewing existing traffic violation rules in the light of the Vision Zero principles and of ensuring due process of law.)
- The role of voluntary organisations (e.g. the government is evaluating the road safety work of the 'Nationalföreningen för trafiksäkerhetens främjande' (National Society for Road Safety, NTF) and its use of state funds.)
- Alternative forms of financing new roads (e.g. possibilities are studied for other forms of supplementing public financing of major road projects.)

In the autumn of 2001 the Government presented an infrastructure plan, where the traffic safety work will fulfil the target of 2007.

2.1.2. Great Britain

Attention to traffic safety has a long tradition in Great Britain. Driving licences and vehicle braking requirements, for instance, were already introduced in the year 1903. A Highway Code was issued in 1931. Three years later the first pedestrian crossing appeared. In fact, during the first 70 years of the last century, many safety related

measures were taken, often ahead of their introduction in other countries. In the more recent period that this chapter deals with, important safety initiatives were taken in order to improve the professional approach to the traffic safety problem and ensure a systematic approach to its improvement. A list of specific road safety activities over 1970 - 2000 can be found in Appendix C. From 1972 onwards training in accident reduction techniques has been provided for local safety engineers. The Institution of Highways and Transportation published guidelines on accident reduction and prevention in 1980 (updated in 1991). The Local Authorities Associations produced a Code of Good Road Safety Practice in 1989 (updated in 1996). The Institution of Highways and Transportation produced Guidelines for Urban Safety Management in 1990 and Guidelines on Road Safety Audit in 1990 (updated in 1996). Safety audits by independent safety experts became mandatory on motorways and trunk roads in 1991.

In 1987, the Government set a national target of reducing road traffic casualties by a third compared to the average for 1981-1985. Measures to achieve this turned out to be effective in reducing the number of deaths on the road by 39% by 1998 and the number of serious casualties by 45%. However, over the same period the number of slight casualties increased by 16%. In 1998, fatalities were reduced by 5% from 1997, and all casualties decreased by 1%.

In 1996, the Safer City-project was launched investing some 5 million pounds on area-wide safety engineering measures in a medium sized town. It reflected the growing attention in Great Britain on the traffic safety problem inside built-up areas. Traffic calming and speed reduction measures already had high priority in many municipalities and the Institution of Highways and Transportation had already produced its Guidelines for Urban Safety Management. The project, however, aimed at demonstrating in practice the benefits of an integrated application of measures of this kind.

In 2000, a new road safety strategy was published by the Government (DETR): "**Tomorrow's Roads - Safer for Everyone**", which set new casualty reduction targets for 2010. These targets are:

- a 40% reduction in the overall number of people killed or seriously injured in road accidents,
- a 50% reduction in the number of children killed or seriously injured, and
- a 10% reduction in the slight casualty rate per vehicle kilometre, all compared to the average for 1994 - 1998. As stressed in the programme, the Government cannot achieve such targets without the co-operation of all other stakeholders involved: local authorities, police, the motor industry, road user organisations, and above all the individual road users. The main spirit behind the programme is that road crashes are not solely random events and that serious outcomes of road crashes are avoidable to a large extent. The programme itself addresses 10 main themes, each clearly elaborated in a strategy, a set of specific actions or points of attention, and a timetable for their implementation. The themes are:
 - safer for children
measures include more traffic calming, child safety audits, home zones, improved child restraints, national guidelines on pedestrian training, improve school resources, increase parent involvement, support school travel plans, encourage cycle training and use of cycle helmets, encourage community training schemes increase access to road safety materials via the Internet
 - safer drivers training and testing
measures include more road safety education in schools, logbook scheme for learner drivers, raise standards of driving instructors, develop theory test and add hazard perception tasks, consider further changes to practical driving test, consider

introduction of P plates, raise standards of fleet driver and advanced driver training, publicise dangers of mobile phones, develop better information and assessment for older drivers

- safer drivers - drink drugs and drowsiness
measures include review of penalties for drink drive offenders, review high risk offender scheme, increase number of rehabilitation course, strengthen police powers for roadside testing, introduce evidential breath testing, consider changes to drink drive limit, develop drug screening devices, support police drug recognition training, improve publicity on fatigue and continue research on driver fatigue and on accident risk of commercial drivers
- safer infrastructure
measures focus on development and improvement of local transport plans and the delivery of their safety content, cascading good practice from Gloucester Safer City urban safety management project, and implementing the actions in the Highways Agency safety plan for the national road network
- safer speeds
measures include revised guidance on setting local speed limits, increasing number of 20mph zones, creating a better speed management strategy and speed hierarchy for roads, development and extension of speed camera funding, explore use of new technology for speed reduction, extend use of controlled motorways, improved publicity campaigns,
- safer vehicles
measures include continued support for EuroNCAP, improved side and front impact compatibility, improved pedestrian protection, intelligent seat belts, improved seat belt wearing rates, front under-run guards for HGVs, improved vehicle lighting and braking
- safer motorcycling
measures include new licensing rules for learners, enhanced training, developing guidance for older motorcyclists, working towards a new helmet standard
- safer pedestrians, cyclists and horse riders
measures include local plans for walking and cycling measures, home zones, raise driver awareness of vulnerable road users through better training, promote cycle helmet wearing,
- better enforcement
measures include improving public awareness of penalties, research into dangerous driving, consider increase in penalties for careless driving and for speeding, improve driver improvement schemes
- promoting safer road use
including closer liaison on publicity campaigns, use of information technology, support-advertising regulators in cracking down on irresponsible speed-related advertising.

2.1.3. The Netherlands

Forced by the sharply rising number of traffic fatalities in the Netherlands from the end of World War II (about 1,000) to the early 1970's (over 3,000), a lot of measures were taken in the relatively short period of time of about one decade. Important measures concerned, for instance, speed limits for the different parts of the road network, the physical protection of car-occupants and moped drivers, drinking and driving legislation, and the use of traffic calming measures in built-up areas. Again a list of specific road safety activities over 1970 - 2000 can be found in the Appendix C. Over the period 1973 - 1985, the remedial actions resulted on average in a yearly risk reduction of about 9%, while for the last four decades annual reductions of the order of 6.5% were achieved.

In 1983, a National Road Safety Plan was issued. As in many other countries, the then customary philosophy was still: “the solution to the problem is to take away its cause”. In fact, the policy plan can be characterised as an extensive list of measures of this kind. Soon afterwards it was recognised, however, that there were some drawbacks with such a mono-causal approach, since, for instance, it did not take into account that a solution for one cause might increase problems of another kind, nor that a different solution might solve other problems as well. Facing the complexity of the road safety problem, in the next period principles were developed on the segregation and/or integration of incompatible travel modes and/or traffic participants, on a hierarchical road-infrastructure, on pedestrian precincts, on bicycle paths and routes, on traffic circulation, etc. This resulted in an integrated road safety philosophy, which has been the basis of long-term road safety policy plans since the mid-1980's:

- The first “Long-term Road Safety Plan” (MPV-I) was issued in 1987. The plan set a target of 25% less injury accidents for the period 1985 - 2000. To realise this, “spearheads” or focus areas were defined as drinking and driving, speed, hazardous locations, children, the elderly, and safety devices. Basically, the approach had a reactive and curative character, aimed at addressing problems when and where they occurred.
- In 1989, a new edition of the 'Long-term Road Safety Plan' (MPV-II) was released. It paid further attention to the spearheads. Apart from this, it emphasised the importance of participation in the policy processes by local and provincial authorities and other stakeholders.
- Soon after in 1990, the road safety target was redefined and accentuated in the second “Structure Plan for Traffic and Transport” (SVV-II), in which the target became a 50% reduction in fatalities and 40% in injury accidents for the period 1986-2010.
- In the early 1990's, it was no longer taken for granted that the latter targets would be met by means of the spearhead policies alone. It also became obvious that the spearhead policies were not effective in addressing problems at their source. In a study by nearly all Dutch road safety research institutions led by SWOV and titled - *Towards a sustainable safe traffic system*- an outline of a new vision was developed for coping with the road safety problem in the next decades. It stressed a preventive, structural, and lasting approach.
- In response, MPV-III, issued in 1991/92, adopted a two-sided policy of renewing and intensifying the spearhead approach on the one hand, and the implementation of this “**sustainable safety**” vision on the other.

The starting point of the concept of “sustainable safety” is to drastically reduce the probability of accidents in advance, by means of infrastructural design. In addition, where accidents still occur, the process that determines the severity of these accidents should be influenced in such a way that serious injury is virtually excluded. The concept is based on the principle that “man is the measure of all things”. A sustainable safe traffic system has an infrastructure that is adapted to the limitations of human capacity, through proper road design, vehicles equipped with tools to simplify the tasks of man and constructed to protect the vulnerable human being as effectively as possible, and a road user who is adequately educated, informed and, where necessary, controlled. The key to arrive at a sustainable safe traffic system lies in the systematic and consistent application of three safety principles:

- functional use of the road network by preventing unintended use of roads;
- homogeneous use by preventing large differences in vehicle speed, mass and direction;

- predictable use, thus preventing uncertainties amongst road users, by enhancing the predictability of the course of the road and the behaviour of other road users.

The three safety principles require the specification of the intended function of each road and street. Roads should be built with one of three major traffic functions in mind. These are:

- the flow function: enabling high speeds of long distance traffic and, often, high volumes;
- the distributor function: serving districts and regions containing scattered destinations;
- the access function: enabling direct access to properties alongside a road or street.

Besides a traffic function, streets and roads in built-up areas should allow people to stay in the vicinity of their house safely and comfortably. This so-called residential function could well be combined with the access function. Furthermore, road users must be prepared to accept the restrictions of their individual freedom in return for an improved level of safety. Acceptance of such restrictions could perhaps be achieved by applying social marketing strategies. Education could and should play an important role in the transition period from the traffic system of today to the sustainable safe system. Education could concentrate on the why and the wherefore of sustainable safety. Public awareness, public participation, and education should create support for implementation and find their place alongside implementation of other key elements of this vision.

With respect to vehicles, the diversity of vehicles should be kept to a minimum. Furthermore, the various types should be clearly distinguished. When used in the same traffic area, vehicles should demonstrate the same behaviour as far as possible, or otherwise be provided with separate facilities. In the sphere of passive sustainable, safety provisions are those that work independently of the driver or the passenger: 'built-in' devices like solid passenger compartments of cars, combined with crushable zones and airbags (in addition to the compulsory use of seat belts). Improvement of the front-end design of cars, to reduce injuries to pedestrians and cyclists, is relevant as well. In the field of active safety a lot of progress may be expected from devices which provide relevant information to the road users, improve their observation, or simplify their tasks (emergency manoeuvres). The practical application of electronic equipment is now being emphasised. An interesting development is the so-called Intelligent Speed Adapter (ISA). This device prevents the speed of a vehicle from exceeding a location-specific maximum, by means of electronically- sent signals from its surroundings. The technology for the components of this device is available; integration of these components has not yet been realised, however. Two real problems have to be solved: gaining public acceptance and support, and developing an implementation strategy.

The consistent application of the three sustainable safety principles on the functional, homogeneous and predictable use of the road network requires the support of all actors and their commitment to implement measures in a co-ordinated manner. In order to create such a partnership, the key stakeholders had to be involved in developing the vision and its implementation. With a view to promoting and enhancing the implementation of measures of this kind, the central government, the representative bodies of the provincial and the local administrations, and the Union of Water Boards agreed upon an action programme for the period 1997 - 2002. This so-called Start-up Programme, regarding in fact the first phase of their combined efforts, defined the accepted tasks and shared responsibilities for the execution of the planned programme of measures. The central government was providing one half of the total financial

means required (approximately €110 million); the other partners the second half. The following measures are part of this Start-up Programme:

- road classification programme (for the complete road network of almost 120,000 kilometres of road length), which lets roads fulfil their functions satisfactorily and forms a basis to solve the problems of contradictory design requirements;
- stimulate a low-cost introduction of 30 km/h-zones inside built-up areas (excluding roads with a flow or distributor function); an extension of possible 30 km/h-zones, from 10% at the start of the period to 50% by the end of 2000, was agreed upon;
- use simple means to introduce 60 km/h-zones for minor rural roads; aiming some 3,000 kilometres of road length in 60 km/h-zones to be realised at the end of 2000;
- if necessary and possible, infrastructural measures like cycle facilities, roundabouts, and small-scale measures to support 30 km/h-zones or 60 km/h-zones;
- inside urban areas require mopeds to use the carriageway instead of cycle tracks or cycle paths;
- indication of 'right-of-way' at every junction (outside the 30 km/h-zones); bring the priority rules for cyclists and mopeds into line with the rules for motorised traffic;
- public information campaign to support the introduction of Sustainable Safety; better law enforcement by the police and education programmes;
- the introduction of a road safety audit;
- intensified surveillance and traffic law enforcement;
- supportive measures for knowledge transfer, and
- the planning of the second implementation phase of Sustainable Safety.

In parallel with this first stage of implementing the Sustainable Safety programme, the proposed National Traffic and Transport Plan for the Netherlands, 2001 - 2020 has been debated in Parliament, but has not yet been formally accepted. With regard to safety, the proposal defines and clarifies the responsibilities of all stakeholders. Moreover, it states: "Greater mobility should not be achieved at the cost of safety and quality of life. There is a notable pay-off to be achieved here in further reducing traffic casualties, hence the follow up of the Sustainable Safety Programme". This proposal involved boosting the safety of the infrastructure, training, information, and stricter enforcement of traffic rules, as well as measures to reduce the pressure on the subsidiary road network which will benefit its safety, and substantial further expansion of 30 and 60 km/h road networks. A revised plan is now being drawn up.

2.2. The national traffic safety organisations for road safety

2.2.1. Sweden

Sweden is governed at three different levels: the central, the regional, and the local level:

- The central level includes the Parliament, the Government and its ministries, and the central government agencies. The State has general responsibility, among others, for the security and well being of citizens.
- At the regional level, Sweden is divided into 21 counties, each with a county administrative board. The boards represent the central government at the county level. Among other things, they are responsible for police matters. Each county constitutes a police district. The county councils handle, in general, matters that are too comprehensive and costly for individual municipalities.

- At the local level, Sweden is divided into 289 municipalities. Within certain limits, municipalities and county councils have independent powers of decision-making. They are obliged to provide certain basic and/or vital facilities and services.

Most traffic and transport in Sweden takes place by road. The road network is divided into state roads (i.e. European highways, other national roads, and county roads), local authority streets and roads, and private roads (a quarter are publicly used and maintained, but the remainder are unpaved forestry roads).

The Swedish National Road Administration (SNRA) or Vägverket, is the national authority assigned the overall sector responsibility for the entire road transport system. This system is made up of the people who use the system, the physical infrastructure, and the rules and information that support the system. Consequently, the SNRA is responsible for drawing up and applying road transport regulations. It is responsible for the planning, construction, operation and maintenance of the state roads. The sector responsibility involves also representing the State at national level in issues relating to the environmental impact of the road transport system, road traffic safety, accessibility, level of service, efficiency and contributions to regional balance. The responsibilities regard also issues relating to intelligent transport systems, vehicles, public transport, modifications for the disabled, commercial traffic in addition to applied research, development and demonstration activities within the road transport system. SNRA manages the state-owned road network in counties and exercises supervision of the municipal road management. A quarter of the private road lengths (publicly used, 3% of total kilometrage) are entitled to public grants.

In the interests of road safety, SNRA co-operates with the police, the 289 municipalities, and all the other stakeholders. The police forces are responsible for surveillance and enforcement. The municipalities are responsible for road safety within urban areas, except on roads under the jurisdiction of SNRA. Other participants in road safety work are the county administrative boards, the National Society for Road Safety NTF, and a variety of organisations representing the disabled. NTF is a grassroots organisation whose members include 21 county road safety federations and some 70 national organisations. A large proportion of its work is state-financed. Besides that, SNRA co-operates with insurance companies and the Swedish automotive industry that is active in improving road safety by changing the design of vehicles. The Swedish Motor Vehicle Inspection Company (AB Svensk Bilprovning) is responsible for annual inspections of motor vehicles registered in Sweden.

A former Swedish Transport and Communications Research Board (Kommunikationsforsknings-beredningen, KFB) has acted as an independent body. In cases where responsibility did not rest with other government agencies, KFB initiated and financed transport and transport safety research, to be carried out by research institutes. Shortly, such activities will in future be carried out by the Swedish Agency for Innovation Systems (VINNOVA).

Research and Development related to traffic safety are pursued by the Swedish National Road and Transport Institute (Väg- och transportforskningsinstitutet, VTI), as well as by some universities and some public and private research institutes. VTI conducts applied research, commissioned by the transport sector, in the fields of infrastructure, traffic and transport. Their expertise covers traffic engineering, traffic safety, economics of transport, environmental aspects of transport systems, railway engineering, road user behaviour, vehicle engineering, human factors, collision safety and the planning, design, construction, maintenance and operations of highways and railways. Such R&D is mainly financed by the government.

2.2.2. United Kingdom

Road safety policy at national level in England is the responsibility of the Road and Vehicle Safety Directorate of the Department for Transport (DfT). DfT is supported by the Home Office, which is responsible for policy on policing and the courts, by the Department of Health, and by the Department for Education, which is responsible for schools policy. The Scottish Executive and Welsh Assembly have responsibility for various aspects of road safety policy in Scotland and Wales, respectively; working closely with the DfT. Road Safety policy in Northern Ireland is the responsibility of the Department of Environment and the Department of Education in Northern Ireland. Several executive agencies are related to DfT, taking responsibility for various government road safety functions. The Highways Agency is responsible for delivering the DfT's road programme and for maintaining the national road network of motorways and trunk roads in England. The Driver and Vehicle Licensing Agency is responsible for issuing driver and vehicle licences, and the Driving Standards Agency for maintaining driver-training standards and for the register of driving instructors. The Vehicle Certification Agency and the Vehicle Inspection Agency support the DfT Vehicle Standards Engineering Division in maintaining vehicle regulations. Under the jurisdiction of the Home Office, 52 regional police forces are on duty in the UK, each responsible for policing in its area. Most police force areas cover similar geographical areas as one or more local highway authority areas. The police are responsible for surveillance and enforcement. The Association of Chief Police Officers oversees several subgroups developing police policy on road safety matters. R&D on traffic safety is funded mainly by the DfT Road and Vehicle Safety Directorate, and by the Highways Agency, but substantial programmes are also funded by various foundations such as the AA Foundation for Road Safety Research.

Road safety policy in Great Britain is a part of transport policy. As recently stated in the 'Transport 2010; The 10 Year Plan', the basic principle is that "*people travel safely and feel secure whether they are on foot or bicycle, in a car, on a train, or bus, at sea or on a plane*". In the national road safety strategy "Tomorrow's Roads – Safer for Everyone", a new long-term target was set to reduce the number of people killed or seriously injured in road accidents by 40%, and children by 50%, over the next decade. "*This aim will involve action by everyone to achieve it, including government, local authorities, the police, and car makers*". The Plan provides the resources to enable central government, the Highways Agency and local authorities, through their Local Transport Plans, to take action on road safety to support this strategy. Local authorities have to report annually on their Plans and their progress towards meeting the national casualty reduction target.

A large number of non-governmental organisations (NGOs) are involved in the road safety debate in Britain. They are encouraged to comment on the progress of the government's programme to achieve the casualty reduction target, through membership of a road safety advisory panel to which DfT reports its activity. A major part of this strategy involves local casualty reduction programmes. Prominent among these is the Parliamentary Advisory Council for Transport Safety, which informs parliamentary representatives on road safety issues. Other NGOs represent the interests of user groups such as pedestrians, cyclists, motorcyclists, motorists and freight transport. Other organisations contributing to road safety include the Royal Society for the Prevention of Accidents (RoSPA) which monitors all accidents including leisure accidents, household accidents, and accidents in course of work, and the Institute for Advanced Motorists (IAM) which provides higher level training and assessment for experienced drivers.

TRL is an independent centre of research in surface transport issues and the leading national provider of road safety research. The organisation provides research based technical help that enables customers to obtain improved value for money, generate competitive advantage and a better understanding of transport problems. TRL employs a staff with a wide range of professional disciplines. Facilities include a driving simulator, an indoor impact test facility, a test track, and separate self-contained road network. Many universities and consultant groups also contribute to the national research programme. Some research tests for vehicle safety are also carried out by test centres such as the Motor Industry Research Centre (MIRA) and the Millbrook Test Centre.

Various professional groups have made major contributions to road safety engineering practice through development and dissemination of good practice; an important example is the Institution of Highways and Transportation (IHT). The IHT is a society concerned specifically with the design, construction, maintenance, and operation of sustainable transport systems and infrastructure. Its aims are:

1. to provide a forum for the exchange of technical information and views on highways and transport policy;
2. to produce practical technical publications; to provide specialist advice to government and other bodies;
3. to make roads safer for the travelling public; and
4. to encourage training and professional development to meet today's requirements.

2.2.3. The Netherlands

The organisation of traffic safety action in the Netherlands can be characterised as involving all stakeholders in traffic safety. The kind of organisational model, thought to be originated from the way polders traditionally are administered, is often described as 'the polder model'. It mirrors the view that the citizen is competent in arranging - and responsible for - his own affairs, with a minimum of statutory means and a maximum of forming coalitions and alliances. Consensus, self-regulation, a situation in which each of the partners is achieving profit, etc., is still primarily striven for in advance; the national government primarily acting as a judge, stimulator, mediator, catcher, etc. It is found again in policies on the decentralisation of national tasks, on privatisation of public enterprises and institutions, etc. It is also found again in the 'National Traffic and Transport Plan for the Netherlands, 2001 – 2020', with, as motto: "decentralised, if possible; centralised, if necessary". As a result, road safety policy is drawn up and executed at different government levels: national/state, regional, and local. Furthermore, a number of different government sectors are involved in the policy making for road safety, each with its own task and powers: road authorities, police, justice, education bodies, etc. Since each level has its own task and powers, it is not always easy for one level to commission a lower level without mutual consent. For example, although responsibilities for construction and maintenance of roads are clear (the state is responsible for the national roads, the provinces for provincial roads, and the municipalities for municipal roads), the state, provinces, and municipalities are co-operatively responsible for the road network consistency. Other aspects of governmental action (e.g. enforcement of traffic laws, education) are the decentralised responsibility of governmental bodies at different levels. They are, however, not necessarily provincial and municipal organisations. The police and justice organisation also have their own levels and regional structures, as well as education independently having its own services. As a consequence, in order to conduct a coherent road safety policy, horizontal co-ordination (between sectors), and vertical co-ordination (between levels) is required.

The Ministry of Transport, Public Works and Water Management (MoT) has a central responsibility for road safety policy as far as road users, vehicles and infrastructure are concerned. Since 1992, a consultation body on road safety: 'Overlegorgaan Verkeersveiligheid' (OVV) exists. All key actors (including private sector) are represented in this body. It serves by law as a platform for obligatory consultation on the intended policies of the Minister of Transport with respect to organisational matters and subjects that are primarily the responsibility of other ministries, but being adjacent to traffic safety. The OVV has its own independent chairman and secretariat. It produces a 'Report of Findings' on subjects discussed. Governmental representatives include: the Netherlands Police Institute, the Public Prosecutor's Office, the Inter-provincial Co-operation Organisation (IPO), the Dutch Waterboards (UvW) and Union of Dutch Municipalities (VNG). Moreover, private sector and social organisations are represented, such as: Royal Dutch Tourist Club (ANWB), the Central Driving Test Organisation CBR, Driver Education Organisation (BOVAG), Vehicle Industry (RAI), the Truckers Industry, (TLN) the Dutch Cyclists' Union, Motorcyclists Association (KNMV), Dutch Traffic Safety Organisation (3VO), Dutch Association of Insurers, and the SWOV Institute for Road Safety Research.

In 1994, arrangements were made between the Ministry of Transport, the twelve provinces and the Dutch municipalities, about the vertical and horizontal co-ordination in the 'Decentralisation Agreement'. Some of the main issues of this agreement were:

- within the general framework of the national policy, policies are drawn up as much as possible at the level where problems have to be solved;
- it is the task of provinces to co-ordinate policies at the regional level, and of municipalities to do that at the municipal level;
- each province has a Provincial Safety Board (ROV), in which all parties involved in traffic safety discuss the alignment of their individual activities at the regional and local level;
- the provinces provide the secretariat of the ROVs and stimulate the municipalities to carry out an active and coherent policy.

The policy co-ordinating role of the provinces is, in the first place, aimed at better harmony of regional traffic and transport policy, in particular by integrating road safety policy in longer-term regional and transport planning. The following representatives take part in each ROV: Province, Municipalities (through a chosen delegation), Regional MoT Directorate, Police, and Justice. In addition, the private sector organisations taking part in the OVV are represented, albeit not always in each ROV. In 1997 the Decentralisation Agreement was evaluated. It was concluded that the aims had not sufficiently been achieved. As a result of this, further agreements were made regarding each party's role. These roles in the realisation of traffic and transport plans were set down in the Traffic and Transport Planning Law in 1998. Among other things, it was established that the state and the provinces can give directions to lower levels, if the national plan is not fully implemented by provinces or provincial plans by local authorities.

SWOV Institute for Road Safety Research is the central research institute for road safety in the Netherlands and addresses the traffic safety problem in general. It has a non-governmental status. SWOV draws up its research programme as well as its knowledge distribution programme and offers them to the Programme Board for approval. In this board, representatives from several parties who have interest in the results of SWOV work have a seat. Execution of these programmes is funded by the MoT. Research is also carried out by universities and some research institutes of the Netherlands Organisation for Applied Scientific Research (TNO). Some private

consultant and engineering firms and information and technology centres are also active in the field.

2.3. The common and different policy and organisational features

The level of traffic safety of a country is determined to a substantial degree by factors which lie outside the direct influence of its traffic safety policy, or the way those factors can administratively be handled by means of policies. Moreover, these factors might differ substantially for different countries. Both aspects are highly relevant in addressing the 'common and different policy and organisation features' of the SUN countries. Such factors concern, for instance, geography and characteristics of the landscape, the climate and the light conditions, or demography and population characteristics, and, of course, the many aspects regarding the mobility and the traffic infrastructure of the three countries. The differences that are relevant for the different transport systems of the SUN countries are discussed in the next section on the transport background information. With this previous remark and its implications for comparisons in mind, this section will merely be focussed on comparisons of *safety* policy and *safety* organisation. A more practical remark also to be made in advance, is that safety policy and its organisation can be addressed from different points of view or on different levels. Here, the hierarchical division of policy and organisation into a strategic, a tactic, and an operational level is chosen.

On *the strategic level*, traffic safety policies in the three countries have much in common. In each safety programme statements can be found that lack of road safety is not an unavoidable side-effect of road transport, but that it is the transport system which has fundamentally to be arranged in such a way that people can travel without the harm of fatalities and (serious) injuries. The implementation of this abstract objective requires its translation into tangible objectives and in particular into intermediate targets. Nowadays and for several years, each of the three countries has set quantified targets, monitored these on a regularly basis, and - what is more - sharpened the targets over time to reach the eventual objective. The three most recent targets have different apparent fatality reduction percentages over different periods to 2010, although in fact the British target does not have a separate fatality target. If compared to the actual fatality levels in 2000, and assuming the British target for fatal and serious injuries combined referred directly to fatalities, the targets for 2010 imply that different fatality reduction percentages need to be achieved between 2000 and 2010: for Sweden 32.5%, for Britain 37%, and for the Netherlands 29.5%. The British target appears the most difficult to achieve because its trend in fatal injuries has reduced substantially less than that for serious injuries over recent years. Against the actual target definition, the likelihood of reaching the 2010 target looks much better.

Target setting proved to be a valuable means to get, and to keep, traffic safety on the political agenda. It is also an efficient managerial tool to define responsibilities for the different levels of administration and among other actors in the field. The actual policies in the three countries also correspond with each other to a great extent. This is expressed by the fact that each contains a set of similar points of specific attention. These points of attention mainly address the same types of problems, for instance: speeding, vulnerable road users, the infrastructure, drinking and driving, and so on; albeit sometimes in a more or less elaborated or intensified way. In the case of Sweden, they are contained in the 'short-term action plan', for the Netherlands it are the 'spearheads' of the national road safety plan, and with regard to Great Britain they are referred to as the road safety 'themes'.

Interestingly, however, the safety visions of the three countries differ. In principle, this could have different impacts on the way the safety problem will be handled. And, of course, different approaches might lead to different results. These differences in vision refer to the “*Vision Zero*” approach in Sweden and the “*Sustainable Safety*” strategy in the Netherlands on the one hand, and the more problem-oriented and professional practitioner led approach in Britain on the other hand. Although a shift in the application of certain types of solutions and measures can - at least in the Netherlands - be traced, it is still too early to demonstrate a corresponding difference in the safety profits in practice, when these are detectable at all. And the reason why is obvious. The actual application of the sustainable safety principle in the Netherlands only started in 1998 on a limited budget. This is even more the case for the implementation of the vision zero approach in Sweden, operationally starting in 2000. Moreover, a part of the applied sustainable safety and vision zero measures belong to infrastructural measures that have already traditionally and intensively been used in Britain (e.g. roundabouts). Stating a difference in safety vision is one matter, but answering the question why this difference has arisen between countries that have so much in common regarding their safety problem and policies, is another. A clue might be the fact that achieving the safety target was no longer taken for granted in the Netherlands and Sweden at a certain point in time, while simultaneously it was concluded that some safety problems could not be addressed as before. This situation stimulated a search for a new approach. Possibly, an intensified application of existing measures still offers enough improvement opportunities, as the current British programme is aiming to realise.

On *the tactical level*, we have to deal with the practical means, sometimes expressed as the ‘toolbox of policymakers’. It basically concerns the funding of the safety programme, its organisational structure, the planning and decision making, and so on. It also concerns education, information transfer, enforcement, rules and regulations, guidelines, and so on. Enough expertise on such topics is certainly present in the SUN countries, while their organisational structures, although differing, are covering the same topics and expertise. On the tactical level, opportunities to influence mobility and the transport system from a perspective of traffic safety seem to be of more interest. After all, exposure, and the conditions under which it occurs, are of major importance for traffic safety. Some clues can be found, but not enough to provide a clear focus in safety programmes. Nevertheless, with regard to the sustainable safety strategy, indeed attempts are being made in the Netherlands to systematically transfer traffic onto the safer - higher - road types. However, attempts to encourage people to make use of safer transport modes, in particular public transport, are usually a result of lack of road capacity, leading to traffic congestion, etc. This kind of solution is - of course - especially relevant in conurbations. Public support for safety measures is also essential. That public support is of great importance seems to be a lesson learnt in each of the three countries. All safety programmes refer to it and in each, there is an attempt to create and foster public support. Different ways are being applied, presumably taking into account national preferences using studies, like the SARTRE project (SARTRE, 1997), assessing public attitudes.

The operational level is concerned with safety actions, (whether or not integrated with other fields of policy making like, for instance, the environment), and about specific measures. Looking to the lists of traffic safety activities in Appendix C, it is clear that most types of remedial action have been taken in all of the three countries. Broadly speaking, the only observable difference is in fact the timing. In trying to define differences, some account needs to be taken of scale of application, which is not always clear from the action plan description, but differences are revealed by the research in the chapters 4 to 6. In a way, the similarities should be expected. Among our

“information societies”, rapid exchange of knowledge and experience is usual, particularly in cases where we are dealing with the same kind of problems. With respect to this, the importance of road safety research also has to be stressed. Development of new approaches and publication of evaluations of their effectiveness in a scientific reliable manner, has contributed and will significantly contribute to effective safety policies.

2.4. The transport background

The transport systems developed in the three countries are to a considerable extent different. The transport systems have been developed to suit the demand for transportation of persons and goods. The road network almost always offers today a choice of transportation in all three countries, since about one motor vehicle is available per two persons. However, the transport systems are influenced by a lot of factors that differ in the SUN countries and the same factors influence the traffic safety situation on their roads. In Table 2.1 the relevant basic data are presented for Sweden, the UK(GB) and the Netherlands in 2000.

Data for 2000	Sweden	UK(GB)	The Netherlands
Road traffic fatalities	591	3,409	1,082
Population (million)	8,882	58,058	15,864
Road length (thousand km)	210.0	391.70	118.68
Motorway length (km)	1,510	3,465	2,275
Area (thousand km ²)	449,760	244,046	41,526
Motor vehicles (million)	4,880	28,760	8,469
Passenger cars (million)	3,999	23,923	6,987
Lorries (3,5 tonnes) (thousand)	104	829	180
Motor vehicle km (billion)	70.00	467.70	127.71
Motor vehicle km on motorways (billion)	9.50	94.10	51.21
Cycle kilometres (billion)	3.0	4.0	15.1
Motorcyclist kilometres (billion)	0.7	4.4	1.7
Mopedist kilometres (billion)	0.2	0.4	1.0
Road user person-km (billion)	122.0	754.4	210.3
% passenger cars of motor vehicles	81.9	83.2	82.5
% lorries of motor vehicles	2.1	2.9	5.3
Metre road length per capita	23.6	6.6	7.5
Metre motorway length per 1000 inhabitants	170	60	144
Population density per area km ²	20	238	382
Kilometre road length per area km ²	0.47	1.61	2.86
Metre motorway length per area km ²	3	14	55
Mot. veh. kms on motorway per mot. veh.	1,946	3,272	6,047
Mot. veh. kms on motorway per person	1,070	1,621	3,228
% of motor vehicle km on motorways	13.6	20.1	40.1
Motor vehicles per population	0.549	0.495	0.534

Motor vehicle km per motor vehicle	14,344	16,262	15,079
Motor vehicle km per population	7,881	8,055	8,050
Kilometres travelled per person	13,735	12,994	13,256
Motor vehicle kms per road km and day	913	3,271	2,948
Motor vehicle kms per motorway km and day	17,418	74,404	61,671

Table 2.1. *Characteristics of the road transportation systems in Sweden, the UK(GB), and the Netherlands*

The overall travel pattern seems to differ very little between the countries, because the kilometres travelled and the motor vehicle kilometres per capita are almost the same (respectively about 13 thousand and 8 thousand kilometres), as also are the shares of cars (about 82.5%) in the national motor vehicle fleets. The number of motor vehicles per capita is 10% higher in Sweden and almost 8% higher in the Netherlands than in Britain, but this is compensated by the same percentages fewer kilometres driven per motor vehicle in respectively Sweden and the Netherlands. Although the numbers of fatalities in the three countries differ, they are also almost proportional to their national motor vehicle fleets; fatality rates are further discussed in chapter 3. Almost everything else differs between the three countries.

Sweden is the largest of the SUN countries. It is almost twice the size of Great Britain and almost eleven times that of the Netherlands. Sweden has the smallest population and Britain the largest. Thus, the population density is lowest in Sweden: almost 12 times lower than in Great Britain and 19 times lower than in the Netherlands. Although Britain has a lower population density than the Netherlands, England (Great Britain without Wales and Scotland) contains 50 of the 58 million British inhabitants and has a population density that almost equals the population density of the Netherlands.

The average daily traffic density or the motor vehicle flow (AADT = average annual traffic per day) on roads is highest in Britain, where the average density is 11% higher than in the Netherlands and three and a half times the average density in Sweden. Sweden is thus a relatively empty country, both in population and traffic density. Generally differences in traffic flow levels are related to differences in the road safety of specific road user groups. A high traffic flow generally forces the car traffic to drive at lower speeds than on roads with a low traffic flow. Thus car collision speeds and car occupant risk might be expected to be highest in Sweden and lowest in Britain. If this would turn out not to be the case then speed enforcement and/or the car safety measures might be expected to differ between Sweden and Britain. A high traffic flow and a high population density may present a problem for pedestrian and cyclist safety, because then pedestrians and cyclists have to cross busier roads. Since cyclists in the Netherlands ride in total 4 - 5 times more kilometres than in Britain and Sweden, it may be expected that a cyclist safety problem exists in the Netherlands. Since the traffic flow is highest in Britain, it also may be expected that the largest pedestrian safety problem is to be observed in Britain. If the latter two problems do not exist it would mean that there have been more road safety measures taken for the protection of these respective road user groups than in the other two countries. Whether such anticipated safety differences for these road user groups (car occupants in Sweden, cyclist in the Netherlands, and pedestrians in Britain) caused by flow and exposure differences are observed or are prevented by additional measures, will be discussed in later chapters, especially in chapters 3, 6, 7 and 8. Similarly, there are proportionately more motorcyclist kilometres ridden in Britain, and mopedist kilometres ridden in the Netherlands.

The motor vehicle flow density on motorways in Britain is more than 20% higher than in the Netherlands and 4 - 5 times higher than in Sweden. This gives an indication of the difference in motorway design concerning the number of lanes and exits/entries between the countries (Sweden mainly two-lane motorways with long distances between entries/exits, in contrast to multiple lane motorways in the densely populated areas of England and the Netherlands). It can also be seen that the percentage kilometrage for the motorway system in the Netherlands is twice that in Britain and three times that in Sweden. Since vehicle kilometres driven on motorways are safer than equivalent travel on other roads, this indicates that the similar overall risk level is made up differently in the three SUN countries. It also suggests that a higher car occupant risk per vehicle kilometre can be expected in Sweden than in the Netherlands and in Britain, unless the car occupant risk on roads other than motorways is higher in the Netherlands and lower in Sweden. Chapters 7 and 8 provide some of the answers to these questions.

The fact that double the percentage of national vehicle kilometres occurs on the motorway system in the Netherlands than in Britain is the result of the relatively larger and denser motorway system in the Netherlands (144 metres per 1000 inhabitants, and 55 metres per square kilometre area) than in Britain (60 metres per 100 inhabitants, and 14 metres per square kilometre area). The Swedish motorway system is large with respect to the population (170 metres per 1000 inhabitants), but has a relatively low density (3 metres per square kilometre area). This typifies the Swedish road transport system with its relatively empty high-quality roads that mainly only connect between cities and also the relatively wide and empty rural roads that connect scattered villages. The relatively low density of the public road network in Sweden is compensated by a private (partially used publicly) road network that reaches into the forest settlements and is larger than the public road network.

One implication of the transport-related characteristics discussed may be that the comparison of the safety on the road networks of the SUN countries will be difficult. Loosely speaking, England seems more similar to the Netherlands than to Sweden, while the rest of Great Britain (Scotland and Wales) seems more similar to Sweden than the Netherlands. However, since the SUNflower project concerns the national road safety statistics and strategies of the three nations, the underlying regional differences and similarities require further research.

2.5. Conclusions

- The road safety policies of the SUN countries have been developed over several decades. They have all been based on the realisation of a target for the reduction of fatalities (and serious injuries) in a defined future period, and they have also mainly involved the same types of measures;
- The recent formulations of the road safety plans in the Netherlands and Sweden are based on an explicit vision that aims to prevent serious outcomes of road crashes by reshaping the road transport system to an inherently safe system, where the recent road safety plan of Britain is based on the application of good practice by (local) safety professionals with particular focus on improving the safety of road user groups with relatively high risk;
- Although the road safety measures taken in the past by each of the SUN countries are mainly the same, the timing of their implementation and their legal basis are different (e.g. limits for speed and blood alcohol level; they also differ in the application intensity of the measures, as shown in later chapters);

- Different transport system characteristics exist between the SUN countries, which have implications for the differences that can be expected between the fatality risk levels of specific road user groups in the SUN countries, unless more and/or additional safety measures have already been taken for these road user groups in the country with the higher expected risk for that group:
 1. The Swedish traffic density is the lowest of the SUN countries, while also the use of the motorway is the lowest. Both would contribute to the expectation of a higher car occupant risk in Sweden than in the other two countries;
 2. The British traffic density is the highest of the SUN countries, which implies on the one hand that a relatively low car occupant risk would be expected for Britain and on the other that British pedestrians have to cross the busiest roads. The latter contributes to the expectation of relatively larger pedestrian safety problem in Britain than in the other two countries, unless more pedestrian safety measures have been taken in Britain;
 3. The traffic density in the Netherlands is somewhat lower than in Britain, but the Dutch motorway use is the largest of the SUN countries. It would contribute to the expectation of a lower car occupant risk than in the two other countries, unless the car occupant risk on other roads than motorways is higher in the Netherlands.
- The general characteristics of the organisation of safety activities is also similar in the three countries, with each having a willingness to debate safety issues in Parliament, a strong central co-ordinating ministry, good vertical co-ordination of safety activities from central to local groups, with supporting finance, and influential non-governmental/non-profit organisations with a strong interest in safety.

3. The traffic safety situations in the SUN countries for 2000

The reported data for the overall road safety comparison between Sweden, the United Kingdom (actually the data for Great Britain, without Northern Ireland), and the Netherlands are given for 2000 in Table 3.1.

2000	Fatalities	Severely injured	Slightly injured	Population (million)	Motor vehicles (million)	Vehicle km. (billion)	Motor vehicles per inhabitant
Sweden	591	4,103	18,520	8,882	4,880	70.00	0.549
UK(GB)	3,409	38,155	278,719	58,058	28,760	467.70	0.495
Netherlands	1,082	11,507	34,577	15,864	8,469	127.71	0.534

Table 3.1. *Basic data of Sweden, Great Britain, and the Netherlands for 2000*

It is generally accepted that registration rates and definitions of fatalities are reasonably consistent between the three countries. So from this data, the fatality rates (the road traffic fatalities per amount of inhabitants, motor vehicles, or motor vehicle kilometres) are initially considered, as shown in Table 3.2.

Fatality rates	Per Population (hundred thousand)	Per Motor vehicles (ten thousand)	Per Motor vehicle km (billion)
Sweden	6.65	1.21	8.44
UK(GB)	5.87	1.19	7.28
Netherlands	6.82	1.28	8.47

Table 3.2. *Fatality rates in Sweden, Great Britain, and the Netherlands for 2000.*

By any of the three rates definitions, the rates do not seem to differ much between the SUN countries. However, the rates per population and per motor vehicle kilometre are significantly different from the rates for the total of the SUN countries. The UK(GB) has a significantly lower rate per vehicle kilometre (and per population) than the Dutch and Swedish rates, which are not significantly different from each other.

Compared to other countries, the fatality rates in the SUN countries are the lowest in the world. What are the reasons for this relatively low level of road traffic fatalities in the three countries and why is total fatality risk in Britain lower than in the other two countries? It will be difficult to give definite answers, because a lot of hypotheses ought to be tested and the data is not always fully comparable or consistent. The apparently conflicting country differences for fatality rates of Table 3.2. and for rates of severely injured and slightly injured of Table 3.3. illustrate such problems.

2000	Rates of severely injured per amount of			Rates of slightly injured per amount of		
	Population	Motor vehicles	Vehicle km	Population	Motor vehicles	Vehicle km
Sweden	0.462	0.841	0.059	2.085	3.795	0.265
UK(GB)	0.657	1.327	0.082	4.801	9.691	0.596
Netherlands	0.725	1.369	0.090	2.180	4.117	0.271

Table 3.3. *Reported rates of severely and slightly injured in Sweden, Britain, and the Netherlands*

The 'slight injury' rates in Britain seem much higher than in the Netherlands and in Sweden. Concerning 'severely injured', Sweden seems to have the lowest rates and the Netherlands the highest. This would lead to quite other indications of the safety differences between the countries. However, these rates depend also on police reporting and definition differences between the countries, because the ratios of severely injured to fatalities for respectively Sweden, the UK(GB), and the Netherlands are 6.9, 11.2, and 10.6, while the respective ratios of slightly injured to fatalities are 31.3, 81.8, and 31.9. From recent research in the Netherlands, it is known by comparison of police data and medical registrations for 2000, that the under-reporting of serious injuries is about 30% and for slight injuries about 65%. From older similar studies in Sweden and Britain (OECD-IRTAD, 1994) the under-reporting of serious and slight injuries are respectively almost 50% and 75% for Sweden, and about 20% and 35% for Britain. Thus most likely the severely and slightly injured are both the least under-reported in Britain and the most in Sweden. However, the underreporting-adjusted rates are still differing, as shown in Table 3.4.

2000	Rates of seriously injured victims per amount of			Rates of slightly injured victims per amount of		
	Population	Motor vehicles	Vehicle km	Population	Motor vehicles	Vehicle km
Sweden	0.92	1.68	0.12	8.34	15.18	1.06
UK(GB)	0.82	1.66	0.10	7.39	14.91	0.92
Netherlands	1.04	1.96	0.13	6.22	11.76	0.77

Table 3.4. *Adjusted rates of severely and slightly injured in Sweden, Britain, and the Netherlands*

The adjusted injury rates for Sweden are higher than for Britain, which corresponds with the difference in fatality rates. The higher rates for seriously injured and the lower rates for slightly injured rates for the Netherlands may be partially due to a definition difference. In the Netherlands the serious injuries are defined by injuries that need at least 24 hours hospital care and not by severity classifications of injuries as in most countries. However, the larger traffic share of cyclists and mopeds in the Netherlands may explain a real difference in relatively more severe accident outcomes than in the other countries.

In the next sections it is demonstrated that the fatality rates for specific road user groups differ even more between the three countries than the total fatality rates. Moreover, these group risks show sometimes quite other differences than for the total fatality rate. For some road user groups the British risks are the highest.

3.1. Road users and fatalities

In Table 3.5 the numbers of fatalities in different types of collisions between transport modes and in single accidents are presented by mode. Table 3.6 shows the same for percentages of these fatalities.

For Sweden these tables show that 393 car occupants were killed in 2000 or 66% of the 591 fatalities. In Britain the killed car occupants are 49% of all fatalities and in the Netherlands 47%. The winter period has also more darkness in Sweden than in Britain and the Netherlands, but although this increases the risk for fatal accidents, it decreases the use of cars. Cars are mainly used for working trips and other urgent trips during the winter period.

The next groups of interest are pedestrians and cyclists. In Sweden the number of killed pedestrians is close to 11% of the fatalities in the year of 2000. In Britain the corresponding value is 25% and in the Netherlands 10%. Killed cyclists in the Netherlands are 18% of all fatalities, 8% in Sweden, and just 4% of all fatalities in Britain.

The composition of the proportions of motorised two-wheeler fatalities differ between the Netherlands and Britain. In both countries 18% of the fatalities involve motorised two-wheelers, but in Britain, where the use of mopeds is very limited, just over 17% are motorcyclist fatalities and in the Netherlands mopeds represent 10% and motorcyclist 8% of the fatalities. In Sweden the motorcycle and moped fatalities are together 8% of all fatalities. In Sweden the use of motorised two-wheelers and cycles is limited during the winter.

Lorries and buses are involved in 26% of the fatalities in Sweden, 22% in GB and 21% in the Netherlands (to the 17.5% for lorries and buses 4.3% is added as their part in the 15% involved in 3-vehicle accidents, because $15\% \cdot 17.5 / (100 - 23.3 - 15) = 4.3\%$). Fatalities in single vehicle accidents are 43% in Sweden, 23% in the UK, and 33% in the Netherlands. The UK groups together fatalities among road users in collisions with trains, trams, or animals that together contribute less than 1% of fatalities. In Sweden, almost 2% of fatalities result from collisions with wild animals.

Summarising the above

- Sweden has a higher proportion of passenger car fatalities than in the other countries;
- UK has a higher proportion of motorcycle rider and pedestrian fatalities;
- Netherlands has a higher proportion of bicyclist and moped rider fatalities.

The use of bicycles in a country is related to the climate, the absence of hills, and the distances travelled. In the Netherlands all these factors are favourable for cyclists, while in Sweden the reverse is true. As will be shown later, the high proportion of Dutch cycle fatalities is mainly due to exposure as their risk is low, while the high proportion of pedestrian fatalities in the Britain probably results more from high risk. As also shown later car occupants appear to have a lower risk of death in the UK. Both this and the

higher pedestrian fatality numbers may be related to the busier traffic environment in Britain.

Sweden 2000	Fatalities										Total	
Killed as	In single accidents	In collision with										
		Pass. Car	Lorry	Bus	Motor	Moped/ Cycle	Animal	Train	Tram	Other		
Car occupant	158	125	85	2				9	2	1	11	393
Lorry occupant	13		11									24
Bus occupant												
Motorcyclist	19	10	6	2		1	1					39
Mopedist	1	3	5			1						10
Cyclist	10	20	10	2		2					3	47
Pedestrian	0	49	13	7	1	1					2	73
Other	2	1	1								1	5
Total	203	208	131	13	1	5	10	2	1	17	591	

Table 3.5a. *Collision matrix with fatalities for Sweden*

Great Britain 2000	Fatalities										Total	
Killed as	In single accidents	In collision with										
		Pass. Car	Lorry	Bus	Motor	Moped/ Cycle	Animal	Train	Three vehicles	Other		
Car occupant	577	486	227	29	13				2	312	21	1667
Lorry occupant	32	19	33	2						32	9	127
Bus occupant	6	2	3							4		
Motorcyclist	157	225	41	6	10	1				127	23	590
Mopedist	2	3	5			1				1	3	15
Cyclist	14	47	36	6	5	2				13	3	126
Pedestrian	0	590	148	60	41	3				19	10	871
Other	6	1	1							4	7	19
Total	794	1373	494	103	69	7	0	2	512	76	3430	

Table 3.5b. *Collision matrix with fatalities for Great Britain*

The Netherlands 2000	Fatalities										Total
	Killed as	In single accidents	In collision with								
			Pass. Car	Lorry	Bus	Motor	Moped/ Cycle	Animal	Train	Tram	
Car occupant	265	117	92	8	2	3	2	13	1	10	513
Lorry occupant	24	8	19	1				6		2	60
Bus occupant											
Motorcyclist	31	36	12	1	2	2		1		4	89
Mopedist	29	32	28	3		4		7	1	3	107
Cyclist	5	101	55	6	3	19	1	4		4	198
Pedestrian	1	58	23	4	5	6		1	7	1	106
Other	7							1			8
Total	362	352	229	23	12	34	3	33	9	24	1081

Table 3.5c. *Collision matrix with fatalities for the Netherlands in 2000*

Sweden 2000	Fatalities (percentage)										Total
	Killed as	In single accident	In collision with								
			Pass. Car	Lorry	Bus	Motor	Moped/ Cycle	Animal	Train	Tram	
Car occupant	26.7	21.2	14.4	0.3	0.0	0.0	1.5	0.3	0.2	1.9	66.5
Lorry occupant	2.2	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1
Bus occupant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Motorcyclist	3.2	1.7	1.0	0.3	0.0	0.2	0.2	0.0	0.0	0.0	6.6
Mopedist	0.2	0.5	0.8	0.0	0.0	0.2	0.0	0.0	0.0	0.0	1.7
Cyclist	1.7	3.4	1.7	0.3	0.0	0.3	0.0	0.0	0.0	0.5	8.0
Pedestrian	0.0	8.3	2.2	1.2	0.2	0.2	0.0	0.0	0.0	0.3	12.4
Other	0.3	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8
Total	34.3	35.2	22.2	2.2	0.2	0.8	1.7	0.3	0.2	2.9	100.0

Table 3.6a. *Collision matrix for Sweden in 2000 (percentage fatalities)*

Great Britain 2000	Fatalities (percentage)										Total
	Killed as	In single accidents	In collision with								
			Pass. Car	Lorry	Bus	Motor	Moped/ Cycle	Animal	Train	Tram	
Car occupant	16.8	14.2	6.6	0.8	0.4	0.0	0.0	0.1	9.1	0.6	48.6
Lorry occupant	0.9	0.6	1.0	0.1	0.0	0.0	0.0	0.0	0.9	0.3	3.7
Bus occupant	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Motorcyclist	4.6	6.6	1.2	0.2	0.3	0.0	0.0	0.0	3.7	0.7	17.2
Mopedist	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4
Cyclist	0.4	1.4	1.0	0.2	0.1	0.1	0.0	0.0	0.4	0.1	3.7
Pedestrian	0.0	17.2	4.3	1.7	1.2	0.1	0.0	0.0	0.6	0.3	25.4
Other	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.6
Total	23.1	40.0	14.4	3.0	2.0	0.2	0.0	0.1	14.9	2.2	100.0

Table 3.6b. Collision matrix for Great Britain in 2000 (percentage fatalities)

The Netherlands 2000	Fatalities (percentage)										Total
	Killed as	In single accidents	In collision with								
			Pass. Car	Lorry	Bus	Motor	Moped/ Cycle	Animal	Train	Tram	
Car occupant	24.5	10.8	8.5	0.7	0.2	0.3	0.2	1.2	0.1	0.9	47.5
Lorry occupant	2.2	0.7	1.8	0.1	0.0	0.0	0.0	0.6	0.0	0.2	5.6
Bus occupant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Motorcyclist	2.9	3.3	1.1	0.1	0.2	0.2	0.0	0.1	0.0	0.4	8.2
Mopedist	2.7	3.0	2.6	0.3	0.0	0.4	0.0	0.6	0.1	0.3	9.9
Cyclist	0.5	9.3	5.1	0.6	0.3	1.8	0.1	0.4	0.0	0.4	18.3
Pedestrian	0.1	5.4	2.1	0.4	0.5	0.6	0.0	0.1	0.6	0.1	9.8
Other	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.7
Total	33.5	32.6	21.2	2.1	1.1	3.1	0.3	3.1	0.8	2.2	100.0

Table 3.6c. Collision matrix for the Netherlands in 2000 (percentage fatalities)

3.2. Age groups and road user groups

The age distribution of fatalities in the three SUN countries is similar, as shown in Figure 3.1, although Sweden has less child fatalities and more elderly fatalities than the other two countries.

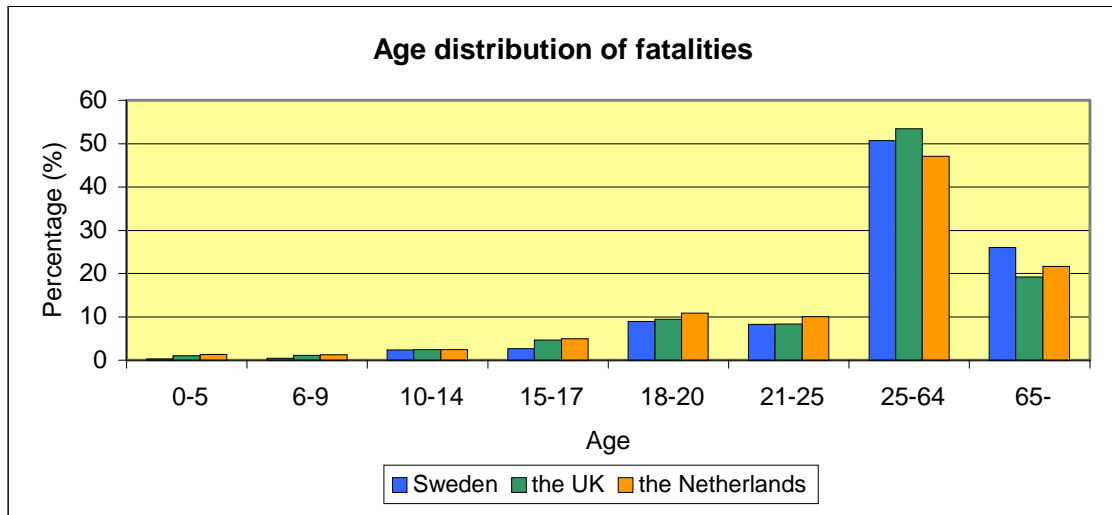


Figure 3.1. *Percentage distribution of fatalities in Sweden, the United Kingdom and the Netherlands*

Comparing the distribution of age groups in the population in Figure 3.2 for the three countries shows that Swedes are a little older. This is, however, not enough to explain the higher number of fatalities among elderly drivers.

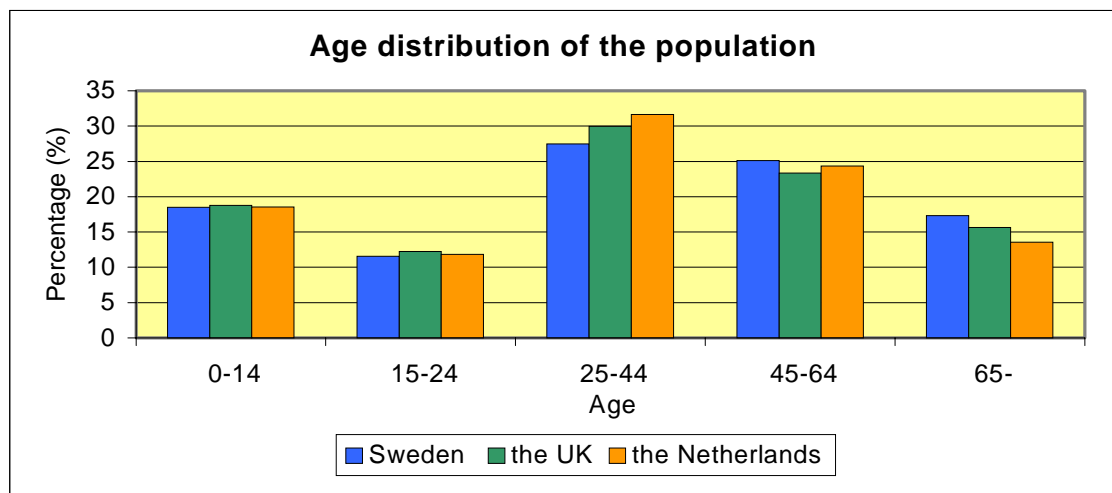


Figure 3.2. *Age distribution of the population in Sweden, the United Kingdom, and the Netherlands*

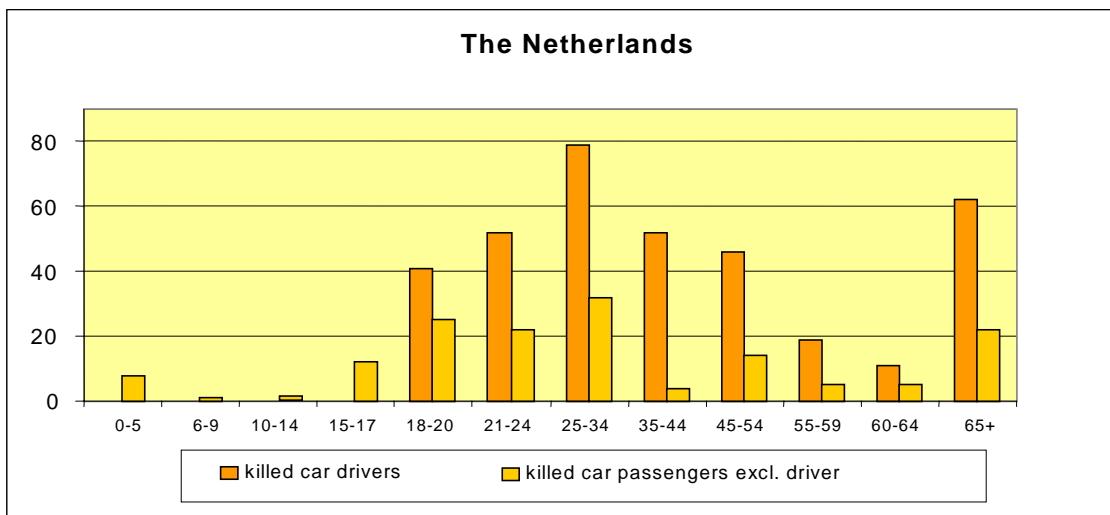
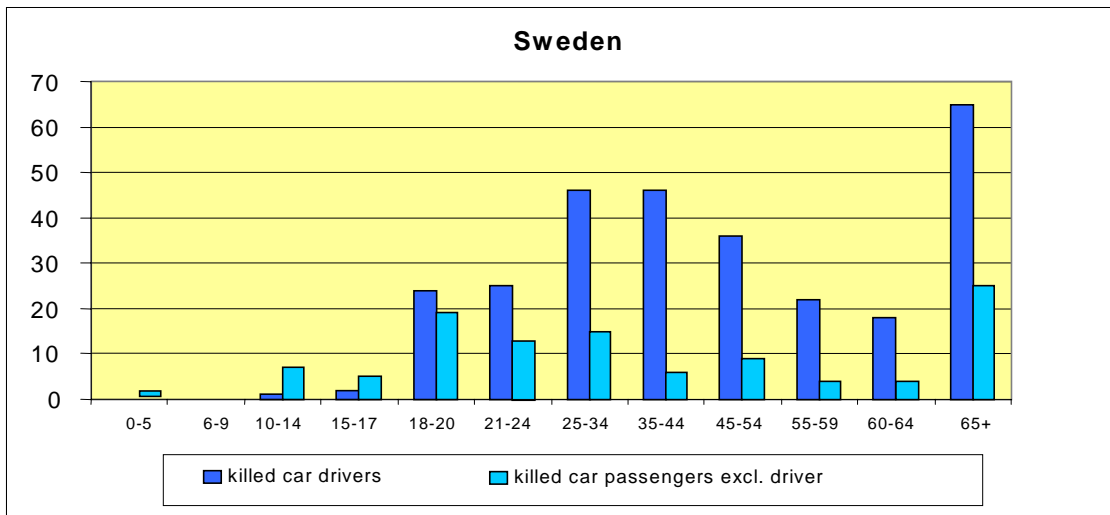


Figure 3.3. The age distribution of killed car drivers and passengers in Sweden, Great Britain, and Netherlands (2000)

The age distributions of fatalities in different road user groups are also compared. Figure 3.3 gives the age distribution of killed car drivers and killed car passengers for each of the three countries. The age pattern for fatalities among car occupants seems almost the same for the three countries, with the exception of the much higher number of fatalities among elderly drivers in Sweden. In the other two countries, the largest number of car occupant fatalities is among the 25-34 year old group. In Sweden, the number in this age group is similar to that in the 35-44 age group, and both are lower than the number aged 65 or over.

Figures 3.4, 3.5 and 3.6 show the age distribution of fatalities for all modes in each of the three countries.

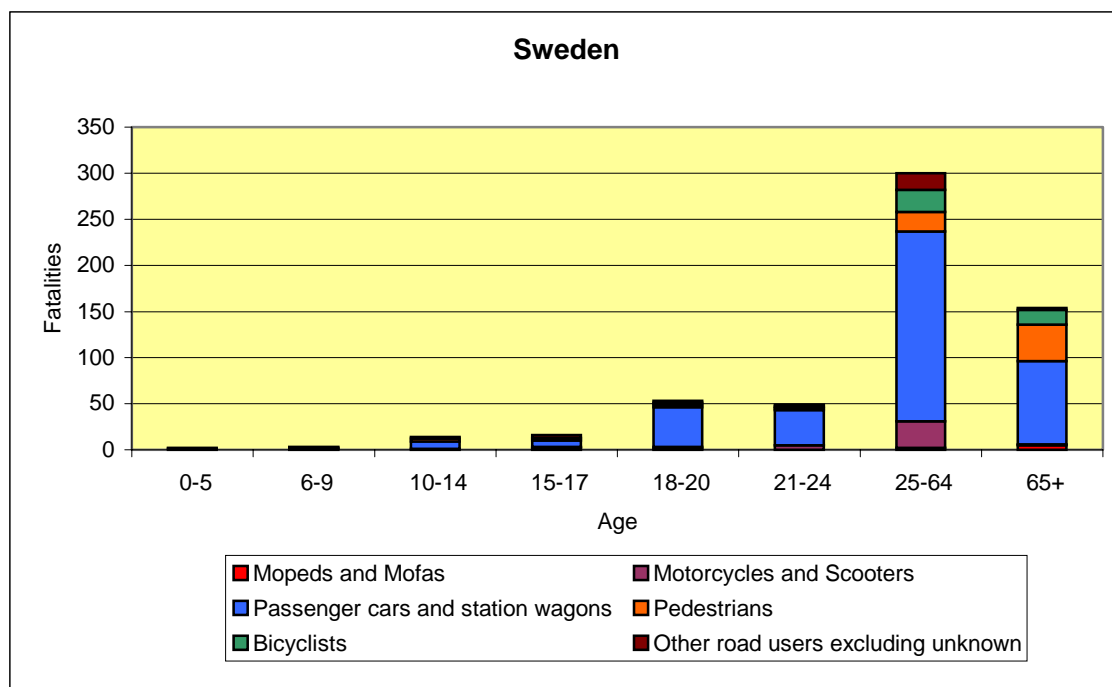


Figure 3.4. *Fatalities per age group and transportation mode in Sweden for 2000*

Most safety problems in Sweden are associated with car use; the other main fatalities are among pedestrians, especially elderly pedestrians. The youngest road users seem to have a relatively safe situation.

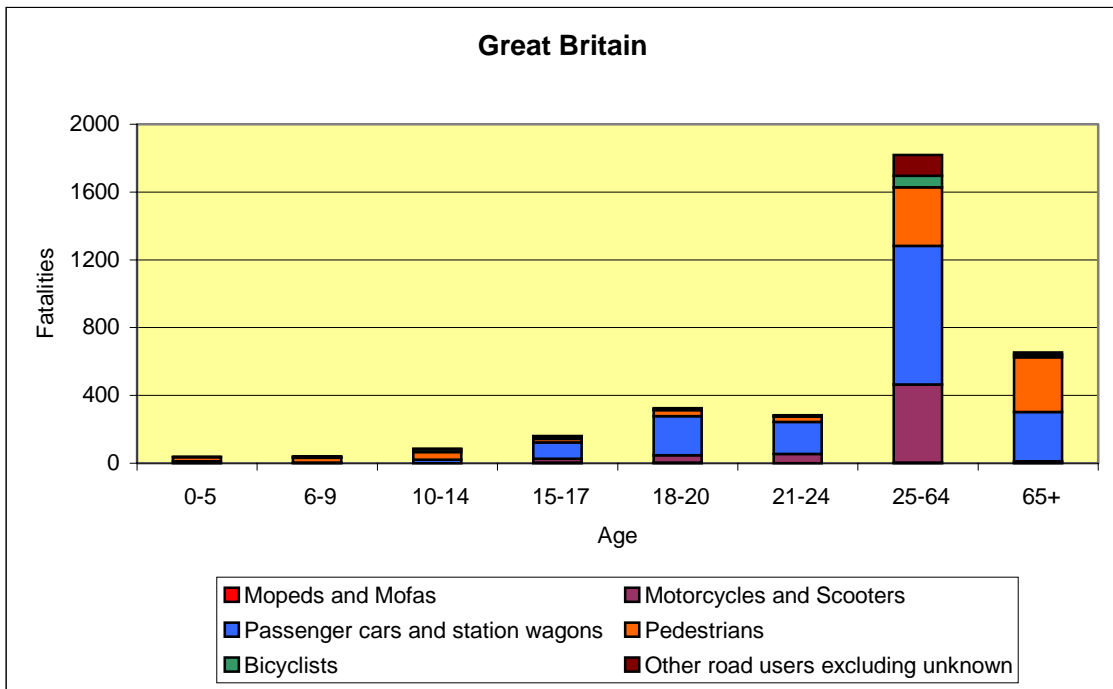


Figure 3.5. *Fatalities per age group and transportation mode in the UK for 2000*

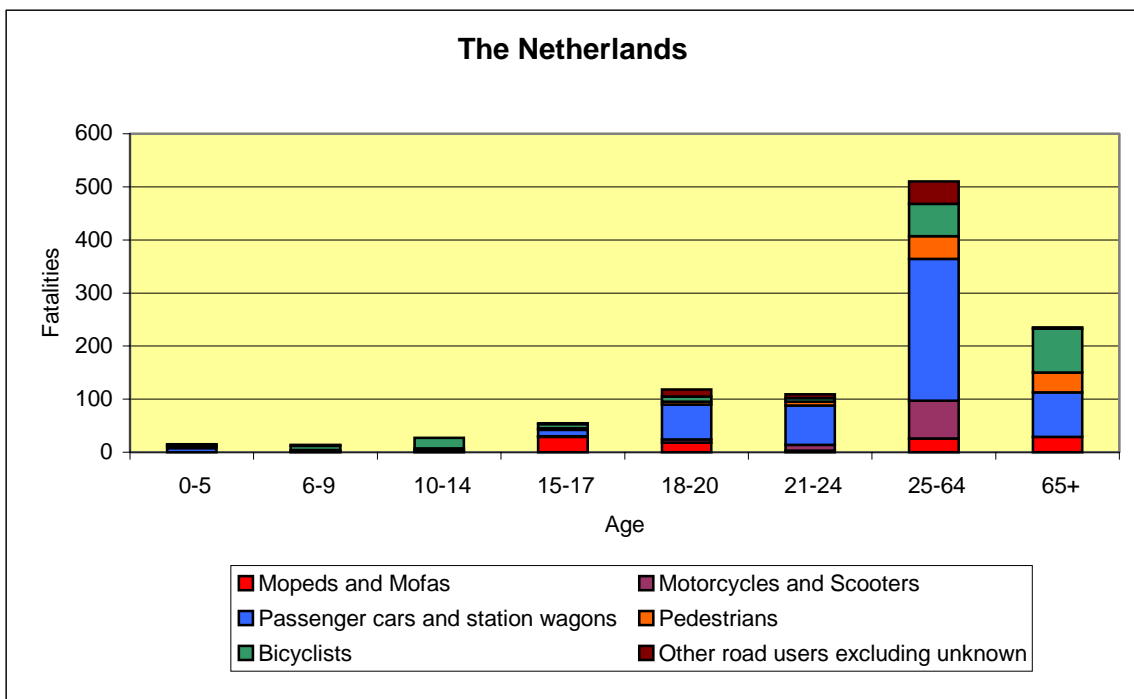


Figure 3.6. *Fatalities per age group and transportation mode in the Netherlands 2000*

The UK has a large pedestrian problem, especially among the youngest and the elderly. Motorcycle use also contributes to the fatality problem. The car seems to be

a safe mode itself, but seems to create a bigger fatality problem for other road users compared to Sweden and probably also to the Netherlands.

3.3. Road user rates

In Table 3.7 the fatality distribution by road users is presented again together with the fatality rates, where the fatalities are related to billion motor vehicle kilometres and to billion kilometres travelled on the roads.

Sweden	Fatalities	Fatality distribution road users	Fatality risk distribution 70×10^9 vkm	Vehicle kilometrage 10^9 vkm	Fatality rate 10^9 vkm	Person kilometrage 10^9 pkm	Fatality rate 10^9 pkm
Car occupant	393	66.50%	5.61	59	6.66	92	4.27
Lorry occupant	24	4.06%	0.34	9	2.67	12.5	1.92
Bus occupant		0.00%	0	1.1	0	10.5	0
Motorcyclist	39	6.60%	0.56	0.7	55.71	0.8	48.75
Mopedist	10	1.69%	0.14	0.2	50	0.2	50
Cyclist	47	7.95%	0.67			3	15.67
Pedestrian	73	12.35%	1.04			3	24.33
Other	5	0.85%	0.07				
Total	591	100.00%	8.44	70.00	8.44	122	4.84

UK(GB)	Fatalities	Fatality distribution road users	Fatality risk distribution 468×10^9 vkm	Vehicle kilometrage 10^9 vkm	Fatality rate 10^9 vkm	Person kilometrage 10^9 pkm	Fatality rate 10^9 pkm
Car occupant	1665	48.80%	3.56	378.7	4.40	575	2.9
Lorry occupant	121	3.50%	0.26	79.8	1.52	100	1.21
Bus occupant	15	0.40%	0.03	4.8	3.13	50	0.3
Motorcyclist	590	17.30%	1.26	4.4	134.09	5	118
Mopedist	15	0.40%	0.03	0.4	37.50	0.4	37.5
Cyclist	127	3.70%	0.27			4	31.75
Pedestrian	857	25.10%	1.83			20	42.85
Other	19	0.60%	0.04				
Total	3409	100.00%	7.29	467.7	7.29	754.4	4.52

The Netherlands	Fatalities	Fatality distribution 10 ⁹ vkm	Fatality risk distribution 128*10 ⁹ vkm	Vehicle kilometrage 10 ⁹ vkm	Fatality rate 10 ⁹ vkm	Person kilometrage 10 ⁹ pkm	Fatality rate 10 ⁹ pkm
Car occupant	513	47.40%	4.02	100.9	5.08	152.93	3.35
Lorry occupant	60	5.50%	0.47	23.1	2.60	28.5	2.11
Bus occupant	0	0.00%	0	0.61	0	6.35	0
Motorcyclist	89	8.20%	0.70	1.68	52.98	1.98	44.95
Mopedist	107	9.90%	0.84	1.04	102.88	1.14	93.86
Cyclist	198	18.30%	1.55			15.1	13.11
Pedestrian	106	9.80%	0.83			4.3	24.65
Other	9	0.80%	0.07				
Total	1082	100.00%	8.47	127.71	8.47	210.3	5.15

Table 3.7. *Fatality distribution, vehicle and person exposure and fatality rates for different modes in Sweden, Great Britain and the Netherlands (2000)*

The proportions of fatalities for different transportation modes are shown in the third column of Table 3.7. In the fourth column the fatality risk proportions refer to risk per total vehicle kilometres for the countries, 70.0 billion kilometres in Sweden, 467.7 billion kilometres in Britain, and 127.7 billion kilometres in the Netherlands. In the sixth column the fatality risks relate to the vehicle kilometres travelled by each mode (bicyclists and pedestrians not included). In the last column the fatality rates per mode are related to the kilometres travelled by the modes (bicyclists and pedestrians included).

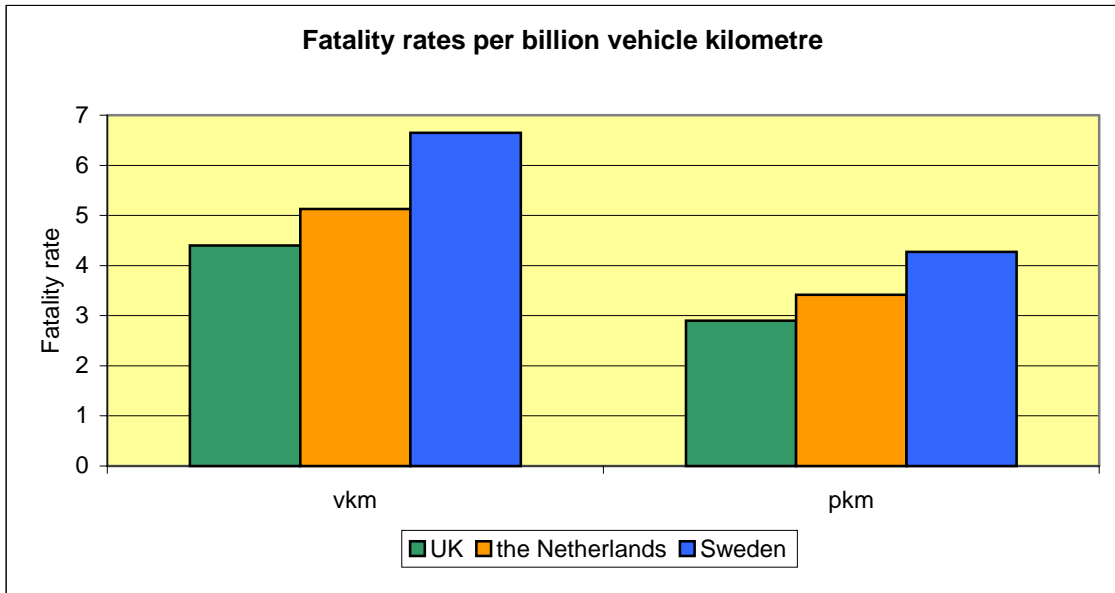


Figure 3.7. *Fatality rates for car occupants per billion motor vehicle kilometre (vkm) and per million kilometres travelled (pkm) for Sweden, Great Britain, and the Netherlands.*

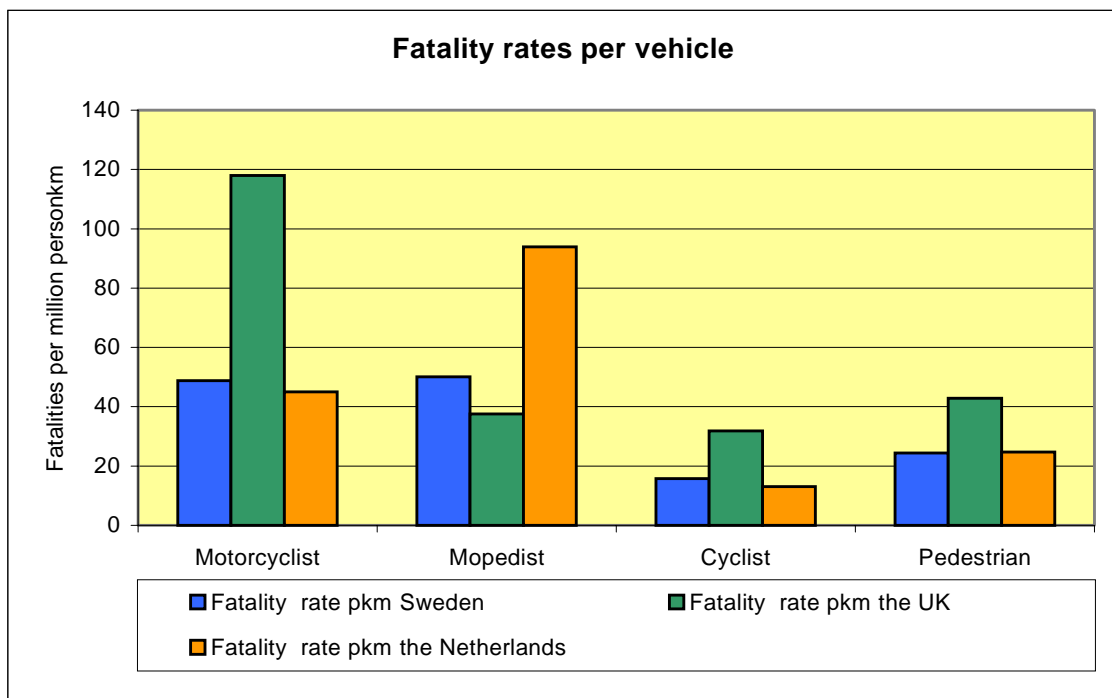


Figure 3.8. *Fatality rates for motorcyclists, mopedists, cyclists and pedestrians in Sweden, Great Britain, and the Netherlands.*

The total fatality rates are lowest in Britain and highest in the Netherlands. These fatality rates are 10% to 15% lower in Great Britain than in the Netherlands and Sweden. As discussed these differences for Britain, although small, are statistically significant. Regarding different transportation modes there are, however, large and some statistically significant differences. In Figures 3.8 and 3.9 the numbers of fatalities for different transportation modes are illustrated for the three countries.

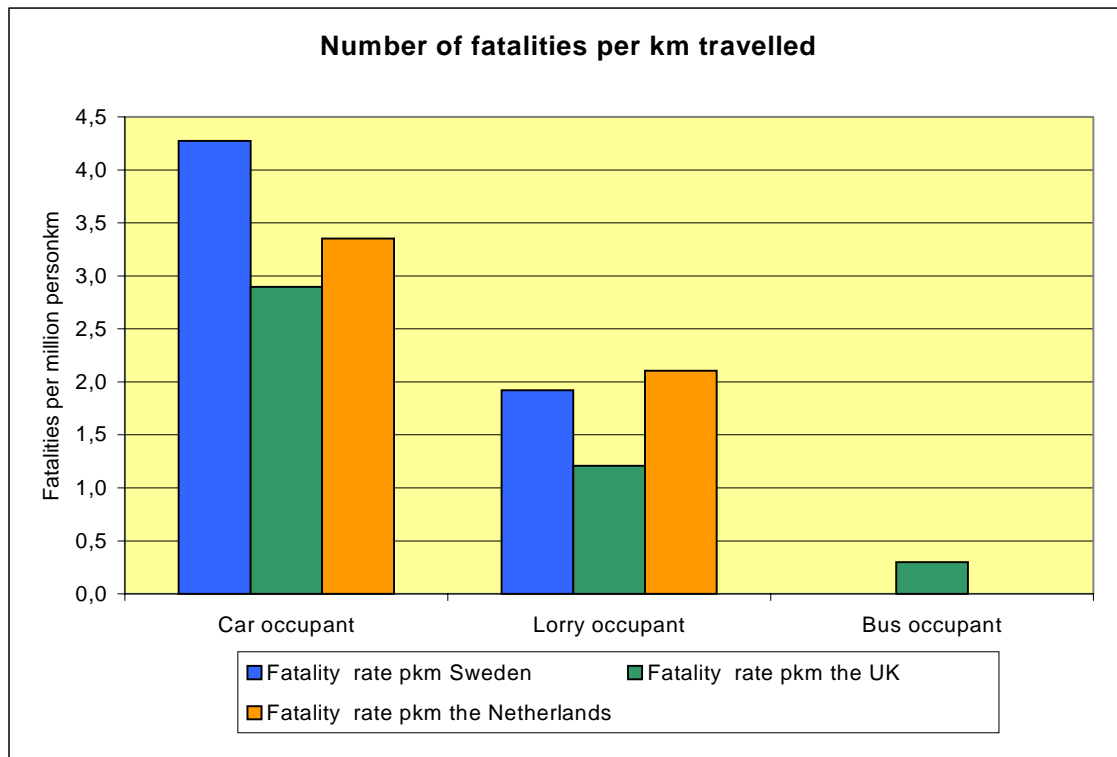


Figure 3.9. Number of fatalities per kilometres travelled in Sweden, Great Britain, and the Netherlands; for car, bus and lorry occupants.

Sweden has the highest car occupant rate. The Netherlands has the highest rate for lorry occupants. The low rates for car and lorry occupants in GB are interesting and need a further explanation. The Netherlands and Sweden have low/safe bus transportation compared to Britain.

Britain has a much higher motorcycle fatality rate than Sweden and the Netherlands. The Netherlands has higher moped fatality rate than Sweden and Britain. The Netherlands and Sweden have almost the same fatality rates for motorcyclists, cyclists and pedestrians. These are more-or-less double in Britain. It is this high level of car occupant safety that makes Britain the safest country. One attempt to look deeper in that dimension is to look at driver fatality rates, as presented in Table 3.7. for the three countries.

2000	Driver Fatalities	Population (million)	Motor vehicles (million)	Vehicle kilometres (billion)	Fatalities per million population	Fatalities per million mot. veh.	Fatalities per billion veh km	% killed drivers of fatalities
Sweden	301	8.882	4.880	70.00	34	62	4.3	51
UK(GB)	1087	58.058	28.760	467.70	19	38	2.3	32
Netherlands	362	15.864	8.469	127.71	23	43	2.8	33

Table 3.8. Driver fatalities and driver fatality rates in Sweden, Great Britain, and the Netherlands for 2000

About 51% of the fatalities are killed motor vehicle drivers in Sweden, compared with 32% in Britain, and 33% in the Netherlands. Concerning driver fatalities, the rates are the highest in Sweden and the lowest in Britain, almost 40% lower. One way to make the fairest comparison is to compare the fatality rates on the more or less identically built motorways, which is presented in Table 3.8. From this Table it is seen that Sweden also has a higher fatality rate on motorways than Britain and the Netherlands.

Motorways 2000	Fatalities	Vehicle kilometres (billion)	Fatalities per billion vehicle kilometres
Sweden	24	9.60	2.50
UK(GB)	189	94.10	2.01
Netherlands	116	51.21	2.27

Table 3.9. *Fatalities, vehicle kilometre and fatality rate on motorways in Sweden, Britain, and the Netherlands.*

The simplest explanation for the lowest car occupant rate and lowest total rate of Britain, is that Britain has a lower speed level due to higher traffic density than in Sweden, and to some extent, also with respect to the Netherlands, as discussed in chapters 2 and 7. The higher flow density holds also for residential roads in Britain, which also may explain its higher rates for vulnerable road users. A larger proportion of the 4-way junctions have roundabouts in Britain than in Sweden or the Netherlands, which also may contribute to the lower fatality rate of the British drivers and other car occupants.

3.4. Conclusions

- The fatalities in the three countries are almost proportional to their motor vehicle fleets, but the total fatality rates per population and per motor vehicle kilometres are significantly lower for Britain.
- The age distributions are rather similar, although somewhat more elderly are present in Sweden.
- Sweden has a safety and risk problem for car occupants. The lowest car occupant fatality rate of Britain and the highest of Sweden are most interesting.
- The Netherlands has a safety and risk problem for mopeds and also a safety problem for cyclists. The cyclist problem is not primarily a risk problem, because the Dutch cyclists have the lowest fatality rate per cycle kilometre. However, this cyclist fatality rate per cycle kilometre is still higher than the car occupant fatality rate per vehicle kilometre, and due to the large amount of Dutch cycle kilometres it is a safety problem.
- The UK has a safety and risk problem with pedestrians and motorcyclists.

4. Drinking and driving

4.1. Introduction

This chapter contains the case study on drinking and driving in Sweden, the United Kingdom (GB) and the Netherlands. All three have good overall safety records. But this does not necessarily mean that they also have good records for drinking and driving. But all three countries have a history of countermeasures showing a concern for the problem of drinking and driving. Sweden was one of the first countries to introduce a legal blood alcohol limit for drivers in 1951. The United Kingdom followed in 1967 and the Netherlands in 1974. The next section of this chapter presents the situation in each of the three countries, focussing on the period 1990-2000. This part starts with a description of the official countermeasures, followed by information on the extent of the problem of drinking and driving and a presentation of available evidence on the effectiveness of the countermeasures. The third section of this chapter gives a comparison between the three countries of both countermeasures and the extent of the problem. This section ends with a discussion on how similarities and differences between the countries can be explained. The last section contains conclusions, which may help to reduce the problem of drinking and driving in the three SUN countries as well as in other European countries.

4.2. Drinking and driving in SUN countries

In order to enable a comparison between countries, the situation in each country has to be described in a more or less standard way. There are three sections for each country: official countermeasures, extent of the problem of drinking and driving and evaluation of countermeasures. Official countermeasures against drinking and driving usually consist of legal definitions of the offence of drinking and driving, police powers to detect offenders and sanctions for drinking and driving, or more generally treatment of drinking drivers. Of particular interest are both the official regulations as well as the actual practice with regard to countermeasures. A description of the actual practice depends on availability of official statistics and the results of special studies with additional information. There may be considerable differences between countries in this respect, making it difficult to make a correct and meaningful comparison. The same problem exists with regard to a description of the performance indicators for the extent of the problem of drinking and driving. In a similar way, the data available for evaluation and the design of the evaluation studies may be very different. For several aspects there is no proper evaluation at all.

4.2.1. Sweden

4.2.1.1. Official countermeasures

Regulations

Sweden introduced legal blood alcohol limits in 1951. The lower limit was set at 0.05%; a second limit was set at 0.15%, with more severe sanctions. The lower limit was changed from 0.05 to 0.02% in 1990. Lowering of the second limit from 0.15% to 0.1% followed in 1994. Swedish police have the power to stop drivers at random and require a screening breath test. Since 1990, evidential testing is done by means of breath testing (or in special cases by blood testing). The testing of drivers involved in injury accidents is compulsory. With a blood alcohol level between the two limits, fines are

given together with a disqualification from driving for at least one month. In some parts of Sweden trials are being held with conditional disqualification if drivers have ignition interlock systems installed in their vehicle. Drivers with a level over the higher limit are disqualified for at least 12 months. In such a case a provisional licence can only be regained by passing a medical test as well as a driving test. Drivers with a blood alcohol level over 0.1% will also get a prison sentence with a maximum of two years. Again since 1994, the courts can offer a conditional prison sentence to drivers over the higher limit if they attend special rehabilitation courses.

Practice

The annual number of screening breath tests by the Swedish police shows a gradual increase over the years, with an additional, temporary peak around 1994. The number for 1994 was almost 1.8 million. The most recent number is more than 1.0 million. Between 1990 and 2000, the annual number of drivers suspected of drinking and driving declined from about 25,000 to half as much. Only about 800 suspected drivers were involved in an injury accident. A majority of these drivers are male and half are less than 35 years old. In 1990 the number of suspected drivers who were found to be over the limit was about half the total number of suspected drivers. This number declined over the same period, but less than the total number of suspected drivers, to 9,000. About 30% of these drivers have no valid driving licence and about 55% are over the 0.1% limit. In recent years prison sentences are gradually being replaced by conditional sentences with some form of treatment. The number of drivers attending a rehabilitation course is about 2500. So far, about 500 ignition interlocks have been installed.

4.2.1.2. Extent of drinking and driving

Official statistics for Sweden show the number of all injury accidents with drivers suspected of drinking as well as the proportion of all injury and fatal accidents with (suspected) drinking drivers. Since it is compulsory to test drivers involved in an accident, these figures should be almost complete. However, there are suggestions that the actual number of accidents with drinking drivers is underestimated. Since 1990 the number of all injury and all fatal accidents with drinking drivers declined by almost 50%. The decline was not continuous, but rapid in the early nineties, followed by a stabilisation during the late nineties. Recent numbers are 50 fatal accidents and 800 injury accidents with a (suspected) drinking driver per year. The total numbers of injury and fatal accidents show a similar, but less pronounced trend. As a result the proportion of injury accidents with a drinking driver declined from 7 to 5% and of fatal accidents from 14 to 10%. Figure 4.1 shows the trend for drivers over the limit in fatal accidents.

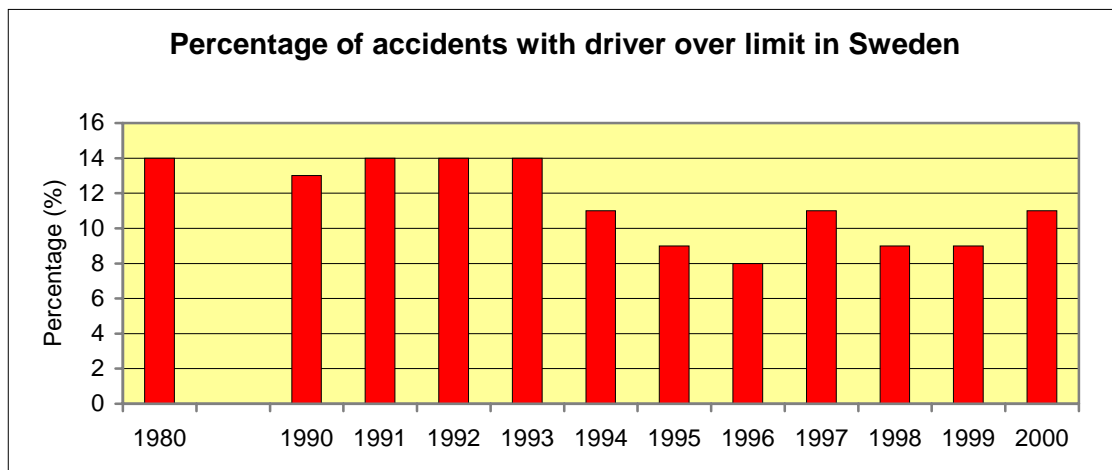


Figure 4.1. *Percentage of accidents with driver over limit (since 1990: 0.02%) in Sweden*

The proportion of car driver fatalities with a positive alcohol level is 20% and for car driver fatalities with a level over 0.1% this is 14%. There is other evidence from interview surveys of Swedish drivers indicating a positive change in opinions and habits with regard to drinking and driving since the legal change in 1990.

4.2.1.3. Evaluation of countermeasures

There are two studies based on time series of numbers of traffic accidents used to assess the impact of countermeasures. One to evaluate the effects of the lowering of the lower legal limit from 0.05% to 0.02% in 1990, the other to evaluate the lowering of the higher limit from 0.15% to 0.1% in 1994. Both studies make a correction for total alcohol consumption and for vehicle kilometres (based on petrol consumption) during the study period. The effects of the legal changes are found to be significant. However, the design of the studies does not exclude the effects of other factors, which may have coincided with the legal changes and of accompanying measures such as increased police enforcement. As reported above, the number of screening breath tests showed a peak around 1994. As a result, it can be expected that the number of accidents with drinking drivers will be influenced by the number of screening breath tests. It is not known if the legal change in 1994 would have had a significant effect in the absence of an increase in the number of screening tests, or if this increase is itself part of the effects of the legal change. Furthermore the 1990 change included the lowering of the limit from 0.05% to 0.02%, together with the introduction of (intensified enforcement by) evidential breath testing. Which element was more effective or what role was played by publicity is not known. The decrease in number of accidents from 1994 to 1995 does not have to be related to the 1994 legal change. It may well be the last step in a continuous decline, which is evident since 1990 and may have been caused by other factors acting during that period, such as the intensified enforcement. There are no special studies on the effects of sanctions such as imprisonment or disqualification from driving. However, it has been reported that 30% of drinking drivers detected by the police do not have a valid driving licence. This does not mean that disqualification is not effective, it shows that it introduces another problem of driving while disqualified. An evaluation study on rehabilitation programmes has shown positive effects on subsequent problems related to drinking, but did not cover actual or reported drinking and driving itself. No evaluation study has yet been made on the effect of alcohol ignition interlocks. Even if sanctions or treatments of convicted drinking drivers were highly successful in preventing recidivism,

it would only result in a small improvement to the overall problem of drinking and driving and the accidents resulting from it.

4.2.2. United Kingdom

4.2.2.1. Official countermeasures

Regulations

A blood alcohol limit for drivers of 0.08% was introduced in the United Kingdom in 1967. Evidential breath testing followed in 1983, together with a definition of a high risk offender: drivers who are convicted twice within a period of ten years with a blood alcohol level of over 0.2%, or who refused to supply an evidential sample. This definition was revised in 1990. Criteria are now: driving with a level of over 0.2%, or drinking and driving (over 0.08%) again within ten years after disqualification from driving for drinking and driving, or refusal to supply an evidential sample. Random stopping of drivers by the police is allowed by law, but random testing is not. A screening breath test can only be applied after suspicion of drinking and driving, or when the driver is suspected of committing a moving traffic violation, or was involved in an accident. Since 1996, the policy of the police is to breath test all drivers involved in road accidents. The alcohol levels of road user fatalities are available from coroners. The minimum sanction for drinking and driving is a twelve month disqualification. High risk offenders have to pass a medical test to obtain a new driving licence. Rehabilitation courses were introduced in 1993 on an experimental basis and became nationwide in 2000. The courts can offer a reduction in the period of disqualification if drinking drivers attend a rehabilitation course.

Practice

The number of screening breath tests is available for England and Wales only. The annual number has increased slowly over the years to slightly over 0.8 million. The proportion of tests with a positive result slowly decreased to 12%. Interestingly, the absolute number of positive screening tests remained almost constant at 100,000 annually. This may be an indication that the capacity to process drinking drivers at the police station is a limiting factor. The official policy since 1996 is to test all drivers involved in accidents, but only about 200,000 drivers involved in injury accidents are screened annually. This is about 50% of all drivers in such accidents. Before the introduction of this policy about 30% were tested. Almost 8,000 drivers, which is between 3 and 4% of the tested drivers, fail the test. More than 6,000 of these are male car drivers, of which 3000 are less than 30 years old. Around 1990 the total number of convicted drinking drivers in Great Britain was over 100,000 per year, of which some 40,000 were high risk offenders. The following years both numbers declined somewhat to under 90,000 and over 30,000 respectively. Of all high risk offenders, about 5 out of 10 had an alcohol level of over 0.2%, 3 out of 10 had a second offence, and 2 out of 10 had refused to supply an evidential sample. The length of disqualification from driving for high risk offending is over two years on average, with longer periods for drivers with previous convictions for drinking and driving. Court referrals to rehabilitation courses in 2000 already amounted to 55,000 annually, although the number of actual course attendees is only just under 20,000. These courses are primarily meant for first offenders; nearly 30% of those attending are high risk offenders.

4.2.2.2. Extent of the problem

The testing of drivers involved in accidents and of traffic fatalities is incomplete. Calculations are made to estimate numbers and proportions of accidents and casualties with drivers with an illegal alcohol level. Since 1990, the number of fatal accidents with drinking drivers in Great Britain slowly declined from 650 to about 400 annually. The number of serious injury accidents with drinking drivers shows a similar trend from 3,000 to 2,000 annually: most of the decline is found during the early nineties. These trends are not much different from those of all fatal and serious injury accidents. As a result there is no decline in the proportion of fatal and serious injury accidents with drinking drivers. It has been estimated that a drinking driver is involved in about 14% of all traffic fatalities. Figure 4.2. shows the trend of drivers over the limit in fatal accidents. Interview surveys show that British drivers have become more willing to avoid drinking and driving over the last decade.

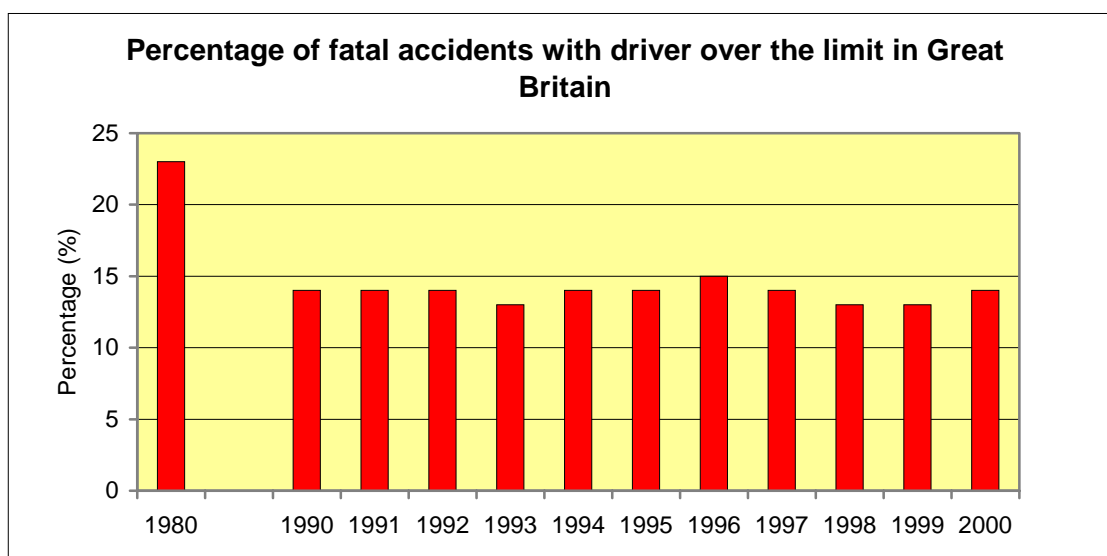


Figure 4.2. *Percentage of fatal accidents with driver over the limit (0.08%) in Great Britain*

There are several points of interest to be found in the results of the testing of traffic fatalities. The proportion of driver fatalities with a blood alcohol level over the 0.08% limit remained almost constant from 1990 to 2000 at around 20%. The proportion for riders of mopeds and motorcycles is relatively low, at about 10%. However, for both riders and drivers aged 16-19, the proportion of these killed with alcohol levels over the legal limit has doubled since 1990 to more than 20%. For pedestrian fatalities whose blood alcohol is known the proportion with a blood alcohol level over 0.08% is very high at almost 40%, which is about 140 drinking pedestrians being killed annually in Great Britain.

4.2.2.3. Evaluation of countermeasures

A study into the effects of the high risk offender programme found that about 30% of high risk offenders re-offend over a subsequent period of 5 to 7 years. This is double the number for 'ordinary' offenders. The high risk offenders were equally likely to re-offend during and after disqualification from driving. Reconviction rates are lower for those high risk offenders who were originally convicted with a blood alcohol level over 0.2% than for the other high risk offenders. These results show that the criteria for a

high risk offender are to a certain extent successful in predicting recidivism. However, they do not show that sanctions for high risk offenders are successful in preventing recidivism or that the scheme is successful in preventing drinking and driving of potential high risk offenders. The effects of rehabilitation courses were also studied on the basis of reconviction rates when these courses were still in the experimental stage. The reconviction rates were found to be lower for those who attended courses than for control groups.

4.2.3. The Netherlands

4.2.3.1. Official countermeasures

Regulations

A legal blood alcohol limit of 0.05% was introduced in the Netherlands in 1974. From the beginning, the police had the power to stop and test drivers at random and to test drivers involved in accidents. Evidential breath testing started in 1987. Over the years changes have been made in the process of applying sanctions and in the sanctions themselves by guidelines from the Ministry of Justice. The aim of these changes was to reduce the workload of police, the public prosecutor and courts (by paying fixed fines to prevent court procedures) and/or to apply tougher sanctions (higher fines, more driving disqualification). In 1996, a program was started with administrative sanctions in addition to and independent of court sanctions. The type of sanction depends on the blood alcohol level, on previous convictions for drinking and driving and on involvement in a serious accident. The measures include: (1) a driver improvement course at an alcohol level of over 0.13% (0.08% for repeat offenders); (2) medical test at a level of over 0.18% or with four previous convictions in the past five years, or when involved in a serious accident, or refusal to be tested; (3) immediate licence withdrawal at a level of over 0.25%, or with four previous convictions in the past five years.

Practice

There is little information on the actual enforcement and sanctioning of drinking and driving. The estimated number of screening tests was about 1 million in 2000. From time to time the Dutch police organise nation-wide random breath testing campaigns. Testing of drivers involved in accidents is recommended, but has not become standard procedure. How many involved in accidents were tested is not known. The number of drivers arrested for drinking and driving was about 31,000 in 2000. The number of drivers convicted for drinking and driving is officially unknown, but it is probably about 24,000. Per year about 8,500 drivers follow driver improvement courses and about 3,500 drivers are medically tested in connection with the administrative sanctions.

4.2.3.2. Extent of the problem

According to official statistics, about 90 road users are killed each year in accidents with drinking drivers and more than 1,000 are admitted to a hospital. The testing of drivers involved in accidents is very incomplete and there is no acceptable method to obtain estimates of the actual numbers from those reported. Instead, the extent and nature of the problem of drinking and driving in the Netherlands is recorded by means of a series of roadside surveys which started in 1970. These surveys provide the distribution of blood alcohol levels for car drivers who were selected at random during weekend nights where use of alcohol is the highest of the week. The proportion of drivers with a blood alcohol level over 0.05% has been more or less stable since 1990 at 4.5%, as shown by Figure 4.3.

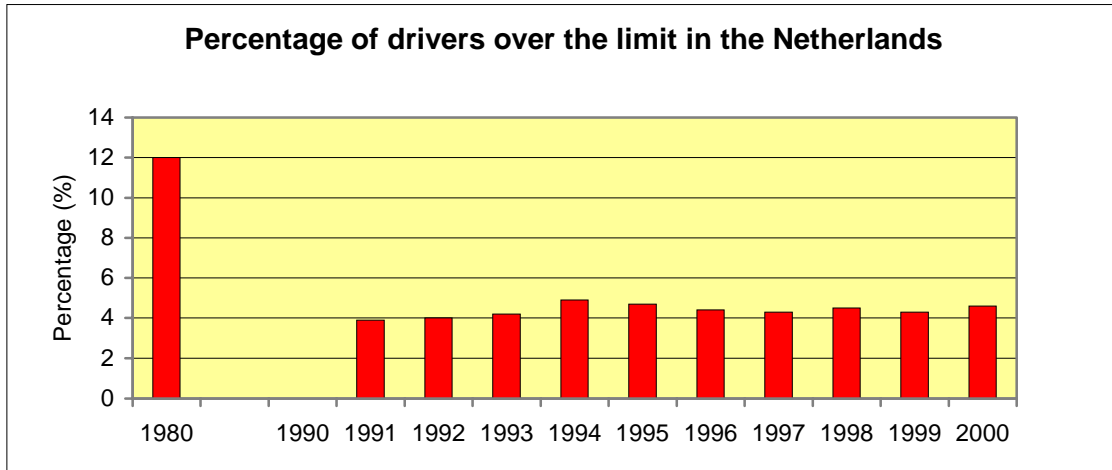


Figure 4.3. *Percentage of drivers over the limit (0.05%) in the Netherlands (weekend nights)*

The risk of getting involved in an accident depends on the blood alcohol level of a driver. With the help of the generally accepted figures of relative risks, the results of roadside surveys can be translated into numbers of drinking drivers involved in accidents. The results of such calculations indicate that the real number of serious accidents with drinking drivers in the Netherlands is probably twice the official number approaching 200 killed (20%) and 3000 serious injured road users in drink driving accidents.

4.2.3.3. Evaluation of countermeasures

A number of small scale studies have been reported of the effect of changing the level of random breath testing. These studies show a negative relation between the level of testing and the level of drinking and driving as measured by roadside surveys. The effects of the driver improvement courses have been studied by interviewing drivers who attended the courses. They showed a better knowledge of the subject of drinking and driving, but no change in (self-reported) behaviour.

4.3. Comparison between SUN countries

4.3.1. Countermeasures

	Sweden	United Kingdom	The Netherlands
Low limit	1951: 0.05% 1990: 0.02%	1967: 0.08%	1974: 0.05%
Detection	Screening: Random +accidents Evidential breath testing	Screening: suspicion or Violation +accidents; Evidential breath testing	Screening: Random +accidents Evidential breath testing
Minimum sanction	Fine + 1 month disqualification	12 months disqualification	Fine
High limit	1951: 0.15% 1994: 0.1%	1990: 0.2% (HRO scheme)	1996: 0.13% + 0.18% (adm. measures)
Minimum sanction	12 months disqualification + medical and driving test + prison	medical test + court decision	0.13%: educ course 0.18%: med. test + court decision

Table 4.1. *Official countermeasures in the SUN-countries*

All three countries have legal blood alcohol limits, but their limit values are different. The lower limit for Sweden is 0.02%, for the Netherlands 0.05%, and for Britain 0.08%. The sanctions for exceeding the limit are different. The Netherlands starts with fines only, for drivers who are just over the limit. In Sweden all drivers over the limit will be disqualified from driving for at least one month. The minimum sanction in Britain is twelve month disqualification. The three countries also have secondary higher limits. Again, the actual levels and the consequences of being found over the limit vary in detail. In Sweden the higher limit is 0.1%, with as a consequence at least a (conditional) prison sentence and twelve month of disqualification. In such a case the drivers licence can only be regained after passing a medical and a driving test. The Netherlands has a differentiated system, starting at 0.13% with a compulsory driver improvement course and a compulsory medical test when over 0.18%. In Britain a medical test is compulsory when over 0.2%. There are differences in how regulations deal with repeat offenders. In Britain a drinking driver who is detected again within ten years is an official high risk offender. In the Netherlands administrative sanctions apply to drinking drivers with four previous convictions in the past five years. Sweden has no special regulations for repeat offenders, but courts can decide how to treat them. The three countries have provisions for special treatment programs for drinking drivers, the details of which are rather different between the countries. The rehabilitation courses in the United Kingdom are aimed at first offenders; attendance is decided by the courts; if drivers accept, their period of disqualification is shortened. In the Netherlands the driver improvement courses apply to all drivers over 0.13%; not attending a course results in disqualification. In Sweden the courts decide who will attend a rehabilitation course, in which case the prison sentence is conditional. Another main element common to all three countries is the use of evidential breath testing and screening breath tests at the roadside, making it easier for the police to select and handle drinking drivers. However, there is a major difference in the conditions for screening breath tests. In Sweden and the Netherlands the police have the power to stop and test drivers at random. In Britain the police are limited in applying a screening test to cases in which a driver is suspected of drinking or another violation, or is involved in an accident. They can stop drivers at random, but

cannot test them at random. In all three countries the regulations allow testing of drivers involved in accidents. This is compulsory in Sweden and official policy in Britain, but only recommended in the Netherlands. Table 4.2. summarises the countermeasure practices.

	Sweden	United Kingdom	The Netherlands
Screening tests per year	1.0 million	0.9 million*)	1.0 million
Per passenger car	1 : 4.0	1 : 26.5	1 : 7.0
Positive in accident	12,500 800	100,000 8,000	? ?
Over limit	9,000	90,000	31,000
Per passenger car	1 : 444	1 : 266	1 : 226

*) Adjusted to GB as 1.1 times the tests of England and Wales as Scotland has 10% inhabitants of GB

Table 4.2. *Countermeasures practice*

The annual number of screening tests are rather similar: in Sweden 1.0 million, in Great Britain (assuming Scotland has the same test rate per inhabitant as England and Wales) about 0.9 million and in the Netherlands 1.0 million. However, if these numbers are related to their passenger fleets (see table 2.1), the countries show remarkable differences. In Sweden there is 1 test a year per 4 cars; the rate for the Netherlands is 1 per 7.0 cars. The rate for Great Britain is 1 in 26.5. These rates can be interpreted in terms of the risk for a driver to be tested and imply that the detection risk for drinking drivers is lowest in the Britain and is highest in Sweden. The number of drivers convicted for drinking and driving is available for Sweden and Great Britain only, with 9,000 for Sweden and 90,000 for Great Britain. There is no official number for the Netherlands, but the number of arrests is about 31,000 (first offenders with a BAC < 0.13% do not have to appear in court). When the numbers are again related to the passenger car fleets, they indicate that in Great Britain and the Netherlands relatively more drivers are being convicted than in Sweden (Great Britain and the Netherlands respectively 1 in 266 and 1 in 226, Sweden one in 444). The problem is that these figures depend on the actual number of drinking drivers on the road, the conviction limit, and on the effort by the police to detect them. Since the enforcement level of drinking and driving is the highest in Sweden and the lowest in Great Britain, the rates would mean that the extent of the drinking and driving problem is the largest in Britain and smallest in Sweden. The intermediate position for the Dutch approaches more the level of Britain than Sweden.

4.3.2. Extent of the problem

There are better indicators for the extent of the problem of drinking and driving than number of convicted drivers, such as the number or proportion of casualties and accidents with drinking drivers. Unfortunately, the testing for and reporting of drinking in accidents is incomplete. For the Netherlands the official statistics of 10% serious casualties from drinking and driving is definitely incomplete. In Britain the blood alcohol level of drivers involved in accidents is available in about half of all cases. There is little information about the completeness of the registration of drinking and driving in accidents in Sweden. But it has been reported that 90% of all traffic fatalities are tested.

The annual number of fatal accidents in Sweden with (suspected) drinking drivers is 50, which is 10% of all fatal accidents. By comparison, the number of fatal accidents with

drinking drivers (over 0.08%) in Britain is somewhat over 400. It has to be noted that the definitions of drinking drivers are different. With the same definition, the rate for Britain would have been even higher. The official statistics for the Netherlands are rather close to those for Sweden. In view of their incompleteness, the actual rate of serious casualties/accidents (relative to the passenger cars or license holders) in the Netherlands is very likely to be about 20%. The focus of the SUNflower-study is on the period 1990 to 2000. However, improvements with regard to drinking and driving have been made before that period in all three countries. The introduction of the legal blood alcohol limit has brought major improvements. Both Britain and the Netherlands also saw a considerable decline of drinking and driving in the period of 1980 to 1990. In general, the situation did not improve much more in all three countries since 1990, except for a period of decline in the early nineties in Sweden.

4.3.2.1. Discussion

The decline in drinking and driving accidents in Sweden in the early nineties coincided with changes in the legal blood alcohol limit, together with the introduction of evidential breath testing. In the following period there was a temporary peak in the number of screening tests from intensified enforcement. All this must have been accompanied with a certain amount of planned and free publicity. There is no way to determine the relative contribution of these elements. From what is known about the problem of drinking and driving through the literature, it is not unlikely that the main contribution came from the intensified enforcement with a peak in screening tests around 1994. But the reason for the police to increase their screening efforts has probably been the legal change. There have been several changes in countermeasures in the period from 1990 to 2000. In Sweden the number of screening tests gradually went up again during the late nineties and rehabilitation courses have been introduced. Great Britain also introduced rehabilitation courses at the end of the period, there was a slow increase in the number of screening tests and the testing of drivers involved in injury accidents went up (from 30% to 50%). Several changes were made to the sanctioning of drinking drivers in the Netherlands during the period of study and administrative measures, including driver improvement courses, were introduced halfway through the period. With the evidence available, it has to be concluded that these additional changes have made no or only small contributions to the overall problem of drinking and driving.

It is difficult to decide what are the differences between the three countries in the extent and nature of the problem of drinking and driving. It is even more difficult to find out why there are differences, or how they related to differences in countermeasures. The following discussion has to be rather speculative. If the available statistics for Sweden and Great Britain are accepted, it seems that the problem of drinking and driving is the most serious in Britain. Bearing in mind the incompleteness of the Dutch statistics, it is likely that the problem of drinking and driving in the Netherlands is also more serious than in Sweden and probably slightly less serious than Great Britain. Sweden has a legal limit of 0.02%, which is low compared with the other two countries. It is not certain that this element by itself has contributed to preventing drinking and driving in Sweden, let alone to the differences with the other countries. Another major difference between Sweden and the other countries is the high number of screening tests from the higher levels of enforcement. As a result the risk for drinking drivers to be detected is relatively high in Sweden. Corrected for 10% more drivers per inhabitant in Sweden, the level of screening tests by the police in Sweden is twice as high as in the Netherlands and 6 times higher than in Great Britain. This difference in levels of drinking and driving enforcement could be an important factor to explain the differences in the extent of the drinking and driving problem of the SUN-countries. This leads to the question of whether the level of the limit is less important than the enforcement levels, although

lower limit levels are also correlated with higher enforcement levels. However, there also is a major difference in the Netherlands with respect to the severity of sanctioning. In Britain all convicted drinking drivers are disqualified from driving for at least twelve months. In the Netherlands, disqualification is decided by the courts and usually reserved for drivers with very high blood alcohol levels. Even though some drivers still drive and some still drink and drive after disqualification, this type of sanction may be more effective in preventing drinking and driving in the general population of drivers than fines alone. Compared to Britain, Sweden also has less severe penalties for drinking and driving, starting with one month disqualification. But at 0.1% blood alcohol level the minimum sanction is also twelve month disqualification plus a (conditional) prison sentence. With the legal limit in Britain at 0.08%, the blood alcohol levels of convicted drivers in Britain is not much different from those of drivers who are convicted in Sweden with a level over 0.1%. This shows that sanctions for drinking and driving are more severe in Britain and Sweden than in the Netherlands. In summary: Sweden has the most screening tests and also fairly severe sanctions, whereas Britain has the most severe sanctions but the least screening tests, and the Netherlands has more screening tests than Britain but milder sanctions. It thus cannot be excluded that the severity of sanctions in Britain acts to some extent as a compensation for the relatively low number of screening tests. It then would explain why the level of drinking and driving fatalities in Great Britain is only slightly higher than in the Netherlands, despite the higher level of screening tests in the Netherlands with the mildest sanctions. However, the general research literature suggests that the effectiveness of higher sanctions is considerably less than the effect of higher detection rates.

So far a tentative explanation for differences and similarities has been made in terms of countermeasures. The problem of drinking and driving will to a certain extent be related to the role of drinking alcohol in society. To complicate matters even more, the selection of countermeasures will also be related to this. The three countries are known to differ in this respect. Sweden has a history with a strong Temperance Movement and regulations restricting the sales of alcohol. The results of an international survey (SARTRE, 1997) of drivers reveals that Swedish drivers drink far less often and have a much lower self-reported frequency of drinking and driving: one in ten drivers in the last month. Dutch drivers admit to drink more often than drivers in Britain. Drivers in Britain tend to drink more at a time. But the self reported frequency of drinking and driving is almost the same. One in four drivers reports drinking and driving in the December month. Without countermeasures Sweden would already have been better with respect to drinking and driving. Availability of quantitative information on the extent of the problem of drinking and driving and evidence on the effectiveness of countermeasures do not guarantee that countermeasures will be taken. Countermeasures are more likely to be introduced and to be effective if the problem of drinking and driving is taken seriously and if particular countermeasures are acceptable to politicians, to executive agencies and to the general public. From this discussion there is little evidence that a countermeasure which was effective in one country will be similarly effective if introduced in another country. Apart from a general willingness to accept the countermeasure in the second country, the problem has to be seen as similar to that in the country where the countermeasure was effective. Moreover, it is probably correct to state that the population of drinking drivers is not homogeneous. A simple distinction can be made on the basis of the blood alcohol level. In fact all three countries have both a low and a higher legal limit and thus make such a distinction. In theory, some countermeasures may be more effective in preventing drinking and driving at low levels and some may be more effective for high levels. The Swedish regulations sanction all drinking and driving, whereas the limits of the Netherlands and of the United Kingdom in a sense accept driving with a low blood alcohol level. Random testing is aimed at all

drivers over the limit. Since the law in Britain does not allow this, the regulations in this country concentrate more on drinking and driving with high alcohol levels.

4.3.3. Conclusions

- The prevention of drinking and driving in the SUN-countries is based on legislation and enforcement. One function of the law is to show that drinking and driving is dangerous and not acceptable. The other function is to threaten potential drinking drivers with sanctions and to enable detection and conviction of drinking drivers. Law enforcement has to be practical and effective. It is quite obvious that a blood alcohol limit is an absolute necessity, together with practical methods for measuring the alcohol level.
- It seems that the problem of drinking and driving is the biggest in Britain and somewhat less in the Netherlands, but it is a much smaller problem in Sweden. Sweden has the most screening tests and moderately severe sanctions. Britain has the most severe sanctions but the least screening tests, while the Netherlands has more screening tests, but the mildest sanctions. It is possible that the severity of sanctions in Britain acts to some extent as a compensation for the low screening test level, while the higher screening test level in the Netherlands could compensate for milder sanctions.
- A very low limit such as in Sweden can be effective in reducing the number of accidents with drinking drivers, provided that is appropriately enforced. The experience in Sweden and other countries where a limit was changed to a lower level shows that the effects depend more on the level of enforcement than on the actual value of the limit.
- Therefore, it is concluded that further increasing enforcement levels on drinking and driving in Britain and the Netherlands will have a positive effect on safety; the safety effect in Britain would be further improved by lowering the limit to 0.05%.
- All three countries also have higher limits with more severe consequences. One argument in support of this is that a higher alcohol level is more dangerous. Another argument could be that a driver with a high alcohol level is likely to have a habit of frequent drinking and driving. Ideally, such regulations should be based on knowledge about different groups of drinking drivers and how they react to countermeasures. However, knowledge is lacking in this area.
- Random breath testing has been found effective in reducing drinking and driving. The level of random breath testing in Sweden is double that in the Netherlands. Random breath testing is not allowed by law in the United Kingdom. Drinking drivers must believe that they run a high risk of being detected (general deterrence). This would only be the case if the testing cannot be predicted by the road user. Even with the highest level of random testing found in Sweden with one test per five licence holders per year, the risk of being tested on a particular trip is still very low, even on weekend night trips when levels of alcohol are usually higher. Random testing therefore should be based on the selected times and places where drinking drivers are likely to be found. This is still a random procedure, because it is not based on individual driver characteristics. The political climate in Britain does not favour random breath testing, but it would improve the efficiency of enforcement on drinking and driving enabling a higher detection level of drinking drivers.
- The sanctions for drinking and driving with an alcohol level over 0.1% in Sweden and over 0.08% in the United Kingdom include a disqualification from driving of at least twelve month. In the Netherlands the courts decide whether a drinking driver is temporarily disqualified and for what period. Disqualification can be effective in preventing drinking and driving in the general population, in addition to fines alone,

especially with respect to repeat offenders, even though some disqualified drivers will still drive (and drink).

- The Netherlands has detailed guidelines on the process of applying sanctions and on the sanctions themselves, which are related to the level of blood alcohol. Drinking drivers with a high level of alcohol will always go to court, where the sanctions are related to the alcohol level, previous convictions, and involvement in an accident or other factors. The administrative measures are in addition to and independent of the court sanctions. All together, the consequences for drinking and driving (once detected) are rather complicated. It is questionable whether potential drinking drivers are aware of all these consequences. If they are not, there will be little effect in terms of preventing drinking and driving. There is no evidence that the introduction of (changes in) these measures has changed the problem of drinking and driving. It is interesting to find out if a simpler system could be used with more effect.
- Several changes in countermeasures were made in all three countries in the period from 1990 to 2000, which have made hardly any change to the overall problem of drinking and driving. What they seem to have in common is that these changes were too gradual or too small to be of interest to potential drinking drivers. Whether these measures would have been more effective had they been better timed (e.g. combined or in bigger steps) and the public made more aware of them is a matter of speculation. The dominant aspect seems to be that intensified enforcement of the legal limits has contributed to the reduction of drunk driving fatalities.
- The effectiveness of publicity is not completely clear. One reason is that there are many different types of publicity. And, if enforcement is accompanied as a rule by publicity, it is not possible to state that only higher enforcement levels lead to a reduction in drinking and driving? Publicity in relation to countermeasures can be used to stimulate a public debate on potential countermeasures. It can accompany and support the introduction of countermeasures, both before and after their implementation.
- In general, official countermeasures do not differentiate between groups of drinking drivers, except between low and high alcohol levels and between first and repeat offenders. Some countries have more strict regulations for drinking and driving by young drivers. There is evidence that this is effective in preventing drinking and driving by this group. The statistics from Sweden and the United Kingdom show that about half of the drinking drivers involved in accidents are young (less than 35 and 30 years old respectively). Countermeasures for this group could result in a reduction of the overall problem of drinking and driving. The Netherlands will most probably introduce a 0.02% limit for novice drivers; not because they drink so much more than other age groups, but because their risks are considered to be higher.
- Both the problem of drinking and driving and the selection of countermeasures are somehow related to the general role of drinking in society. Sweden has a strong temperance movement and regulations restricting the sales of alcohol, while its traffic regulations are aimed at preventing any drinking and driving. The regulations in the United Kingdom concentrate more on drinking and driving with high alcohol levels. The Netherlands is somewhere in between. It probably means that countermeasures can't simply be transferred from one country to another. More or other countermeasures, including higher enforcement intensities, will only be taken if the drinking and driving problem is taken seriously and if countermeasures are acceptable to politicians, executive agencies, and the general public.
- The drinking and driving comparison between the SUN countries was difficult because of the differences in statistics. With harmonised statistics a better comparison could have been made and this might have resulted in more and better based conclusions. To describe countermeasures practice, statistics are needed on

the number of screening tests with their results and with the reasons for screening (e.g. random, accident, other), on the numbers of drivers sanctioned, with blood alcohol level and type of sanction. To describe the extent of the problem of drinking and driving, statistics are needed on the number of drivers involved in accidents with blood alcohol level, and on the blood alcohol levels of all drivers on the road.

5. Seat belts

Seat belt wearing is mandatory in the front seat of passenger cars in the European countries. Most countries have also made it mandatory to use existing belts in the back seat of passenger cars and in lorries, buses etc. "*Seat belt legislation is one of the most important public health measures of modern times*". This was the conclusion in 1988 in "Strategies for accident prevention" for the UK (HMSO, 1988). The UK legislation was later than most other European countries, in 1983. The law was introduced in 1975 in Sweden and 1971 in the Netherlands. Another citation illustrates the effectiveness of seat belts and child restraints: "*International research and experience show that the use of occupant restraints is a highly effective way of reducing serious and fatal injuries to car occupants. The injury reducing effect of seat belts is around 50 per cent for fatal and serious injuries; the serious injury reducing effect of child restraints is around 90 per cent for rearward facing systems and around 60 per cent for forward facing systems*" (ETSC, 1996). The seat belt not only reduces the forces on the body, but also keeps the body in its position in the car in an accident.

5.1. Legislation

5.1.1. Sweden

Sweden introduced the first seat belt law in 1975 concerning car occupants in the front seat of all cars except taxis. Cars have by law been equipped with seat belts since 1967. It has been mandatory for adults in the back seat since 1986 and for children in the back seat since 1988 (see Figure 5.4). Taxi drivers were included in 1999 together with mandatory use in all seats equipped with seat belts in lorries and buses. The law has no longer any exceptions.

5.1.2. United Kingdom

The use by car occupants has developed gradually in the UK, as the protection that they offer has become generally recognised. The fitting of seat belts was made compulsory in the front seats of new cars in 1965 (1967 for vans), and successive publicity campaigns were mounted in subsequent years to educate the motoring public as to the advantages of seat belt wearing. Front seat wearing was made compulsory on 31 January 1983.

Once high wearing rates had been achieved among those travelling in the front seats of cars, attention turned to those in the rear. Provision of mounting points for seat belts in the rear of cars was made compulsory in October 1981. This was followed by the requirement that cars manufactured since October 1986 or first registered since April 1987 should be fitted with rear seat belts. The next legislative step was to require rear seat passengers less than 14 years old to wear seat belts, where available and this took effect on 1st September 1989. There was considerable publicity at this time aimed at encouraging the fitting and use of suitable child restraints, but little attention to adult rear seat passengers. In July 1991, seat belt wearing by rear seat adult passengers became law in cars where belts were fitted and available. The proportion of cars with rear seat belts fitted rose from 34% in October 1989 (when children under 14 were required to wear belts) to 45-50% in 1991 (when all adults were first required to wear belts). By April 2001, over 95% of the cars observed in seat belt surveys were fitted with rear seat belts.

5.1.3. The Netherlands

On January 1st 1971, the presence of seat belts (and their anchoring points) was mandatory for front seats in cars. The obligation applied to new cars or those, since a particular date, having a (new) vehicle registration. Following a transition period of more than four years, on June 1st 1975, it was mandatory to wear a seat belt if they were present. This was not yet the case for delivery vans and lorries. The obligation to have a seat belt (and their anchoring points) on *rear seats* of cars was introduced on January 1st 1990. The mandatory use of these seat belts if present started on April 1st 1992. There was, therefore, a shorter transition period than for cars. The new Highway Code of 1991 makes no distinction between cars, delivery vans, and lorries, as far as seat belt use is concerned. Apart from a few exceptions, this also applies to all occupants. There is now a general obligation to wear seat belts; if they are present they must be worn. There are special laws for children. Table 5.1. gives an overview of the whole law since April 1992.

Person	Front	Rear
Child 0-3 year	Mandatory use of child seats	Mandatory presence: mandatory use Child seat absent: seat belt use not mandatory
Child 3-12 year	Mandatory use of child seats	Mandatory presence: mandatory use Child seat absent: seat belt use mandatory
Child 12y & older	Mandatory use seat belt	Seat belt present: seat belt use mandatory
Adults	Mandatory use seat belt	Seat belt present: seat belt use mandatory

Table 5.1. *Legislation regarding seat belts in the Netherlands*

Adults and children shorter than 1.50 metres, who have to wear a seat belt, may according to the regulations use a 3-point seat belt as a lap belt. Experts advise people to wear a 3-point seat belt.

5.2. Seat belt use

In spite of the legislation the usage differs between the countries. Reported seat belt usage among drivers seems to be highest in the UK and lowest in the Netherlands.

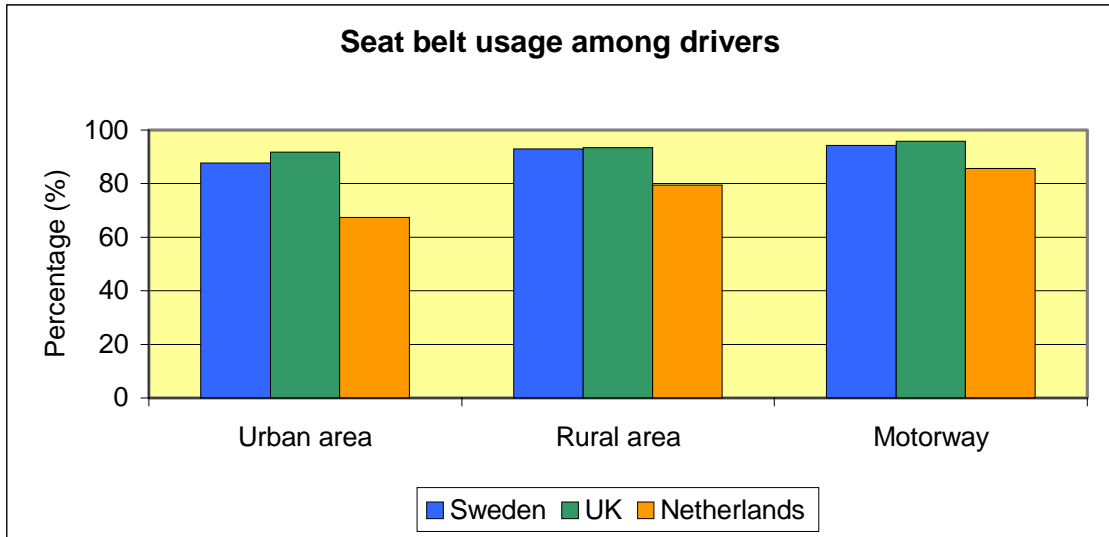


Figure 5.1. Reported seat belt usage among drivers in Sweden, UK, and the Netherlands. (SARTRE 1997: respondents who “very often” or “always” use the seat belt)

The SARTRE-investigation (SARTRE, 1997) also shows that the percentage of cars with seat belts in all seats was lower in the Netherlands (73%) than in the UK (90% and Sweden (99%) in 1997. Almost the same picture concerning drivers wearing rate can be achieved from existing data in IRTAD (International Road and Traffic Accident Database).

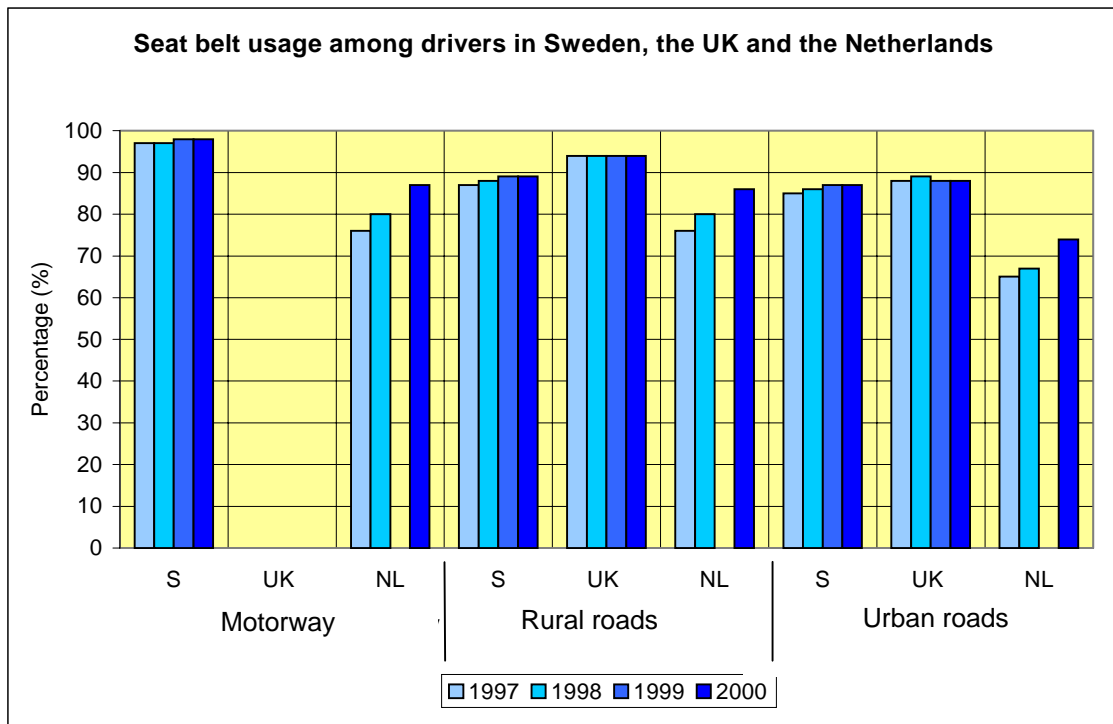


Figure 5.2. Seat belt use of drivers on motorways, other rural and urban roads 1997-1999 in Sweden, the UK, and the Netherlands. Source: OECD-IRTAD database

The usage among drivers in some countries is relatively high on motorways but lower in urban areas. Of particular interest is the fact that the proportion of killed car occupants not using seat belts is (much) higher than the proportion of occupants not using the seat belt. This can be interpreted in two ways: either the effect on fatalities of seat belt usage is very high compared to the non-users or the effect on fatalities of seat belt usage is increasing with increased general usage in relation to non-users. That means that even if the general usage is close to 100% a high proportion of drivers, not using the seat belt, will be killed because the effect on fatality risk of using a seat belt in an accident is decisive. This is of course as valid for the general traffic safety situation as for the individuals. Drivers alone in a car use the seat belt less than if she/he has a passenger and front seat passengers on average have a slightly higher usage than the average driver, as is shown in Figure 5.3.

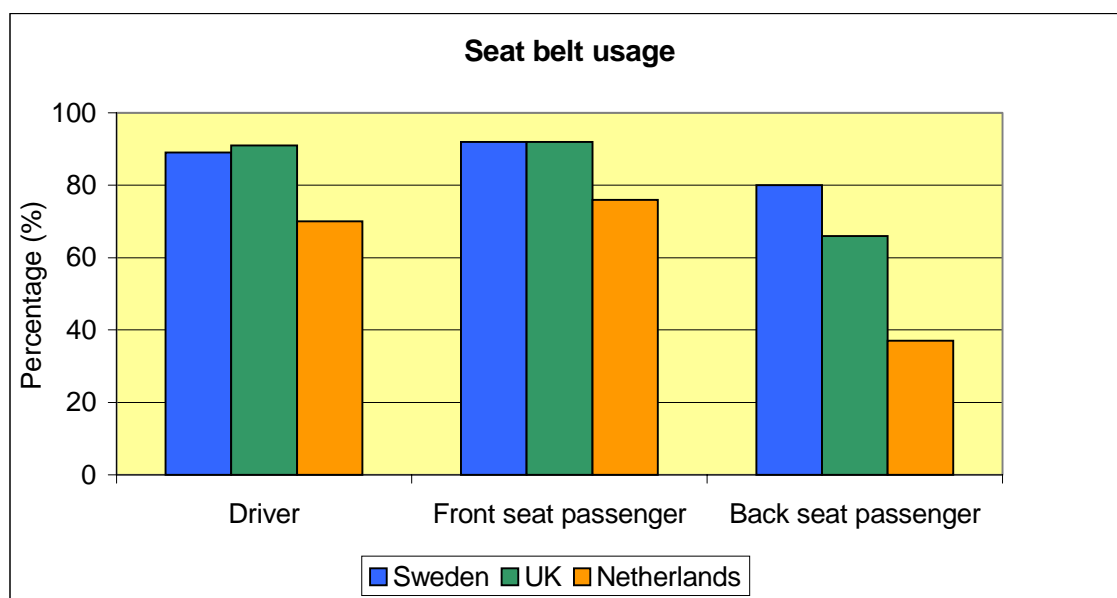


Figure 5.3. *Seat belt usage in Sweden, UK, and the Netherlands 1992- 1995 (ETSC, 1996).*

Seat belt usage has been observed in traffic in each country but over different periods. The investigations are typically made at the same sites and at the same time every year. Figure 5.4 shows the difference in the development of front seat wearing rates over time. Rear seat rates are shown for both adults and children.

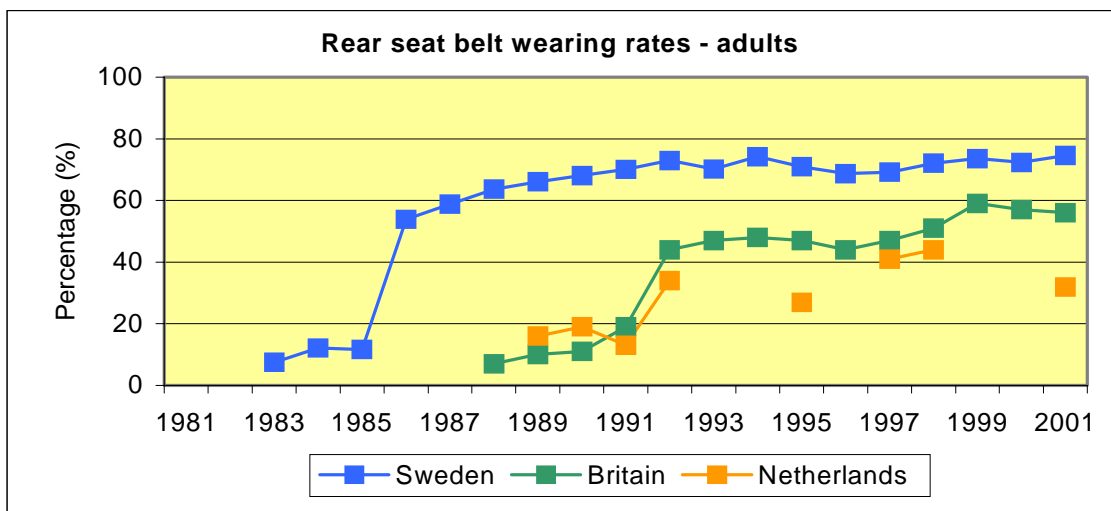
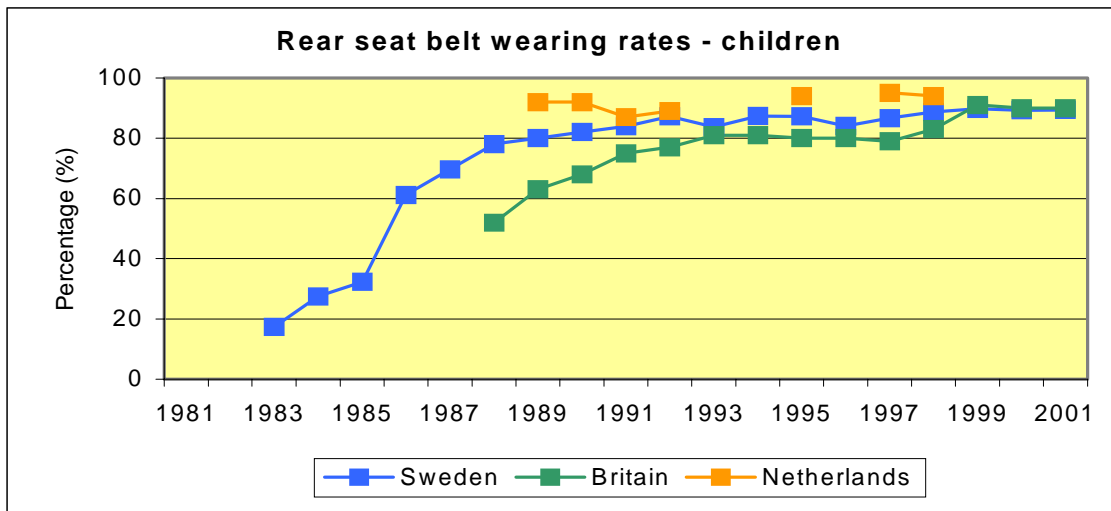
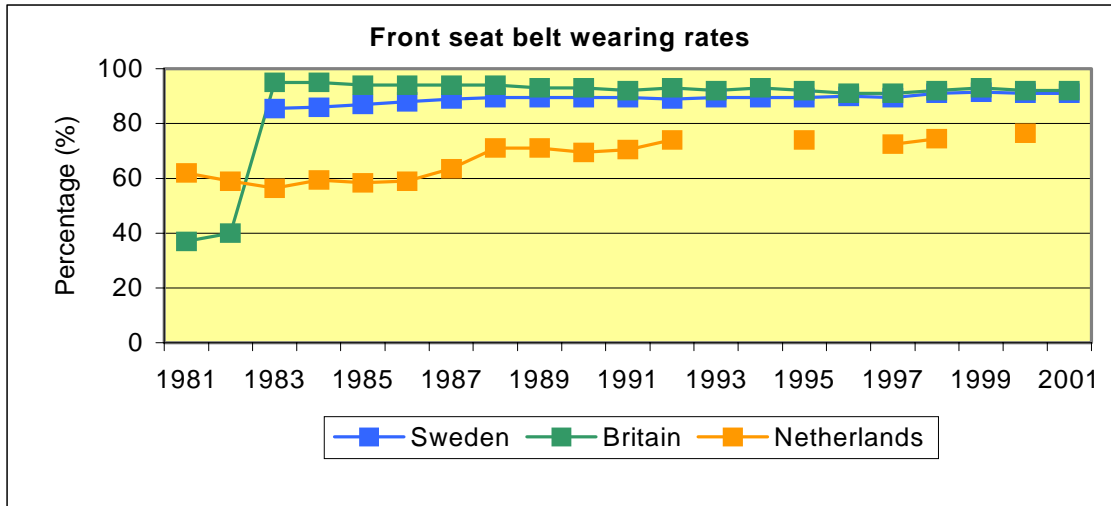


Figure 5.4 Front and rear seat belt wearing rates over time in the SUN countries

Figure 5.4 shows similar front seat wearing rates in Sweden and Britain, with the British rate having risen dramatically in 1983 when the seat belt wearing regulation was introduced. Rear seat belt usage is highest in Sweden. Seat belt use is generally lowest in the Netherlands, apart from children in rear seats.

The Swedish observations show slightly higher front seat wearing rates amongst passengers than drivers. The British observations show rates among female front seat passengers to be higher than driver rates but lower rates among male front seat passengers. Rates are lowest for the 17-29 age group, and highest for the elderly. There are similar differences by age and sex for rear seat passengers. Dutch observations show higher wearing rates when driving in rural areas. This is also indicated by responses to a regular Swedish questionnaire survey. Female wearing rates are also reported higher than male in both front and rear seats. To summarize, higher wearing rates are seen among females, the elderly, front seat passengers, children, and in rural areas.

5.3. Publicity campaigns

Publicity campaigns are important, particularly when laws are introduced, in order to inform the car users. This has been the case in all three countries and today there can be assumed to be a high level of knowledge of the laws concerning seat belts. To keep the knowledge base the campaigns must be repeated. A major rear seat belt wearing campaign was mounted in 1998 in the UK. Prior to that date wearing rates for all rear passengers were 67%, but for adults only 48%.

The campaign took as its starting point the following three facts

- Less than half adult passengers wore rear seat belts
- 120 unbelted rear seat passengers were killed each year
- 40 drivers and front seat passengers were killed by unbelted rear seat passengers

Public perceptions were that the back of the car was safe and that passengers were nowhere near the windscreen and therefore their risk was low. Attitudes to rear seat belt wearing were summed up as:

- I know that it is the law to wear a belt and that seat belts save lives;
- I always wear a seat belt in the front seat and know that I should wear a belt in the rear, but I don't.

Responses from the public on their reasons for not wearing were:

Only travelling a short distance so not worthwhile	55%
Feel restricted and uncomfortable	47%
Feel safe in the back seat	38%
Feel a bit silly wearing a belt	13%
Might crease clothes	13%
Might offend driver	10%

The 1998 campaign focus was therefore to provide new evidence particularly on the likelihood of seriously injuring front seat passenger, and to try to shake out complacency and disbelief. The results showed that between July 1998 and April 1999, the number of responses recognising the likelihood of seriously injuring the front seat passenger had risen from 50% to 65%. Wearing rates increased from 67% to 72% for all rear passengers and 48% to 54% for adult rear passengers, over this period.

5.4. Child restraint system

Different child restraint systems are used depending on the age and weight of the child.

Sweden

Small children are usually placed facing backwards in the front passenger seat. Children are restrained to a high degree. Table 5.2. shows that the use of restraint systems among the youngest is 100 % in 2000.

Age (year)	Use of backward chair for children %	Use of other restraint system %	Percentage of children restrained
0	96.6	3.4	100
1	92.6	7.4	100
2	80.9	19.1	100
3	35.4	64.6	100
4	1.4	98.6	100
5	0	98.8	98.8
6-15	0	98.6-96.0	98.6-96.0

Table 5.2. *The use of different child restraint systems in different age groups in Sweden 2000*

All child fatalities in the age of 0-14 years old in passenger cars between 1992 and the first half of 1997 cars have been investigated in Sweden. In that period 75 children were killed out of a total of 3,089 fatalities in Sweden, which was 2.43 % of all fatalities in traffic. One third were killed in single vehicle accidents and one third in collisions with heavy vehicles; 20 of the child fatalities were not restrained. It is estimated that about 50 of the child fatalities would not have been saved even with modern restraint systems.

The UK

The British use of child restraints is difficult to compare, but it is higher than in the Netherlands.

	Age	% Usage in 2000
Front seat child	0-13	96%
Back seat child	0	95%
	1-4	93%
	5-9	87%
	10-13	83%

Table 5.3. *Usage shares of children by seating position and age groups in the UK*

The Netherlands

Child seats are used both in the front or the back seat. There is no recommendation to place small children facing backward in the front seat.

Are children safe in car accidents? The use of restraint systems in the first three years of a child's life seems similar in the three countries and seems to give the expected

result for the youngest, as shown in Table 5.4, but the random fluctuations of the small numbers are large.

Age	Sweden	The UK(GB)	The Netherlands
0-3	6 (0.4 %)	50 (0,5 %)	24 (0.7 %)

Table 5.4. *The number of fatalities among children of 0-3 years old and its proportion of all fatalities 1998-2000 in Sweden, the UK, and the Netherlands.*

Airbags ought to be regarded as complementary to a proper use of seat belts. But in the situation with a backwards facing child chair in the front seat, an airbag at the front passenger seat must be disconnected or not fitted. In a crash or if the airbag explodes a child can be killed by the airbag itself. In 2000 about half of the cars are equipped with an airbag in the three countries, with Sweden having the highest proportion.

5.5. Sanction systems

Sweden

Legislation concerning seat belts carries the least severe punishment or sanctions of all traffic regulations. The fine had been unchanged since 1975 at about €30, until recently when it was increased to €65. The number of offences is also about 30,000 annually, although almost 10% of the drivers are not using the seat belt (about 350,000 unbelted drivers). The annual numbers of offences are presented in Table 5.5.

Year	1996	1997	1988	1999	2000
Seat belt offences	28,189	28,008	26,000	27,803	33,263

Table 5.5. *Seat belt offences reported by the police in Sweden 1996-2000*

The UK

Three types of action can be taken: fixed penalty notices, written warnings, and court appearances resulting in findings of guilt. Data are available on court appearances for seat belt offences after 1983, but the other two actions have only been recorded since 1992. The available data on offences are present in Table 5.6.

This means that about 200,000 offences are reported by the police, while 9% of the drivers don't use their seat belt (about 2 million unbelted drivers). The fixed fine is £20, although guilt at court can result in fines up to £500 or a maximum of £200 for children not restrained in the back seat.

	Guilt at court	Fixed penalty notices	Written warnings
1984	10.9		
1985	14.1		
1986	19.2		
1987	7.5		
1988	6.8		
1989	7.3		
1990	8.5		
1991	9.9		
1992	8.5	102.3	3.2
1993	7.1	106.2	4.8
1994	6.6	114.7	6.9
1995	6.6	126.3	8.9
1996	6.7	154.3	9.3
1997		175.3	14.3

Table 5.6. *Actions for not wearing seat belts in the United Kingdom (thousands per year)*

The Netherlands

The fine for not using the seat belt is €30 in the Netherlands. The number of fines (about 230,000 in 2001) increased dramatically the last few years, but apparently did not lead to an improved seat belt behaviour. Still, about 20% of drivers do not use their seat belts (more than 1.3 million unbelted drivers) in the Netherlands.

5.6. Conclusions

- Seat belt wearing is very important as a safety measure itself, but it is also important in combination with other measures to protect car occupants in traffic crashes. Recent research suggests that the fatality risk could be reduced with about 60 % by using the seat belt. This is higher than the 40% reduction estimated in some older studies of the 1980s, probably due to the larger share of combinations with airbags, the safer car construction, and the higher average driving speeds of today.
- Awareness of the importance of belt wearing and belt use in the front seats of passenger cars is high (above 90%) in the UK and Sweden. The level of belt use in the Netherlands, the country where the law had been introduced first, is lower (about 80%) than in the two other SUN countries.
- Belt use in the backseat is quite high in Sweden (80%), less in Britain (about 65%) and lowest (about 30 %) in the Netherlands.
- The use of child restraint systems is high (about 95%) in all three countries
- As the costs of belt fitting are already incurred through car manufacture, the benefits can be obtained simply through increasing usage among car occupants. During recent years, the efforts of increasing the seat belt use have been very low in Sweden. More fines are issued in the Netherlands during the last few years, indicating more enforcement activity.
- Fines for not using the seat belt in the SUN-countries seem more or less symbolic. The level of the fine seems contradictory to the fact that the reduction in fatality risk

is as high as 40% - 60%. Not using the seat belt increases the risk as much as driving 20 % faster. In many cases the latter is very serious, and when over the speed limit, a decision of suspending the driving licence can follow; compared with just a fine of €30 - 40 for not using the seat belt. However, Sweden has increased the fine to €65 in 2002.

- In the Netherlands it is reported that 1 in 5 drivers who are not wearing belts is detected, and in Sweden or Britain less than 1 in 10 unbelted drivers. This relatively high chance of being detected in the Netherlands is not alone enough reason for non-belted drivers to change their behaviour, but perhaps more recent figures can lead to other conclusions.

6. Low cost infrastructure improvements on urban and minor rural roads

This chapter focuses on the organisation and implementation of road improvement programmes in the three countries. Major improvements to the national network will be considered in the next chapter. The focus for infrastructure programmes in each country might be influenced by:

- The balance of responsibilities between central and local road authorities,
- The type of road network that has developed over the last 50 years
- The distribution of traffic and accidents on that network, including the relative traffic modes and accident types in urban and rural areas

Earlier chapters have provided an overview of the road networks and the current accident patterns. This chapter will look in more detail at

- The responsibility for the management of safety on the different networks
- The specific improvement programmes that have been developed, particularly over the last 20 years
- The evidence of the effectiveness of these programmes
- The way in which these programmes have influenced overall accident risk, and the potential for further future improvements

6.1. Historical overview of infrastructure improvement policies

This section examines the legislative framework under which infrastructure safety improvements have been funded and delivered, and the timing of key initiatives in the three countries which have led to new programmes or to substantial changes in the priority given to infrastructure safety. Section 6.2 then examines the evidence on the funding provided, the detailed programmes of measures implemented, and their effectiveness.

6.1.1. Sweden

SCAFT guidelines for new residential areas were introduced in late 1960s. In the initial designs each neighbourhood was designed with a ring road from which curved cul-de-sacs branched off. After a few years, this approach was criticised for generating neighbourhoods that were too similar and too enclosed, and for making the organisation of public transport difficult. The guidelines were revised in 1973.

Responsibility for infrastructure in Sweden has primarily been with the central government, and for many decades about two thirds of the total motor vehicle kilometres have been on state roads. Responsibility for the remaining roads was originally split between a very large number of small communities. Prior to 1974, the number of separate communities had gradually been reduced from thousands to a total of 812. In 1982 further reform reduced this number to 300 communities. The old definition of a town or city which was responsible for all roads in an area, disappeared. National roads passing through the area were classed as “State-community” roads, for which the city was responsible but the state provided the funding. In 1991, the State became directly responsible for the whole national road network, even where these roads passed through the urban areas of the former cities. Thus before 1991 there were five different road networks

1. State roads

2. State-community roads
3. Community roads
4. Private roads with maintenance costs paid by the community
5. Private roads

After 1991, the State-community roads became State roads, and some state roads were transferred to the community. The proportion of traffic on the state roads has remained roughly constant because the expansion of the urban road network has been balanced by construction of bypasses around bigger urban areas. The earlier through-traffic in urban areas was thus transferred to the state network of which these bypasses were a part. Between 1968 and 1992 the Road Safety Office was responsible for national road safety, although not for road construction. Since 1993, traffic safety work has been the responsibility of the National Road Administration.

Use of 30km/h speed limits in urban areas has been possible since 1972; these limits are mainly used in residential areas and at some schools and hospitals. There are large differences in use between different regions. In 1981, the 30km/h sign was introduced as a recommended sign for areas which had been limited previously to 50km/h but where humps etc were now installed. In 1989, speed limits of 110km/h were reduced to 90km/h during the summer. In 1997 some roads had speed limits reduced permanently from 110km/h to 90 km/h. 1997 also saw the first central steel wire barrier introduced on a 3-lane road. In 1998, communities were given the right to decide whether they wanted 30km/h limits. Prior to this the community had to obtain agreement of the county, regional, and national road authorities before a 30km/h limit could be installed. The change has resulted in an increase in the use of 30km/h limits. In 2000 legislation was introduced giving pedestrians higher priority on pedestrian (zebra) crossings; the number of crossings was also reduced as the crossing points became more integrated into the road environment.

6.1.2. UK (GB)

Prior to 1974, Central Government controlled all funding and works for all highways, and responsibility for network improvement lay with road safety units reporting the government regional offices. These units were responsible for the initial development of accident investigation techniques and the design of remedial measures. By 1974 an Accident Investigation and Prevention Manual had been compiled by the Road Safety Directorate with the help of some experienced local engineers. In 1974, a major change occurred with responsibility for improvement of the highway network, other than the national network, being given to Local Highway Authorities. They were required to establish routine programmes for investigating sites with accident problems, and developing remedial measures. Although specific targets were not set, this led to the development of specialist safety teams. The same legislation required the local highway authorities to appoint road safety officers who were responsible for developing education and publicity programmes for the authority.

A strong body of experience rapidly developed at local level, and local safety engineers established regional groups for exchanging experience. Through their professional institutions (notably the Institutions of Highways and Transportation), and with the support of central government, the Guidelines for Accident Analysis and Prevention were updated, first in 1980, and again in 1985. These guidelines covered both rural and urban treatments, and included recommendations on organisation, staffing and funding of the programmes, and on database systems. The 1980 guidelines also introduced the concept of safety audit as a tool for preventing accidents. A few authorities were already using this tool but it was not adopted generally until the late 1980s. The Government's

major review in 1983 stated clearly that the casualty reduction target proposed could not be achieved without the innovation and implementation of Highway Authorities who are directly responsible for much of the road safety activity. This was particularly true for local road safety improvement programmes. The Review recommended a substantial increase in the funding available for these programmes. It also recommended that the safety effects of larger schemes should be assessed more clearly and that safety should be given a higher priority in the improvement schemes.

In 1990 the Local Authorities Associations responded to the Review by publishing their Road safety Code of Good Practice that recommended that all local authorities should publish and regularly review a strategy for assisting road casualty reduction in their area, in the form of a Road Safety Plan which identifies target reductions in casualties expected from the strategy. The next major legislative change occurred in 1992 with the Local Government Act that reorganised Local Government and created Unitary Authorities. This meant that another tier of smaller highway authorities were created. In some areas, road safety teams were broken up, and the new authorities, many in urban areas, were often too small to sustain experienced safety teams. Nevertheless, in general, the level of safety engineering works was higher than at the end of the 1980s.

Thinking on treatment of urban areas also changed between 1970 and 1990. In the early part of this period, urban area treatments were generally seen as individual measures forming part of a local safety scheme programme treating a series of high risk sites. In the early 1970s, several urban residential redevelopment programmes included modification of the road network to enhance the environmental quality of the area, through the use of restricted access and or rumble areas at entrances to access roads. At the same time research on road hump design demonstrated that humps could be designed which reduced traffic speeds without undue discomfort. However, very little progress was made with these techniques within safety programmes until the end of the 1970s. By then, proposals had been put forward to demonstrate area wide treatments in large sectors of towns using traffic management techniques and reallocation of road space. The success of this demonstration led to the development of urban safety guidelines, again by local authority engineers through their professional institution, in 1990. By 1990 a variety of initiatives were therefore coming together, from several sources to encourage major changes in local safety programmes. The increase in funds recommended by the 1987 review had begun to materialise. Further guidelines on Safety Audit procedures had been produced, and the procedure was adopted as mandatory by the national road authority. Many Highway Authorities adopted these guidelines into their own procedures as part of their Quality Assurance. However it is still not mandatory to undertake safety audits, although failure to do so could lead to litigation against the Highway Authority, should an accident occur.

Although full scale urban safety programmes were not being adopted, traffic calming programmes, drawing heavily on Dutch experience, were implemented by many authorities. Legislation was established allowing the creation of 20mph zones in residential areas, providing roads were modified to ensure that lower speeds were sustained. In 1996, a further urban safety demonstration project (Gloucester Safer City) was mounted to encourage local authorities to develop holistic urban safety plans rather than apply traffic calming in a piecemeal way. This demonstration also concentrated on improving liaison between the various local professionals (engineers, planners, health, police, emergency services) in developing these strategies, and increasing public involvement in their development.

6.1.3. The Netherlands

During 1970s an entirely different principle to that of the separation of modes of traffic was adopted for residential areas in the Netherlands, compared with the Radburn principle and SCAFT guidelines being adopted elsewhere. The new principle aimed at integration rather than separation, and became known by the Dutch word “woonerf”, nowadays referred to as homezones. Motorised traffic is accepted in these areas, but is subordinate to other road users, and has to travel at “walking pace”. Woonerfs were given legal status in 1976. Evaluation of some areas reported 70% reduction in all injury accidents. However, the application of the woonerf often remained restricted to only a limited number of relatively small areas, due to the very strict design requirements, the high construction costs, and the extra space needed to fulfil the design layouts. In 1983, legislation provided for an alternative approach, by which a legal speed limit of 30km/h could be placed on roads or zones within urban areas. Decentralisation of the management of local road safety activities occurred mainly during the 1980s and early 1990s, and is still ongoing.

Policies for major improvement of roads outside built up areas were developed during the 1960s and 1970s. But alongside investment in motorways during the late 1970s and 1980s, there was also investment on segregated cycle paths. A spearhead policy introduced in the late 1970s included measures to improve blackspots as well as measures for cyclists and moped riders (demonstration projects in The Hague and Tilburg). Major demonstration projects of area wide urban safety schemes were implemented in Rijswijk and Eindhoven in the early 1980s compared traffic safety achieved by three alternative levels of treatment of residential roads - woonerven, 30 km/h zones, and more low cost traffic calming including one way street systems. As a result a general policy of 30km/h zones was adopted. The second road safety policy developed in 1989 recognised the importance of participation by local and provincial road authorities and other stakeholders, in achieving changes to the local road network.

The vision Sustainable Safety, which was developed in the early 1990s, aims to reclassify roads clearly into three categories (through roads, distributors roads, and access roads) leading to a functional hierarchy of roads and streets. To support the reclassification, the infrastructure for each road category will be unique in character, two urban classes and three rural classes are envisaged. The Starting-up phase of Sustainable safety focusses into those sites where there is evidence of high risk. 30km/h urban zones and 60ph rural zones will be extended, priorities made more consistent on roundabouts, and mopeds are required to use the roadway instead of segregated cycle paths. The legislation for introducing a 30km/h speed limit in urban areas was revised in 1999 and less (costly) infrastructural countermeasures were required. By the end of 1999, the legislation was enacted to make it compulsory for all mopeds to travel on the carriageway in urban areas instead of on cycle paths. Right of way for cyclists entering from right was implemented in 2001. In the meantime, for more than 90% of the Dutch road network, categorisation plans have been made and formally established by the road authorities. The period from 2002-2010 is expected to see the further realisation of the planned new road categories. Intrinsic to this is further expansion of the 30km/h and 60km/h networks. But their benefits are not expected to be as high as from previous 30km/h zones because design standards ('low cost implementation') are set lower to enable rapid implementation.

6.2. The tactics, funding and operational activities for infrastructural improvements

6.2.1. Sweden

Prior to 1997, almost none of the traffic safety programmes explicitly included road engineering measures, as a main part of their strategy. Low cost engineering measures were not seen as an important part of the safety programme. This is not surprising given the relatively low traffic flows and accident rates, that result in very few individual high risk sites. As recently as 1994, the Traffic Safety Program for 1995-2000 presented by the National Road Administration did not regard engineering measures as traffic safety measures, except where these involved improvements in intersection layouts (e.g. channelisation, signalisation, and roundabouts). However during the 1990s, there were programmes to improve the use of protective barriers on motorways, and subsequently, from 1998, to use steel rope barriers along the centre of 3 lane inter-urban roads, to separate the traffic streams. Changes were also made during the 1980s and 1990s, to adjust downwards the speed limits on inter-urban roads, using 90km/h limits instead of 110km/h, where these were justified by high flows or by adverse weather conditions.

In urban areas, the replanning of residential roads dated from before 1970. 30km/h speed limits have been gradually introduced over a long period, but the change in 1998 to allow communities to decide for themselves has increased their use. There are now 2000-3000 kilometres of street with speed limits of 30km/h, but this still only represents 6% of community roads, and only about 1 or 2% of the traffic in urban areas. A recommendation in 1982, that all urban speeds should be reduced to 30km/h, was not implemented. No information is available on the funding of these various measures.

6.2.2. UK (GB)

Central Government funds all work associated with Motorways and Trunk Roads. Road safety improvement infrastructure schemes on local roads are financed by Central Government Capital Funds that are bid for by Local Authorities. During the 1980's safety scheme capital funding was allocated annually and was 'ring fenced' so that it was used only for safety schemes. The expenditure was monitored and the greater success in casualty reduction was often rewarded by greater allocation the following year. This acted as an incentive and may have been a major contribution to achieving targets.

Safety funding appears as a specific budget line in Government accounts. But this funding largely represents that allocated for these specific ring fenced local safety schemes. To qualify for funding they needed to show high First Year Rate of Return. Over time this budget line also included funds that were used where Government invited local authorities to bid for more specific safety programmes relating to specific types of engineering or education scheme. Figure 6.1 shows that the budget designated for local safety schemes rose substantially at the beginning of the 1990s, following the recommendation from the 1987 Review that Government should "increase to £30-50 million per year. The programmes implemented by local authorities are usually some 25% higher, supplementing these centrally designated funds from other parts of their central transport budgets.

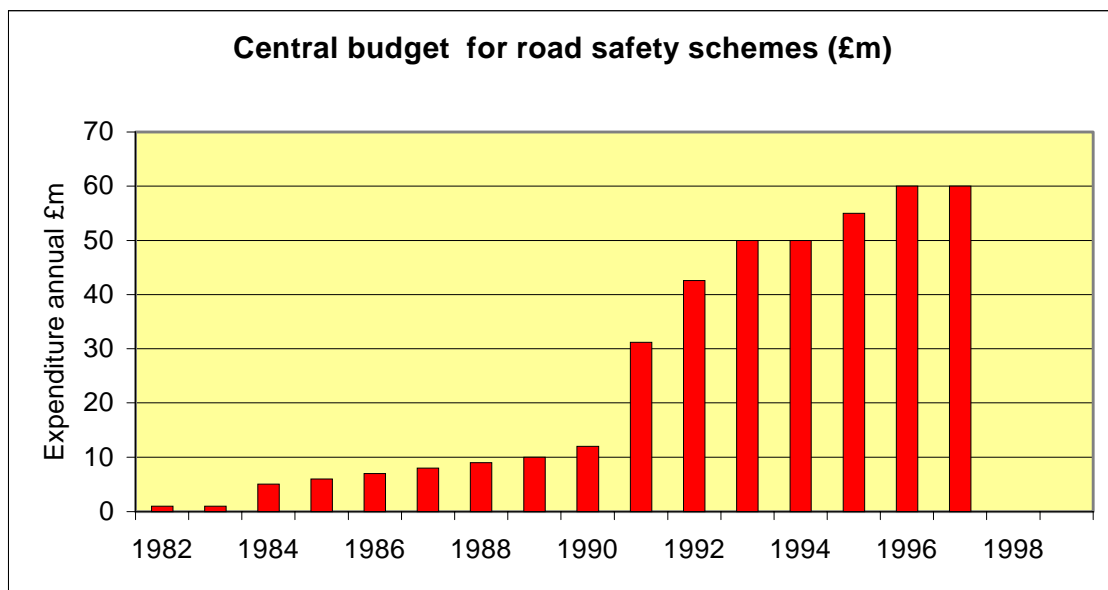


Figure 6.1. *Trend in funding local safety schemes in Britain*

This funding only represents a very small part of the total funding spent on roads, but the primary purpose of the remaining funding is to improve mobility and accessibility, and to maintain structural strength and road surface quality of the network. This expenditure may have consequences for casualty numbers. For example, use of friction coefficients as a key parameter in defining intervention levels for improving road surfaces was driven by the expectation of a reduction in skidding related accidents. A programme of building bypasses to take traffic away from small towns should result in a smaller overall casualty total, providing the town roads are treated to ensure the in-town traffic is not regenerated. But road improvements are in general likely to increase total traffic and therefore total casualty numbers, particularly where the main result is to increase vehicle speeds of existing roads. Alongside the major improvements, large sums are also spent on minor works, and in towns, on urban improvement programmes. These schemes often can have safety objectives, and safety engineers have increasingly used these budgets to partially fund large safety remedial treatments, particularly where routes or areas of towns are treated, where these schemes are too large to qualify for the specific local safety scheme budget.

From 2000/01 the funding mechanism for local authority programmes was changed. Authorities now bid for a single budget to cover all their transport needs. These bids are justified by an integrated Local Transport Plan, for which funding is allocated on a 5-year programme. Part of this plan defines the proposed road safety activity and provides a specific list of local safety schemes. Guidance on the plans requires particular attention to be given to addressing pedestrian and cycling, both in terms of encouraging greater use of these modes, and improving their safety. The lack of a specifically defined safety budget is hoped to encourage more attention being given to safety in schemes with wider objectives. But there is a possibility of less being spent to specific safety schemes, and Central Government is monitoring expenditure to assess any changes in the use of funds. It is too soon to measure the affects of the change. In the 1970's and early 1980's the general approach adopted by many Highway Authorities was to address high risk accident sites (black spots) that were identified by police accident data. The accident levels for intervention varied substantially across the country, between rural and urban areas. A typical definition of a site warranting

investigation was 4 injury accidents located at a specific site within a 12 month period. During the late 1980's and the 1990's, the focus for treatment broadened, but measures continued to be needed at high risk sites. When the casualty reduction targets were set for 2000 many of these sites had been tackled which led to the development of different techniques of addressing whole routes and areas during the late 1980's and 1990's. This also saw different approaches developed for urban and rural areas.

6.2.3. The Netherlands

General funding from central government in the Netherlands has not in the past been 'ring fenced' for safety or transport measures, although there have been directly funded programmes for various times for treatment of residential streets, cycle facilities, and blackspot treatments. There have also been various special incentive programmes, in which authorities were given funds on the basis of good records of reducing casualties. This was done for 5-6 years starting in the mid 1980s (the Minus 25% programme), and again in 1997 to encourage work on sustainable safety. The 1986 funding was linked with greater decentralisation of responsibility to the local authorities and coupled with the requirement to produce casualty reduction plans. However the process of planning, monitoring, and feedback on the basis of results is not generally applied. By 2000, more than half of the investment costs for local and regional work come from their own resources, and less than a half is provided through subsidies by the central government.

High risk sites

Improvement of black spots has continued throughout the last decades. Accident concentrations usually occur at crossroads, but can also occur along stretches of road. As in other countries, several criteria are used to define accident concentrations e.g. five or more injury accidents a year, or more than ten injury accidents within a period of three years. Both criteria result in roughly the same number of crossroads (and to a large extent the same crossroads) being identified. The total number of accident black spots at crossroads has been halved during period 1986 to 1996. However the number of accident concentrations along stretches of road has increased slightly.

The approach to tackle black spots remains a "spearhead" of the national road safety policy plan, but it has now been broadened to an "approach to dangerous situations". The latter include dangerous routes and areas as well traditional black spots. The Black Spot Guidebook, which was written in 1979, has been updated to include methods for dealing with dangerous routes and areas. However these last two methods are difficult to carry out, and many regard them as not very promising. Partly because of this, the interest in "dangerous situations" has declined somewhat recently.

Introduction of 30km/h zones.

The Netherlands adopted 'woonerven' (traffic calming areas) during the 1970s as a means of integrating traffic into residential areas at very low speed. Following the demonstration projects in the early 1980s, a general policy of implementing 30km/h zones was adopted in urban areas. Although this was taken up fairly enthusiastically, it is estimated that only 15% of urban roads had been treated in this way by the mid 1990s, with some 8,500kms of the 55,000kms of urban road being 'woonerven' or 30km/h zones. However, in 1997 a renewed target was set, as part of the sustainable safety initiative, to rapidly increase the implementation of 30km/h zones by treating a further 12,000 kms between 1998 and 2001. A brochure describing minimum layout requirements for 30km/h zones is being prepared. Design standards are being amended to relax current design and layout requirements which are based on optimal safety provision. Due to the wish to reduce investment costs, traffic calming measures

were only required when entering a 30 km/h-zone, at intersections, and at sites which are unsafe or potentially unsafe. It was soon recognised that the foreseen budgets would be insufficient to treat the planned 12,000 extra kilometres of roads and streets - many existing urban roads of wide dimensions were costly to modify to 30km/h standards. Local road authorities applied for budgets to modify a total of some 30,000 kilometres (i.e 2.5 times the plan). By 2002, it is claimed that 50% of urban streets which could be potentially redesigned as 30 km/h-street, has now been treated in this way.

Minor and major roads in rural areas

The Starting-up programme for Sustainable Safety proposed that between 1998-2001 the length of infrastructurally redesigned roads in 60km/h-zones would increase by 3000 kms (about 7% of roads outside built up areas). A manual on design and layout alternatives for these roads has been prepared, and it is reported that this goal has been reached. Currently road authorities in the Netherlands are experimenting with new methods of preventing overtaking on rural single carriageway roads. Experiments how to design the separation (hard and soft alternatives) are being carried out all over the Netherlands and first results are encouraging.

Traffic management

At the end of 1999 moped drivers were not allowed anymore to use bicycle paths in built-up areas. However, road authorities had to decide for each path separately if this general rule could be applied safely. Many local authorities decided to make exceptions to the general rule, mostly because of expected difficulties when mixing mopeds with high motor vehicle volumes at junctions, or with speeding cars at road sections. A first evaluation in 2001 showed a 15% reduction of injury accidents.

Uniform right-of-way rules for all road users were to be introduced in May 2001. Until that moment slow moving traffic had to give priority to motor vehicles coming from right or left. Skipping this exception to the general priority rules could possibly result in many more accidents. Especially because the general priority rules applies to most of the junctions in the Netherlands. Only a small minority of the total number of junctions was provided with priority signs. So the change in priority rules should only be made provided that priority signs were installed at each junction of main roads. However, most local authorities claimed that most of the junctions on their main roads were already provided with priority signs. Within residential areas relevant junctions (considered as not safe) should be reconstructed into raised junctions. At the end of 2001, 57% of local authorities had already implemented these type of reconstructions.

According to national guidelines, roundabouts with bicycle paths in built-up areas should be regulated in such a way that cars leaving the roundabout should give priority to crossing cyclists. This regulation is still being debated among road authorities.

6.2.4. Comparing aspects of management and funding of local safety engineering programmes

- Work on local road engineering programmes is managed differently in the three countries. Britain decentralised responsibility fully in 1974 for all but a relatively small network of national roads. In Netherlands, the transfer of responsibility has been more gradual. In Sweden, although the urban communities are active in local road improvement, the main programmes have always been defined at national level. The rural roads, and particularly the national road network, is the main focus for these programmes. It is not obvious that these differences matter, although it is

difficult to see the same degree of commitment to local safety engineering programmes as part of regular annual plans in the Netherlands and Sweden as in Great Britain. This process appears more formalised in Britain as a result of a large proportion of the funding for this work coming from central budgets and needing to be justified through these annual plans.

- The main effect of the difference in funding mechanisms would appear to be the greater leverage which central government can apply in Britain through being the main source of funding. Increased funding for local safety schemes was a key element of the strategy to meet the casualty target for 2000. In the Netherlands, local activity has been encouraged through a series of incentive programmes. However, where more funding can be obtained through other sources, policies can be developed locally which do not necessarily follow the current government initiatives.
- Remedial programmes directed towards high risk sites and routes have been most evident in Britain, probably reflecting the higher flow levels and therefore higher concentrations of accidents in Britain. Where programmes have been directed at individual sites in Sweden and Netherlands, these have mainly been junction improvements, and most recently these programmes have focussed on introducing roundabouts.
- The presence of these larger local engineering programmes in Britain fostered not only highly skilled local engineers, but also a strong ethos of encouraging good practice and exchanging experience. This is typified by the Code of Practice that was produced by Local engineers advocating Road Safety plans, and by the regular high quality guidelines produced for professional institutes by local engineers. However there remained relatively poor opportunities for direct training in road safety engineering skills, other than through the working environment.
- More general treatment of urban residential areas in Britain has lagged behind the progress in the other two countries, although progress even in those countries has not been as extensive as is sometimes thought. Only recently has the Netherlands made large strides forward in the proportion of roads treated with 30km/h zones, and Sweden is not markedly ahead of Britain. It is likely that the high traffic flow levels in Britain make the clear separation of large parts of the urban area into low speed areas more difficult, unless substantial changes to vehicle routing can be achieved.

6.3. Accident and traffic changes on local roads

6.3.1. Changes in numbers of fatalities

In all three countries there have been large reductions in fatality numbers, with reductions on urban roads being higher than on non-urban roads. However there is a problem in making comparisons because the definition of “urban roads” is not necessarily consistent between the countries, nor has it stayed consistent over time even in individual countries. This is particularly true in Sweden, which is why the data for urban and non-urban roads for Sweden is shown in brackets in Table 6.1. A common way to define urban areas, when accident data are being considered, is by allocating roads according to speed limits. But over the years, speed limits have changed, and in Sweden particularly there has been a substantial programme of bypassing even relatively small towns. So comparisons do not necessarily reflect how conditions have changed on the same set of roads. Nevertheless, the basic picture is clear, and similar in all three countries.

	Percentage reduction 1980 to 2000		
	Urban roads	Minor rural roads	All roads
Sweden	(57)	(15)	30
UK (GB)	59	34	43
Netherlands	54	50	45

Table 6.1 *Fatality reductions on local roads*

	Percentage reduction 1980 to 2000		
	Pedestrian	Pedal cyclist	Motorcyclist
Sweden	45	58	36
UK (GB)	56	58	48
Netherlands	83	61	69

Table 6.2 *Fatality reductions in vulnerable road user groups*

Table 6.2 shows that these changes partly reflect large changes in fatalities among vulnerable road user groups in all the countries, but here we can begin to see some differences. Certainly over the last 20 years, there has been a much greater change in pedestrian fatalities in the Netherlands, although in Sweden, there had already been substantial remodelling of urban networks during the previous decade.

6.3.2. Distribution of fatalities between road user groups and between urban and rural areas

As Table 6.3. shows the distribution of fatalities is also different, with 41% in urban areas in Britain compared with only 27% in Sweden. The relative size of the pedestrian, cyclist and motorcyclist groups is also quite different, reflecting different patterns of modal choice.

	Percentage of urban fatalities	Total percentage of fatalities in each road user group		
		Pedestrian	Pedal cyclist	Motorcyclist
Sweden	27	12	8	8
UK (GB)	41	25	4	18
Netherlands	33	10	18	18

Table 6.3 *Proportion of urban fatalities and distribution of fatalities between road user groups*

6.3.3. Distribution of fatalities between junctions and links (non-junctions)

The distribution of fatalities between junction and non-junction sites differs between urban and rural areas, which is shown by Figures 6.2. and 6.3. Because the balance of urban and rural networks differ, this leads to a different proportion of fatalities at junctions in the three countries. This is relevant when deciding where to focus infrastructure improvements.

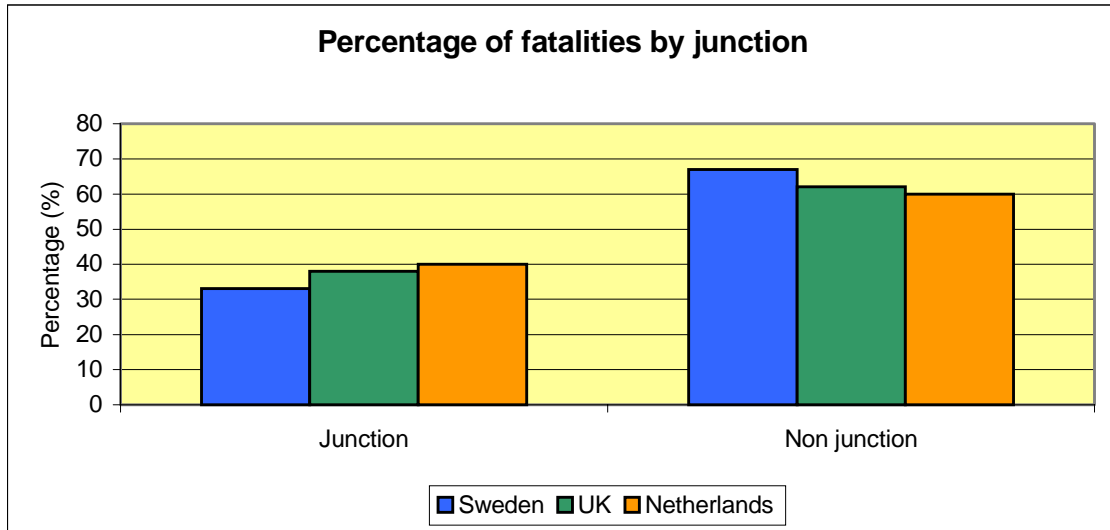


Figure 6.2 Percentage of fatalities by junction

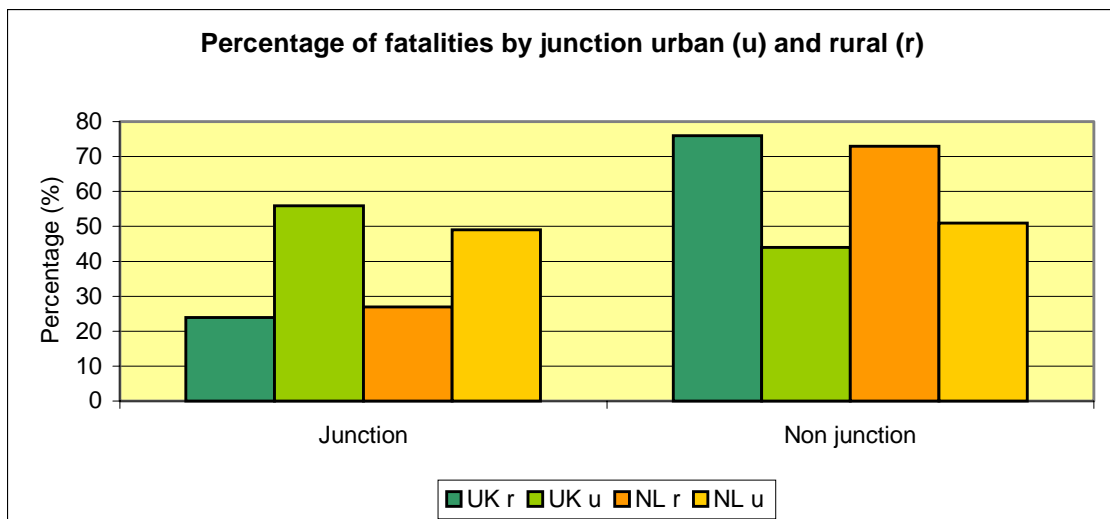


Figure 6.3 Percentages of fatalities by junction in urban and rural areas in the United Kingdom and the Netherlands.

6.3.4. Fatality rates

The density of fatalities on urban roads in Britain is higher than in the Netherlands and double that in Sweden. This is relevant in that it results in a much higher number sites with high accident numbers, which in turn means more individual sites that warrant treatment.

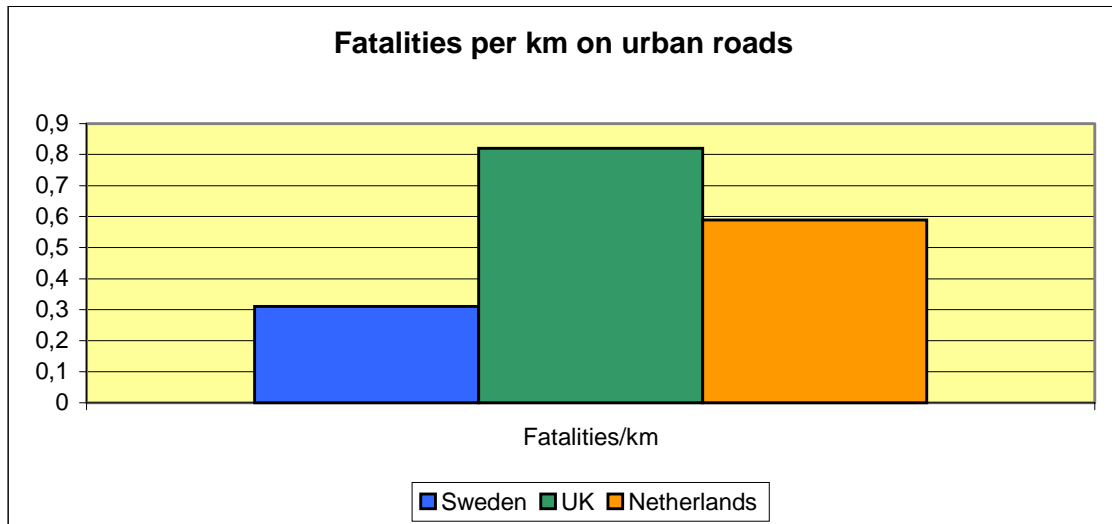


Figure 6.4 Comparison of fatality rates per km on urban roads.

When this comparison is extended to fatalities per vehicle km, it appears that rates in the Netherlands are much higher than in the other two countries. This might be partly the result of the high cyclist flows - which contribute to the total fatalities, while not increasing the total motorised traffic flow in the Netherlands. But it may also be a result of the problems of measuring urban road traffic flows. Taking the two previous rates together suggest that urban traffic flows in the Netherlands are as low as those in Sweden, and half of those in Britain (Figure 6.6). But there is no direct measurement of kilometres driven on urban roads in the Netherlands. Instead, an estimate is made by subtracting an estimate of rural vehicle kilometres from an estimate of all national vehicle kilometres.

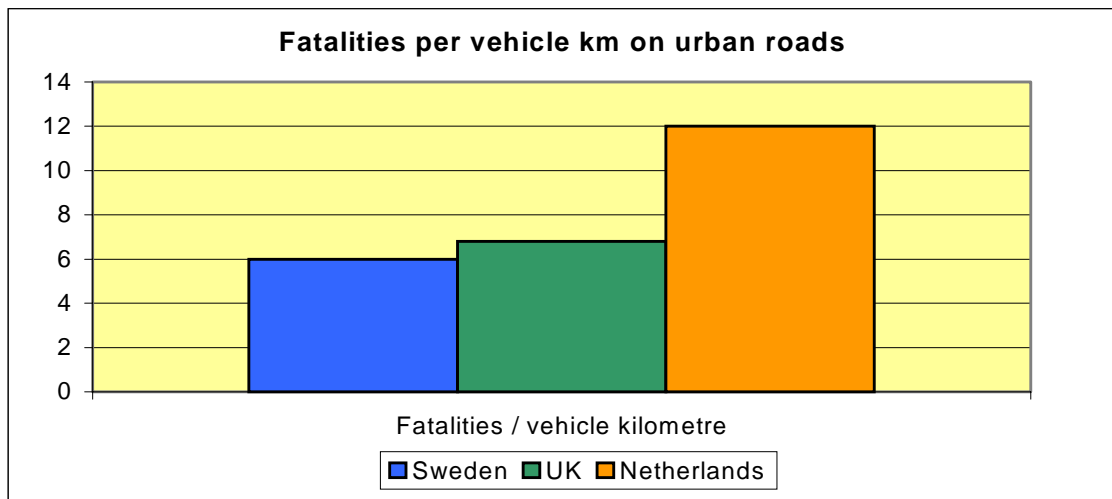


Figure 6.5 Comparison between urban fatality rates per vehicle km

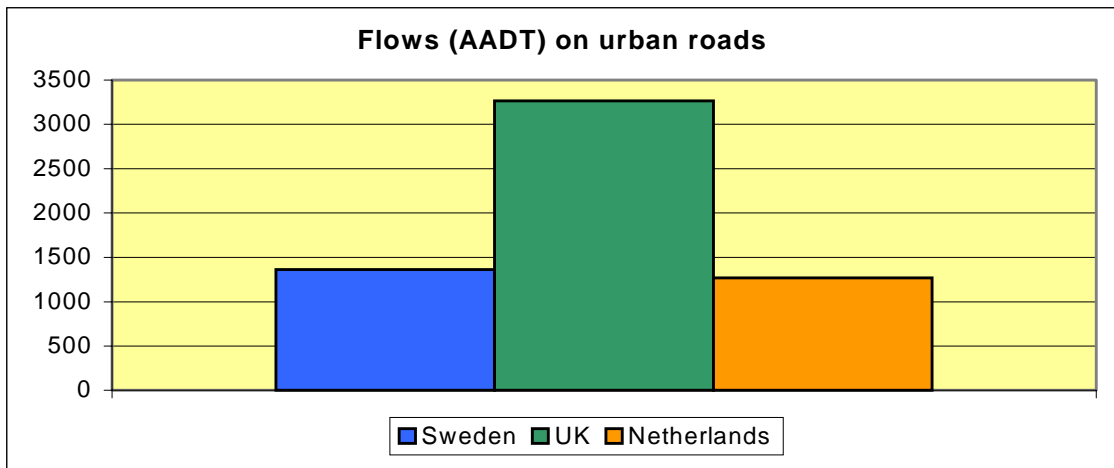


Figure 6.6 Comparison of urban traffic flows

It might be expected that fatality rates per head of population in urban areas would be reasonably consistent. However, comparison for a sample of towns in Britain and Sweden shows overall fatality rates per head to be 60% higher in Britain. Although there are some differences in town size, this difference seems mainly to result from the much higher traffic flows in Britain. Thus for residential roads the fatality rate per kilometre road is the highest in Britain, while the fatality rate per vehicle km is the highest in The Netherlands.

6.3.5. Trends in fatality numbers and rates over time

It is relevant to examine the data available on trends in rates on urban and minor rural roads, to see if they provide any further evidence of the effects of engineering policies in the three countries.

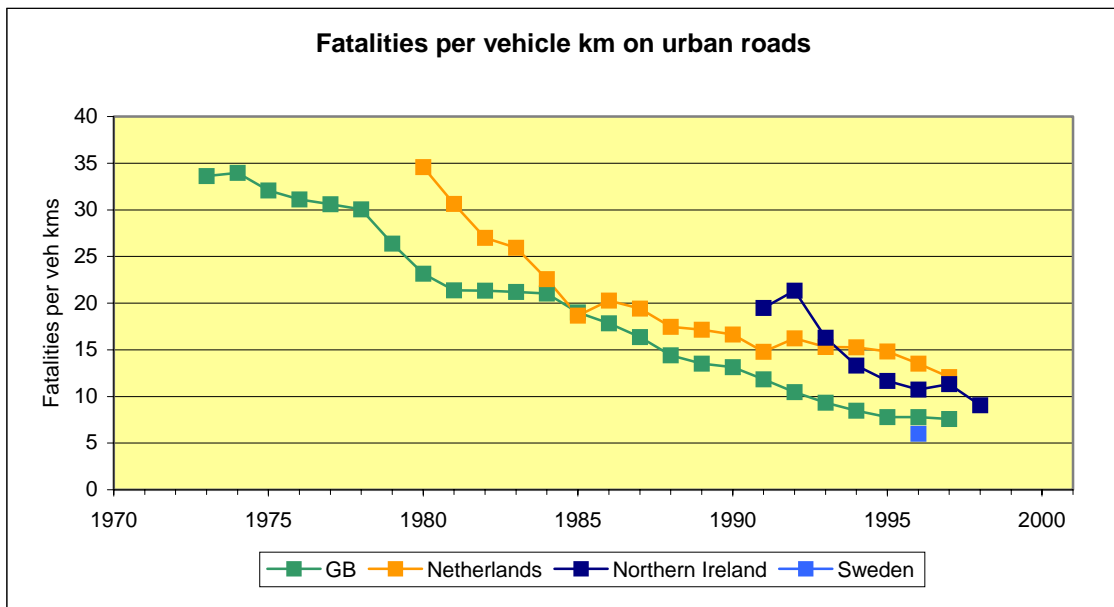


Figure 6.7 Trends in fatalities per vehicle kms on urban roads

Figure 6.7 suggests that the steeper general decline in Dutch fatality rates from 1975-1985 was reflected in the urban areas, but since then, there is little indication that further treatment of residential areas has changed the rate of decline in the Netherlands. The decline in Britain appears as steep or steeper, but part of this is likely to reflect lower activity levels by the more vulnerable road users.

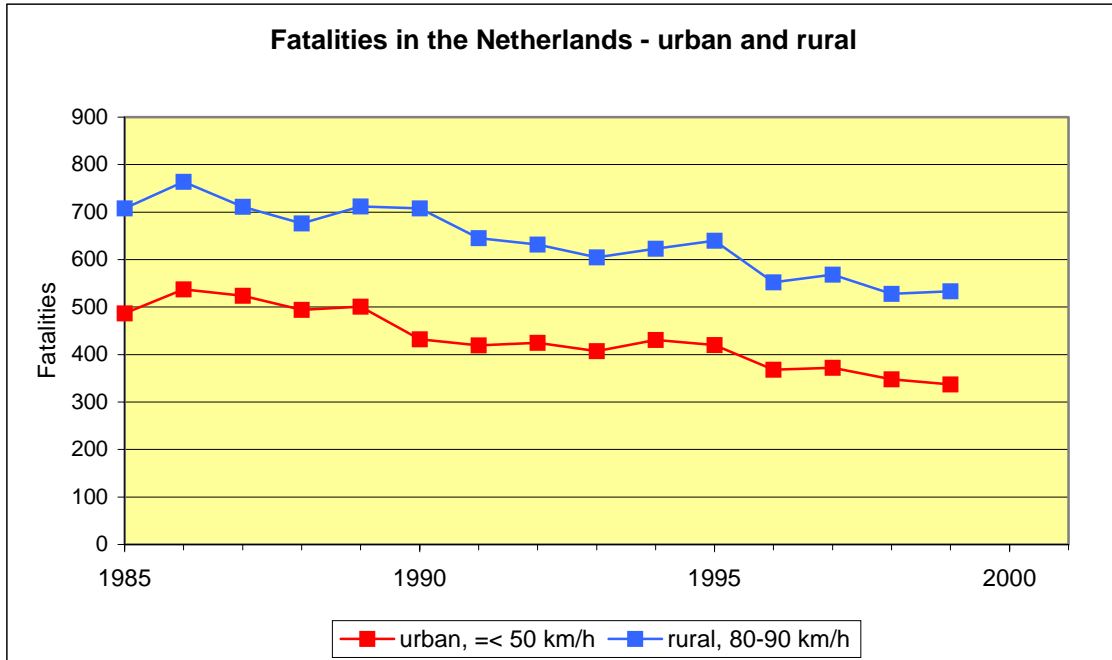


Figure 6.8 Trends in deaths on 50km/h urban roads with trends on rural roads in the Netherlands

Figure 6.8 compares change in numbers of deaths on urban 50km/h roads and rural 80/90km/h roads in the Netherlands. On both road types there has been a similar decline in fatality numbers.

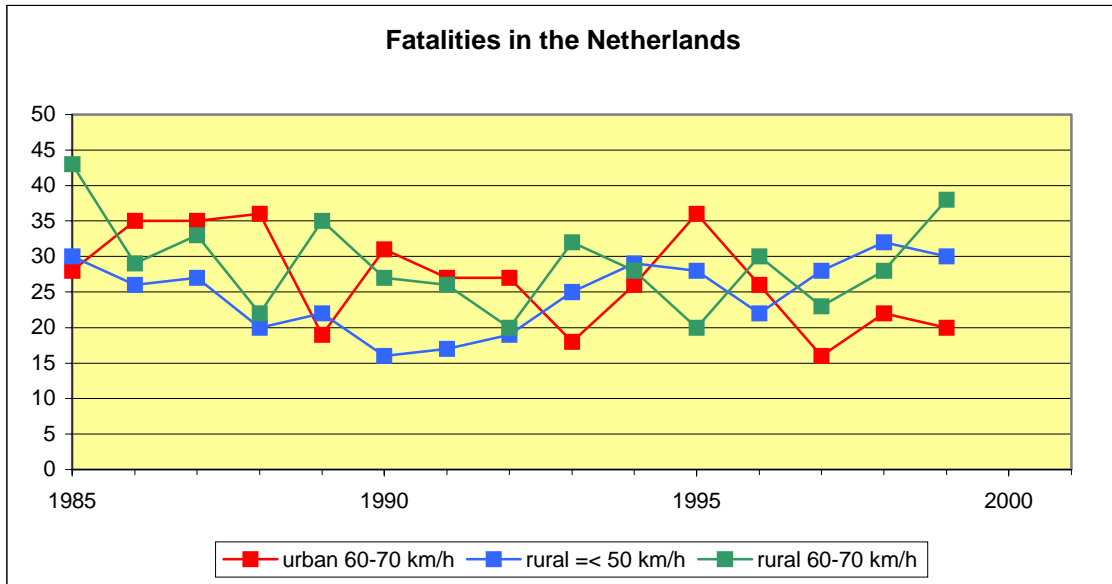


Figure 6.9 Trends in deaths on 60-70km/h urban roads and on rural roads in the Netherlands

Further comparison of numbers of deaths on higher speed roads (60/70km/h) and low speed rural roads in Netherlands in Figure 6.9 suggests that the number of deaths have declined further on these urban roads than on the lesser rural roads, although all these groups only contribute a minority of total deaths.

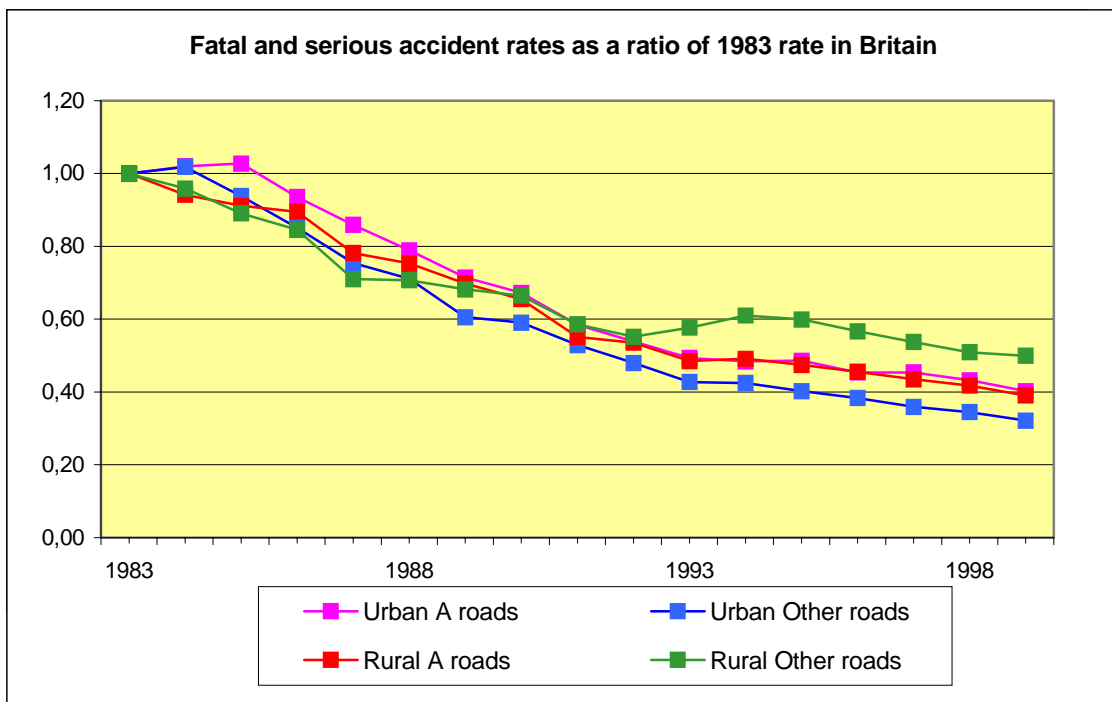


Fig 6.10 Trends in deaths and serious injuries on urban and rural roads in Britain

Figure 6.10 compares trends in fatal and serious accident rates in Britain in relation to their 1983 rate; 1983 is chosen so that the different step changes on the different road types due to the rapid change in seat belt wearing is removed. This does show a larger reduction on minor urban roads than on major rural roads, but partly due to changes in the mid 1980s (possible due to changes in flow estimates). There is little evidence of any substantial recent change in trend that might reflect the introduction of 20mph zones.

6.4. Relating changes to remedial programmes

6.4.1. Low cost remedial measures (high risk sites, routes, and areas)

The main programme of remedial measures at individual sites in **Sweden** has been the introduction of roundabouts at 3 and 4 arm junctions. No direct assessment of the benefits of this programme has been identified. However, roundabouts are to reduce the occurrence of fatal and serious injuries, where an indirect estimate might be made by considering the comparative injury severity at sites where roundabouts are now installed. Accident data for 1999 for different road sections are given in table 6.4 below.

	Total accidents	Accidents with fatalities	Percentage with fatalities
Between junctions	7955	346	4.3
3 arm junctions	3493	73	2.1
4 arm junctions	3238	68	2.1
Roundabouts	270	0	0
Other sites	878	29	3.3

Table 6.4 *Accidents at different types of site in Sweden in 1999*

If as a minimum it is assumed that the total number of accidents at the sites where roundabouts had been installed was the same as at the untreated sites, this would indicate a minimum saving of about 6 fatalities due to the roundabout programme.

In **Britain** an increasing programme of low cost remedial measures has been implemented over the past 20 years, as described in 6.2.

Year	Urban roads		Rural roads	
	Spend £M	Accidents saved per year	Spend £M	Accident saved per year
1982/3	4	600	3	600
1986/7	4	650	3	500
1992/3	34	1150	11	850
1996/9	66	2700	10	800

Table 6.5 *Accidents saved through remedial programmes in Britain*

The results of this programme have been monitored (Table 6.5), and it is estimated that a total saving of about 285 fatalities has resulted over the period 1980 - 2000. More injury accidents have been saved in urban areas under this programme, but the majority of the fatality savings are at rural sites. About a third of the savings in fatalities are from

treatment of junction sites, a further 40% from general improvement of road links, and 10-15% each from improvement in signing and marking at bends, and from improving pedestrian and cyclist facilities. But this programme only shows part of the picture. In 1980s it was estimated that the much larger diverse funding outside this programme had produced a similar total accident reduction. And a substantial part of the funding for traffic calming and area treatment has also been obtained from other sources.

In **the Netherlands**, SWOV estimated in 1996 from an evaluation of 143 black spots that had been treated, that the total number of accidents afterwards was reduced by an average of 32%, and the number of injury accidents by approximately 45%. If 40 black spots are treated each year, this would mean a reduction of about 120 accident each year. There are also a number of locations (5%) where, after carrying out engineering changes, the number of accidents increased. This has improved the insight into the correct way to approach treatment of such locations. The future application of this knowledge could lead to a reduction in number of injury accidents by more than 45%. On the other hand, the most serious black spots have, in the meantime, been improved, whereby the number of accidents of the locations still to be improved could be less spectacular. Together, these factors appear to maintain a percentage reduction of about 45%.

6.4.2. Implementation of 30km/h zones

In **Sweden** in urban areas, the replanning of residential roads dated from before 1970. 30km/h speed limits have been gradually introduced over a long period, but the change in 1998 to allow communities to decide for themselves has increased their use. There are now 2000-3000 kilometres of street with speed limits of 30km/h, but this still only represents 6% of community roads, and only about 1 or 2% of the traffic in urban areas.

In **Great Britain** the 20mph zones introduced from 1992 have also been monitored but establishing the cost and extent of their implementation is difficult. The initial schemes cost between £150,000 and £200,000, with some 70 being introduced in the first three years, but over time the distinction between traffic calmed residential areas, and those established with a 20mph speed limit, has become less clear. The first zones were introduced in 1992. An evaluation in 1996 identified 239 schemes applied for at that time, although only 70 of these had been given permanent status. Monitoring of 72 schemes for which before and after data were available at that time showed that on average the annual accident rate before treatment per scheme was 3.4, which was reduced to 1.3 after the scheme (saving some 60% of accidents). But this implies only a total saving of some 150 accidents on residential roads during 1992 - 1995. It is unclear how many zones have since been permanently installed. However by 1999 the total number of accidents recorded on roads with 20 mph speed limits was only 289. Even if the 60% reduction had been maintained, this implies that the total number of accidents that were on these roads before treatment was about 720. This is less than 1% of the total accidents on urban residential roads.

In **the Netherlands** between 1985 and 1997, it would appear that 10 - 15% of the urban residential roads were converted to 30km/h zones. The average saving of accidents in these zones is quoted as about 40%. Overall therefore this should have reduced accidents on these roads by about 4 - 6% i.e. about 0.3 - 0.5% per year. Between 1997 and 2002 (5 years), the proportion of roads treated has increased to 50%. If a lower percentage change in accidents (e.g. 33%) is assumed, because the treatments have not been so comprehensive, this suggests a further 13% of accidents on these roads should have been saved.

An alternative approach to assessing the savings in fatalities is to examine the number of fatalities now occurring on roads with 30km/h or lower speed limits, and make assumptions about the proportion of fatalities saved by the treatment. Identifying the numbers of accidents in these zones is not straightforward, particularly in the Netherlands where, although accidents are recorded by speed limit, there is confusion between the speed limit of the road and that for a particular vehicle type. Thus mopeds which are restricted to 30km/h but travelling on 50km/h roads, are included with 30km/h speed limit roads. In 2000 there were 17, 2 and 3 fatalities recorded for 30km/h (20m/h) limits for Netherlands, Sweden and Britain respectively. It is assumed that if mopeds on 50km/h roads were excluded, the Netherlands total might be reduced to 12.

Table 6.6 illustrates the implication of following this calculation through with assumptions either that 80% or 90% of fatalities had been reduced in these treated areas.

	No of fatalities in 2000	Assume 90% reduction			Assume 80% reduction		
		Fatalities saved	% Urban	% All	Fatalities saved	% Urban	% All
S	2	18	14	4	8	7	2
UK(GB)	3	27	2	1	12	1	0.5
NL	12	108	34	11	48	17	5.5

Table 6.6 *Estimates of the savings in fatalities through the introduction of 30km/h zones*

The percentages shown using the assumption of 80% reduction seem plausible and reasonably in line with the estimates through other sources. In Netherlands it is estimated that perhaps only 20% of casualties are on truly residential roads, so it would appear that most of the scope for saving fatalities on these roads has now been realised.

Figure 6.11 shows that in the Netherlands, between 1980 and 2000, despite the increase in the length of 30 km/h roads, the length of 50 or 70 km/h roads hardly changed. This shows that the increase in 30km/h roads is not through conversion of speed limits on existing 50 km/h roads, but mainly through new residential roads being built to the new standards. However a more radical change has been targeted over the last 2-3 years, and over this period it is expected that there will be much more direct conversion from 50km/h to 30 km/h roads. Similarly, in traffic terms (fig 6.12), although some traffic growth has been accommodated on new 30km/h roads with very few fatalities, the total traffic on 50 and 70 km/h roads has not changed.

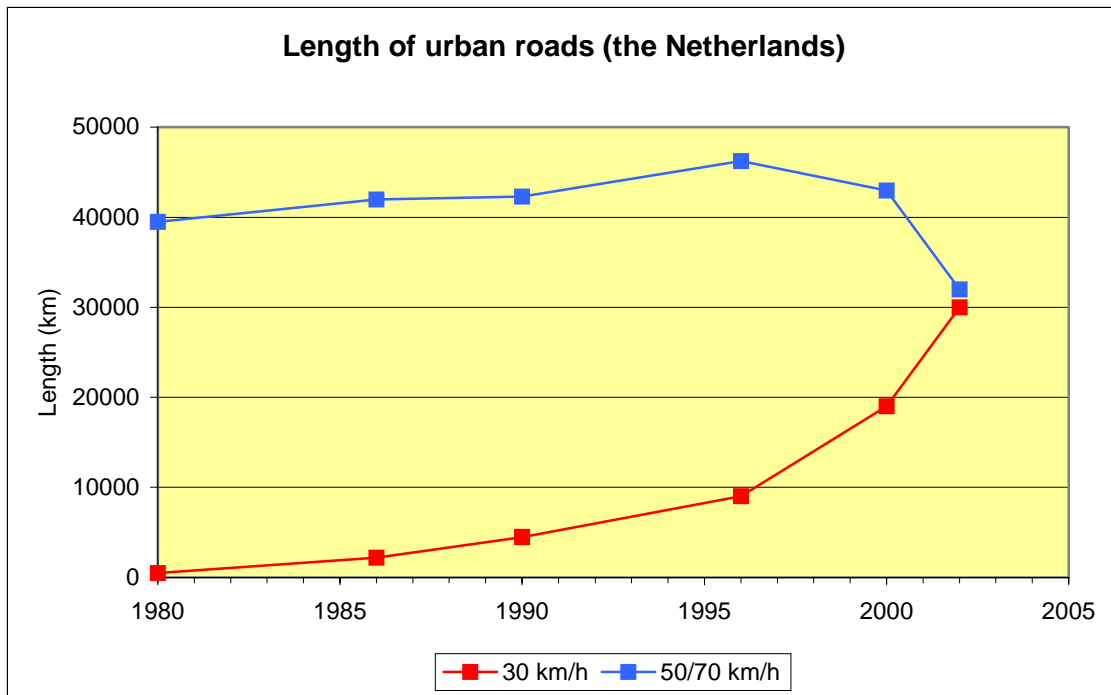


Figure 6.11. Length (kms) of urban roads with different speed limits in the Netherlands

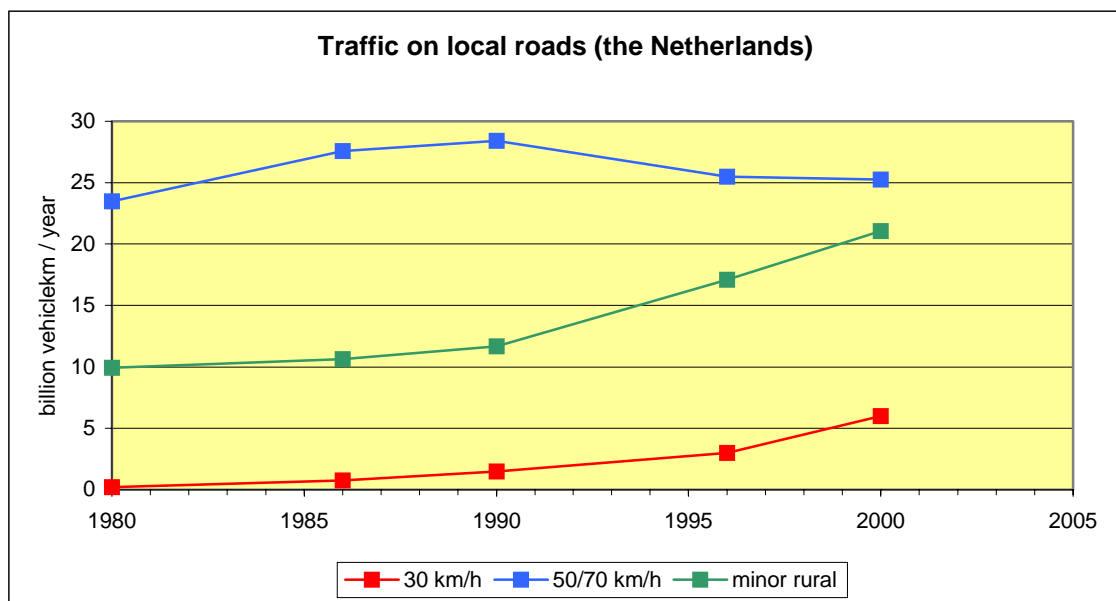


Figure 6.12. Traffic (billion vehicle km per year) on local roads in the Netherlands

6.4.3. Improvements to 50km/h and 70km/h roads in the Netherlands

But at the same time there have been substantial improvements to the 50/70 km/h roads in the Netherlands. These include new roads built to a high standard incorporating roundabout junctions, improvement of 50 km/h roads surrounding 30 km/h zones, and also improvement of some 15% of existing 50 km/h roads. An important feature of these improvements has also been the inclusion of separated cycle paths.

Over the last 20 years there has been a steady growth of the kilometrage of these paths in both urban and rural areas.

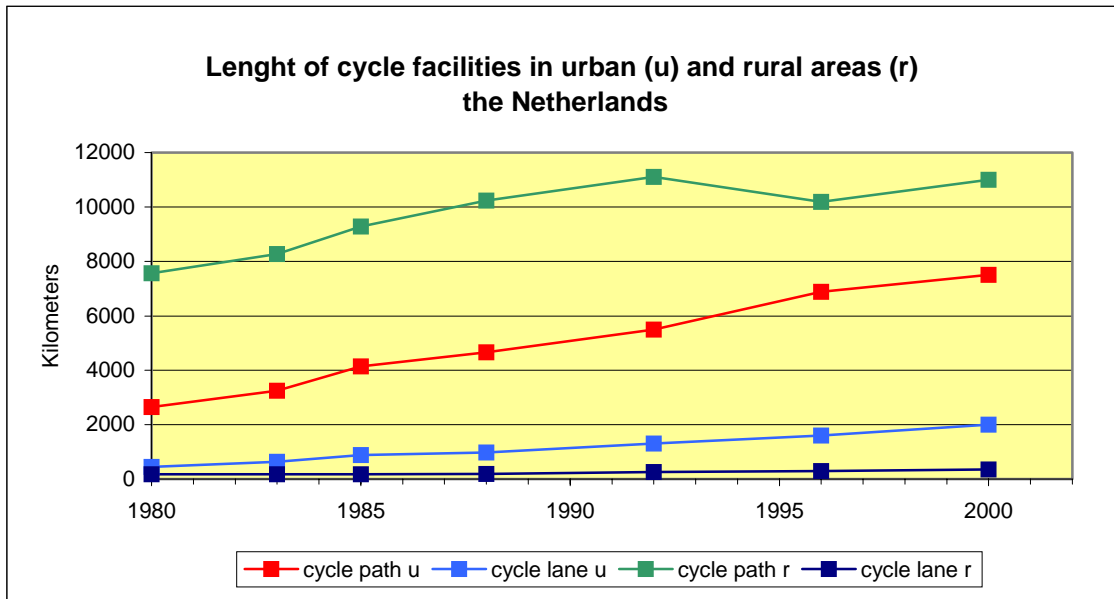


Figure 6.13. Growth in the provision of length (kms) of cycle facilities

6.4.4. Car speeds on urban roads

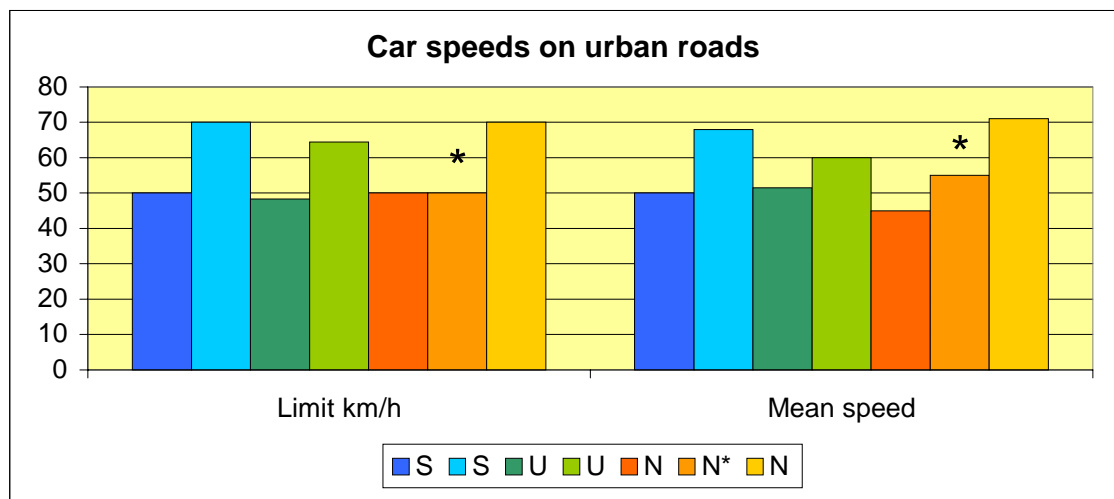


Figure 6.14. Car speeds (km/h) on urban roads

Figure 6.14 shows that the difference in average speeds of traffic in urban areas resulting from the various programmes in the three countries is fairly small, although speeds are slightly lower on those roads in the Netherlands on which mopeds and cyclists are allowed (the asterisk represents roads where mopeds and cyclists are prohibited). Speeds on the higher speed limit roads are slightly lower in Britain. Average speeds on all roads are close to the limit suggesting substantial scope for better enforcement.

6.5. Conclusions

- The focus of engineering programmes differs somewhat in the three countries, as a result of the distribution of accidents and traffic within the road networks. 27% and 33% of fatalities are in urban areas in Sweden and the Netherlands, respectively, compared with 41% in Britain. The pattern of fatalities among road users also varies. Although the total proportion of fatalities among pedestrians and cyclist combined is similar in all three countries, in Britain these are largely pedestrians, with the Netherlands having a high proportion of cyclist fatalities and Sweden a more equal distribution between the two groups. The proportion of motorised two-wheeler fatalities is higher in Britain (nearly all motorcyclists) and the Netherlands (motorcyclists and mopedists) than in Sweden.
- The key question is: how much of the resulting difference in pattern of risk results from the engineering programmes that the countries have adopted? This is difficult to identify due to several programmes being implemented simultaneously. It is also made more complicated by measures combining layout changes with speed limit changes. As a result tracking accident patterns associated with particular groups of roads is almost impossible. We will look at the broad evidence for casualty reduction effects in urban residential areas, urban main roads, and local rural roads.
- Although significantly more kilometres of 30km/h road have been introduced in the Netherlands than in the other two countries, this has not had a substantial effect on urban accident rates until recently. This might be caused because much of the 30km/h limits were on new road sections, rather than converting existing roads. In principle, both Britain and Sweden should be able to gain further accident reduction by extending their lower speed zones. But this will depend on current accident levels, that are already low in Sweden, and in Britain also on the acceptability of reducing speeds when many of the roads needing to be treated carry high flows, and are therefore seen as significant traffic routes.
- It appears that treatment of 50 and 70 km/h roads in the Netherlands has resulted in major casualty reductions, despite lower speed limits not being introduced on these roads. Up to 2000, this programme had more effect on national casualty totals than the programme of introducing 30km/h zones, although without the latter, casualties might have been expected to increase as new urban roads were built.
- Despite the differences in urban programmes, the average speeds in urban roads in the three countries do not differ markedly.
- Over the last 20 years, the Netherlands have managed , relatively effectively, to improve the safety of cyclists, their largest vulnerable road user casualty group, mainly through provision of additional facilities for them, both on and off road. They have also effected a substantial reduction in pedestrian casualties. Although it is not as clear how this has been achieved, it probably is partially achieved by reducing traffic flows and driving speeds. Britain, however, still has a substantial pedestrian casualty problem. Although part of this might be attributed to the greater frequency of busy roads crossed in British urban areas, more detailed investigation of the relative situations of pedestrian safety would be useful.
- It might be expected that fatality rates in urban areas would be reasonably consistent per head of population. Comparison for Britain and Sweden shows overall fatality rates per head to be 60% higher in Britain. Although there are some differences with town size, this difference seems mainly to result from the much higher traffic flows in Britain. Thus the fatality rates per km are double for residential roads and up to six times higher for main roads in Britain; at the same time, the fatality rates per vehicle km are about a third lower in Britain.

- As there is some uncertainty from the national figures on the validity of the comparison of the traffic flows and accident rates for urban roads in the three countries, further investigation at a more detailed level within a small sample of individual towns in each country would be useful.

7. Infrastructure of high quality inter-urban road network

7.1. Historical overview

After the Second World War the pavement quality was most important focus for road improvement and gravel roads got a permanent pavement. At the end of the 1950's substantive development of motorway networks started and at the end of the sixties the motorway length in the UK and the Netherlands was close to 1000 kilometres and in Sweden 300 kilometres. Since 1970 the construction of motorways has dominated road transportation development. The development is somewhat different in Sweden compared to the UK and the Netherlands. In Sweden the motorway development started around the larger cities (bypasses) and not primary to make a good connection between larger cities. By 2000, 20% of the motor vehicle kilometre was driven on motorways in Great Britain and the total length of the main roads was 80,000 kilometres, of which the motorways have 3,465 kilometre. In Sweden 14% of the motor vehicle kilometre was on motorways and the length of motorways was 1,510 kilometres in 2000. The Swedish main road network is about 140,000 kilometres. In the Netherlands the motorway length was 2,275 kilometre of a total road network of 118,680 kilometre in 2000, but the Dutch motorways carry 40% of the national vehicle kilometres.

7.2. The high quality inter-urban road networks

The growth of motor vehicle traffic, both the increased weight of goods transportation vehicles and the growth in number of passenger cars, puts a lot of demands on the road network. New roads also result in a new operational and maintenance strategy. As the number of cars and the economy more or less have the same development in the three countries, the development of the road network is very similar. One alternative to transport of people on road is the railway systems in the three countries. As Sweden has the lowest concentration of inhabitants, the train is very seldom a real alternative, differing from the situation in the Netherlands and in densely populated regions in the UK.

Sweden

Sweden has an important forest industry, which needs a transportation system to serve the paper- and sawmills. Traditionally this transportation was done on rivers but today only road transport by heavy lorry combinations is used. These heavy lorry combinations are 25 metres long and the design of the lorry and the trailer are the concept for almost all Swedish lorry transportation. This also influences the rural road design. EU membership resulted in an increase of foreign lorry-trailers. The energy policy in Sweden has also changed as the nuclear phase-out is, to some extent, replaced by thermal power stations based on burning waste products from households and forest. This also created a lot of long distance transport by lorry combinations. The high quality roads are mainly European roads of 4,900 kilometre length, of which 1,510 kilometre is (mainly two-lane) motorway. They connect most big cities and take 23% of the motor vehicle kilometres, including nearly 14% on motorways. 277 communities represent the local authorities. About 39 % of the traffic is concentrated on the national roads and the length is 14,700 kilometres. The total length of the publicly used private roads is about 210,000 kilometres.

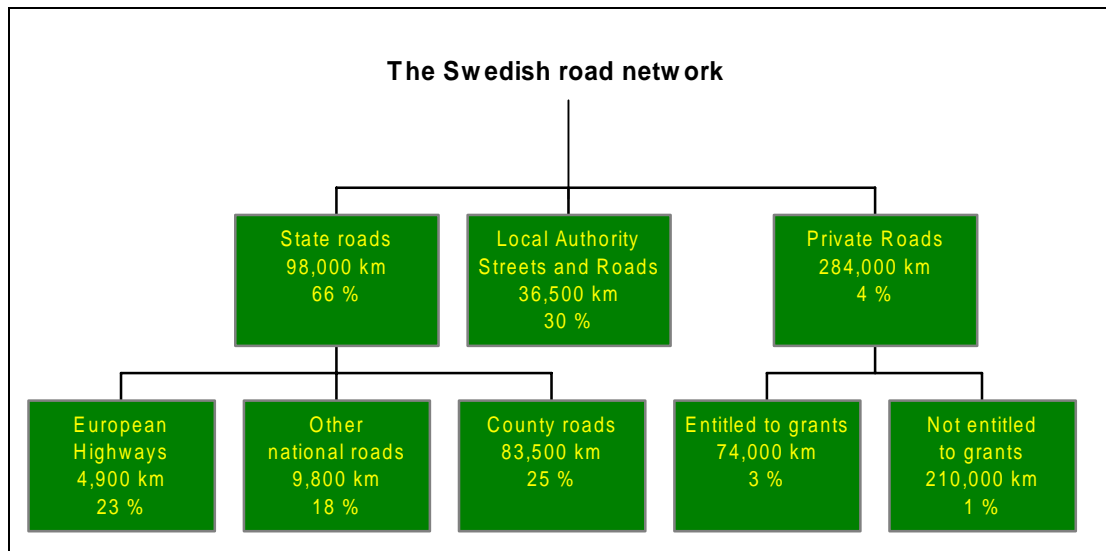


Figure 7.1 . *The road lengths in the Swedish road network and their percentage of traffic*

The UK

The length of the road network in Britain is almost 392,000 kilometres. The A-roads are of the length of 46,558 kilometres and have 43.5 % of the motor vehicle kilometres. The National Highways Agency manages 10,536 kilometers of the network, carrying 53% of all motorway and A-road traffic, of which 2,829 kilometres length is motorway (often with multiple lanes). The total length of the British motorways is 3,465 kilometres and they carry close to 20 % of the motor vehicle kilometres.

The Netherlands

The length of the road network in the Netherlands is 118,680 kilometres. The length of the rural roads is 54,400 kilometres, of which 7,175 kilometres are A-roads for motor vehicles only, and 2,275 kilometres are motorways (often with multiple lanes). 75 % of the motor vehicle kilometres is on roads outside built-up areas and more than 40 % of the motor vehicle kilometres is on motorways.

7.3. Traffic densities and shares and fatality developments per road type and speed limit

Table 7.1. shows the average annual daily traffic (AADT) on the roads types of the SUN countries and the percentage of motor vehicle kilometres on these road types in 2000.

2000	Sweden		UK (GB)		Netherlands	
	AADT	% Veh. km	AADT	% Veh. km	AADT	% Veh. km
All (public) roads	913	99.0	3,271	100.0	2,948	100.0
Motorways	17,418	13.6	67,252	20.1	61,671	40.1
A-roads	5,431	9.4	11,972	43.5	8,851	18.2
All other roads	711	76.0	1,365	36.4	1,336	41.7

Table 7.1. Average traffic per day and road kilometre on road types of the SUN countries in 2000.

The British high quality roads (motorways and A-roads) are the most busy roads. This applies also to roads in built-up areas, as shown in chapter 6, but not for minor rural roads. The Swedish roads are relatively empty. The high quality road network takes 67% of the traffic in Britain and 58% in the Netherlands, but in Britain 44% is on A-roads and in the Netherlands 40% on motorways. In Sweden only 23% of the traffic is on the high quality road network, while the minor rural roads take 47% of the traffic. The traffic distribution in Sweden is the result of its relatively low population density. The motorways and A-roads (also the urban roads, see chapter 6) are much busier in Britain than in the Netherlands. As already shown in Chapter 2, the motorway length per 100 inhabitants is 17 metres in Sweden, 5.7 metres in Britain, and 14.4 metres in the Netherlands, while the motorway length per 1000 square kilometre area is 3 in Sweden, 14 in Britain, and 55 in the Netherlands. Since the population density and motorisation level in the English part of Britain are almost equal to the Netherlands, while Sweden is a relatively empty country, it appears that Britain has a relatively small motorway network.

Each road type has a different speed limit or is divided into groups with different speed limits. The speed limits for comparable road types are not the same in the SUN countries.

Sweden

The speed limits related to the road have been almost the same in Sweden since 1970. The speed limits are 30, 50, 70, 90, or 110 km/h. The speed limits of 90 and 110 km/h are used on high standard roads but also on roads in the North of Sweden (with a very low population). Rural motorways have a speed limit of 110 km/h, but motorways in urban areas have a speed limit of 90 km/h. Two-lane roads with a carriageway width of 13 metres are quite common in Sweden. In rural areas most of them have a speed limit of 110 km/h. During the end of the 1990s some of these roads were given a permanent reduction to a speed limit of 90 km/h. Others were reduced just during wintertime. All other rural roads have a speed limit of 70 km/h. The general speed limit in urban areas is 50 km/h but the speed limit of 30 km/h, which today is decided by the community, has increased in use, although still not common.

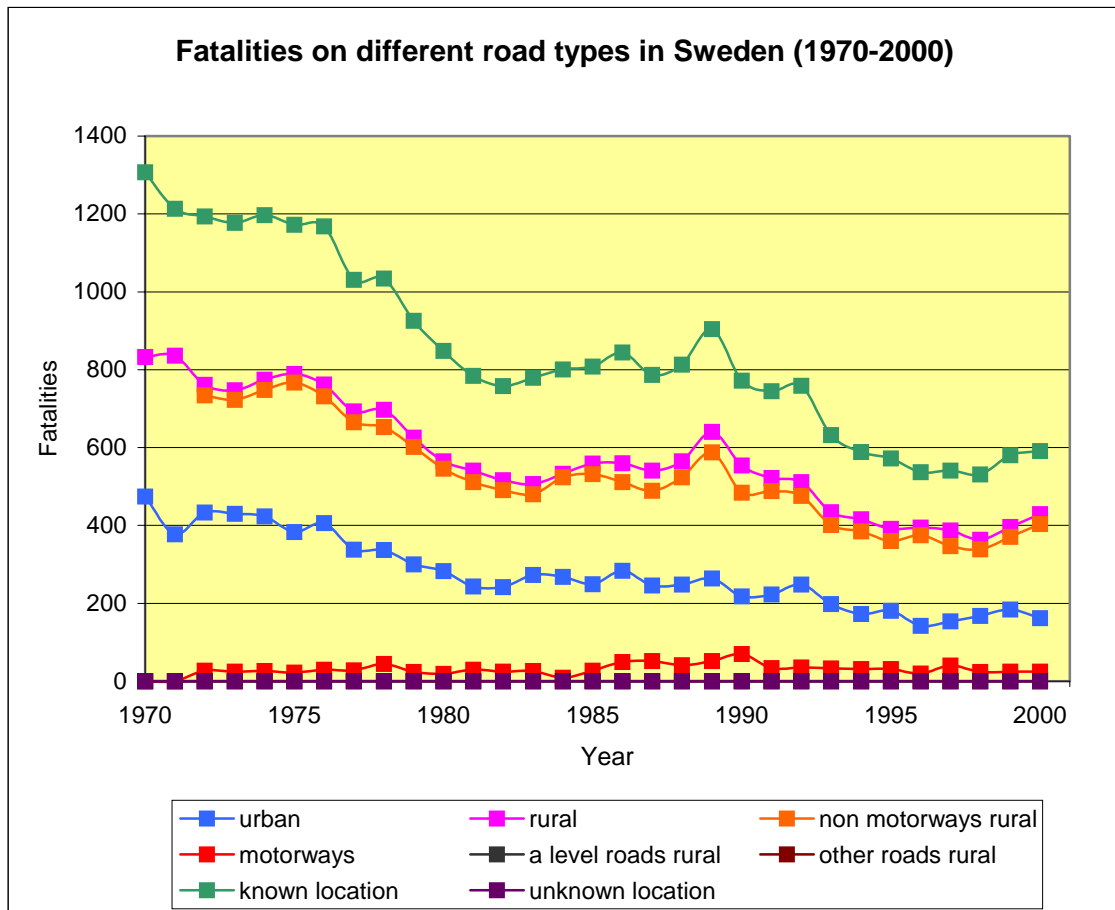


Figure 7.2. *Fatalities on different road types between 1970-2000 in Sweden*

The simultaneous drop of fatalities on nearly all road types after 1975 is a result of increased use of seat belt, child restraint systems, helmet, and daytime running light laws. During the 1980s the fatalities initially decreased further, but rose again after 1984 with 1989 as the peak year. The European roads in Sweden have increased in length between 1985 and 1991. This is also the case with motorways, which have increased as a proportion of European roads. The share of vehicle kilometres on motorways also increased, but that share remained less than in Britain, and much less than in the Netherlands, as shown in Table 7.1. Due to increased gasoline price between 1990 and 1994 and a bad economy (high unemployment), the traffic growth reduced and the number of fatalities decreased in the first half of the 90s.

Some criteria from the 1970s are still used in setting speed limits, but today speed limits are more or less related to the accident records of the sections, with the exception of the roads in the north of Sweden. Some of these still have the speed limit of 110 km/h during the winter period with snow and ice. In the south of Sweden sometimes the speed limit of 90 km/h is lowered to 70 km/h during the winter period (even if snow or ice on the roads is very rare). The 50-percentile of the driving speed is higher than the speed limit in rural areas. To some extent this is a result of the speed surveillance, which accept speeds 10 - 15 km/h over the speed limit. In 2001, this tolerance was reduced to 5 km/h or 10 % of the speed limit. As laser cameras have replaced radar controls by the police, the tolerance limit is now less clear. Speed camera enforcement had only been introduced on 15 road sections in Sweden by the year of 2001. Even though speed limits have been in force since 1967 for the whole network the

differentiation by speed limits was not introduced in the accident statistics until 1985. The speed limit system has been unchanged since 1970. This means that the fatality changes on roads with different speed limits in Figure 7.3 result also from road length changes, from new roads, and from roads reconstructed, for example, to motorway standard.

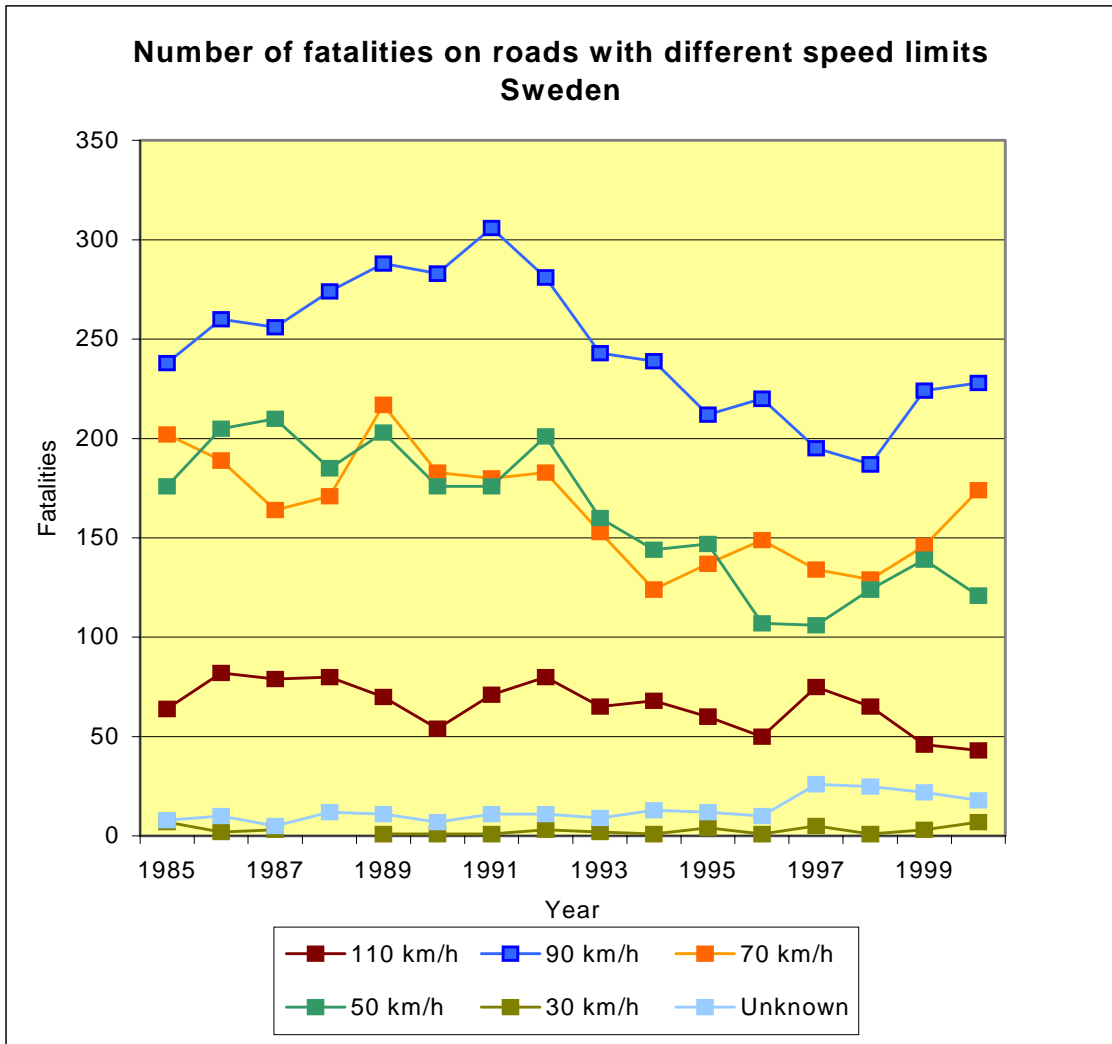


Figure 7.3. The number of fatalities on roads with the valid speed limit 1985-2000.

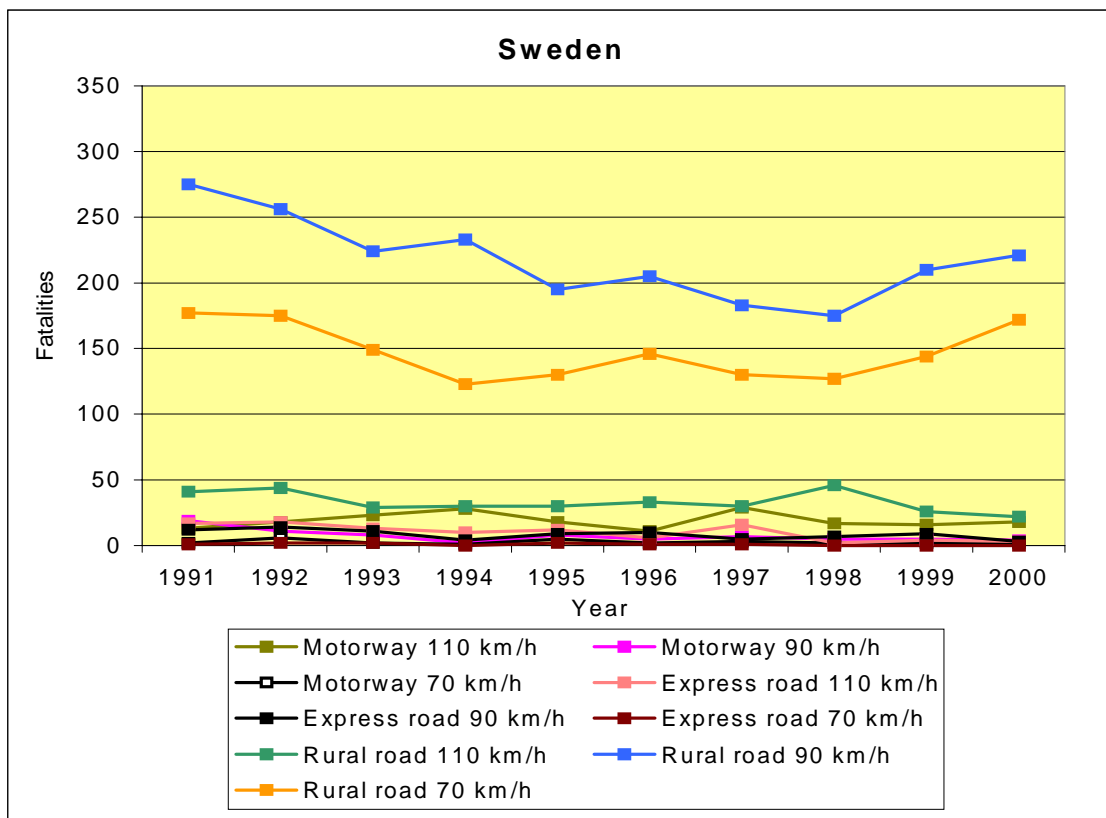


Figure 7.4. Fatalities on road types and speed limits in rural areas 1991-2000 in Sweden

As Figure 7.4. shows the upward trend on 70 km/h and 90 km/h roads during the last years is especially due to fatalities on the two-lane rural roads.

The UK

In Figure 7.5 the number of fatalities on the road types in Britain are presented from 1979 to 2000.

The reduction in fatalities are mainly found on built-up roads. The total growth of the vehicle kilometre was 84% between 1980 and 2000. The traffic on motorways increased about 180%, while its vehicle kilometre share grew from 13.5% to 20%. The traffic growth on other roads was 70% and on A-roads about 75%, thus their share decreased slightly. Since motorways have much less risk than other roads, the relative traffic shift to motorways contributed about 9% to the total risk reduction from 1980 to 2000. If the same total traffic growth had taken place without the relative traffic shift to motorways between 1980 and 2000 in Britain, and taking 25% additional risk reduction for the hypothetically busier non-motorway roads, then about 230 more fatalities would have occurred in 2000. The speed limit system in the UK is more differentiated (and given in miles instead of kilometres). The speed limit system contains five limits in Sweden (30-50-70-90-110 km/h) and six limits in the UK within almost the same speed range of 80 kilometres (32.2 - 48.3 - 64.4 - 80.5 - 96.5 - 112.6 km/h). Although the speed limits outside built-up areas are slightly higher in the UK, the actual average speeds on all road types outside built-up areas seem to be lower. Speed cameras are fairly common.

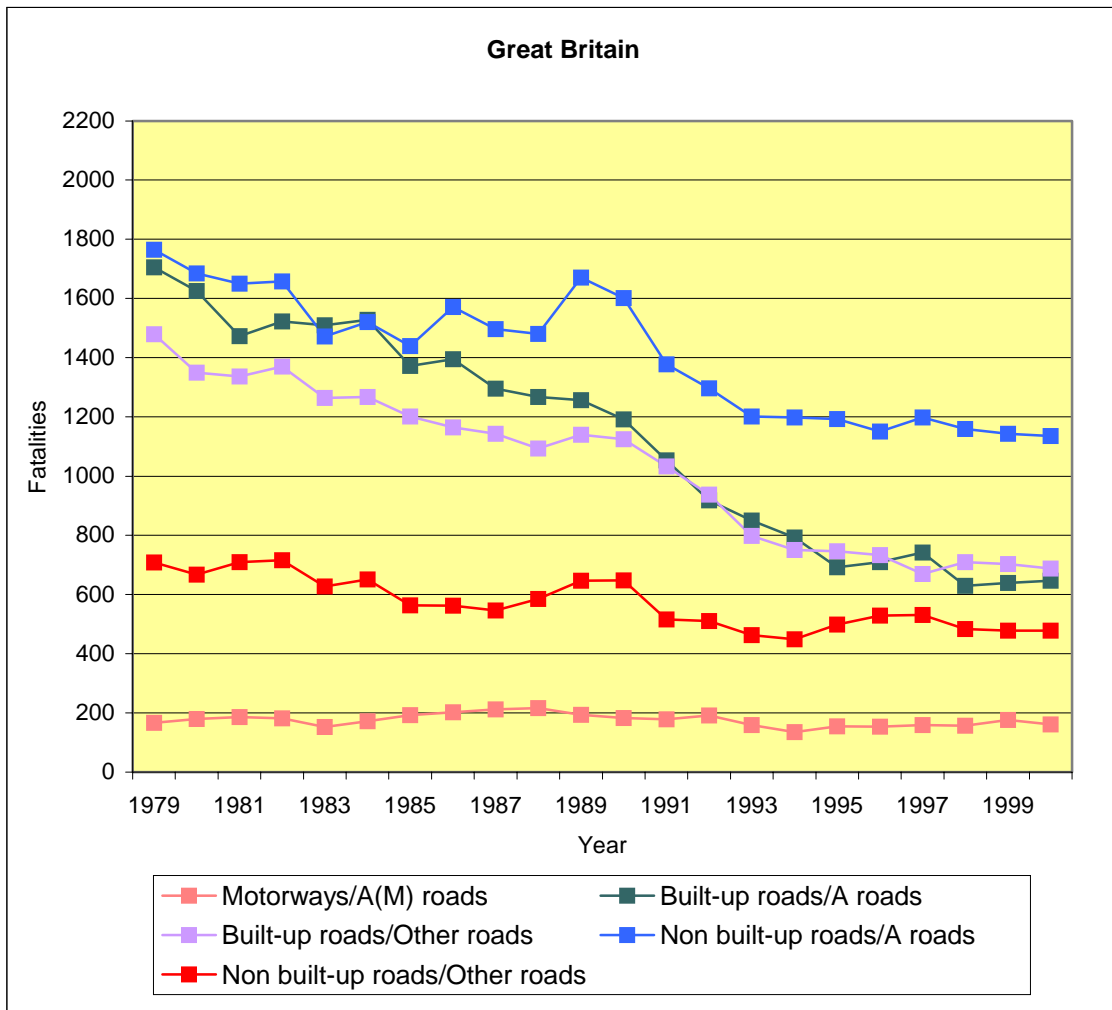


Figure 7.5. *The fatalities on different road types between 1979-2000 in Great Britain*

The Netherlands

The Dutch motorways have either 100 km/h or 120 km/h limits, depending on traffic and exit/entry densities and environmental considerations. The other Dutch speed limits are related to the separation or mixing of fast and slow traffic. On main rural roads with speed limits of 80 or 100 km/h slow-moving vehicles, cyclists and pedestrians are not allowed. The speed limit on minor rural roads with mixed traffic is 80 km/h, but with an agricultural and/or access function it is 60 km/h. The urban speed limits are usually 30 and 50 km/h, but on urban arterials without slow traffic can be 70 km/h. The Netherlands uses speed cameras to enforce speed limits to a great extent (more than 3 million speed fines in 2000 and over 6 million are expected in 2002).

In Figure 7.6. the development of the Dutch fatalities by road type and speed limit is presented from 1980 - 2000. In 1988 the speed limit of 120 km/h was introduced on parts of motorways in the Netherlands.

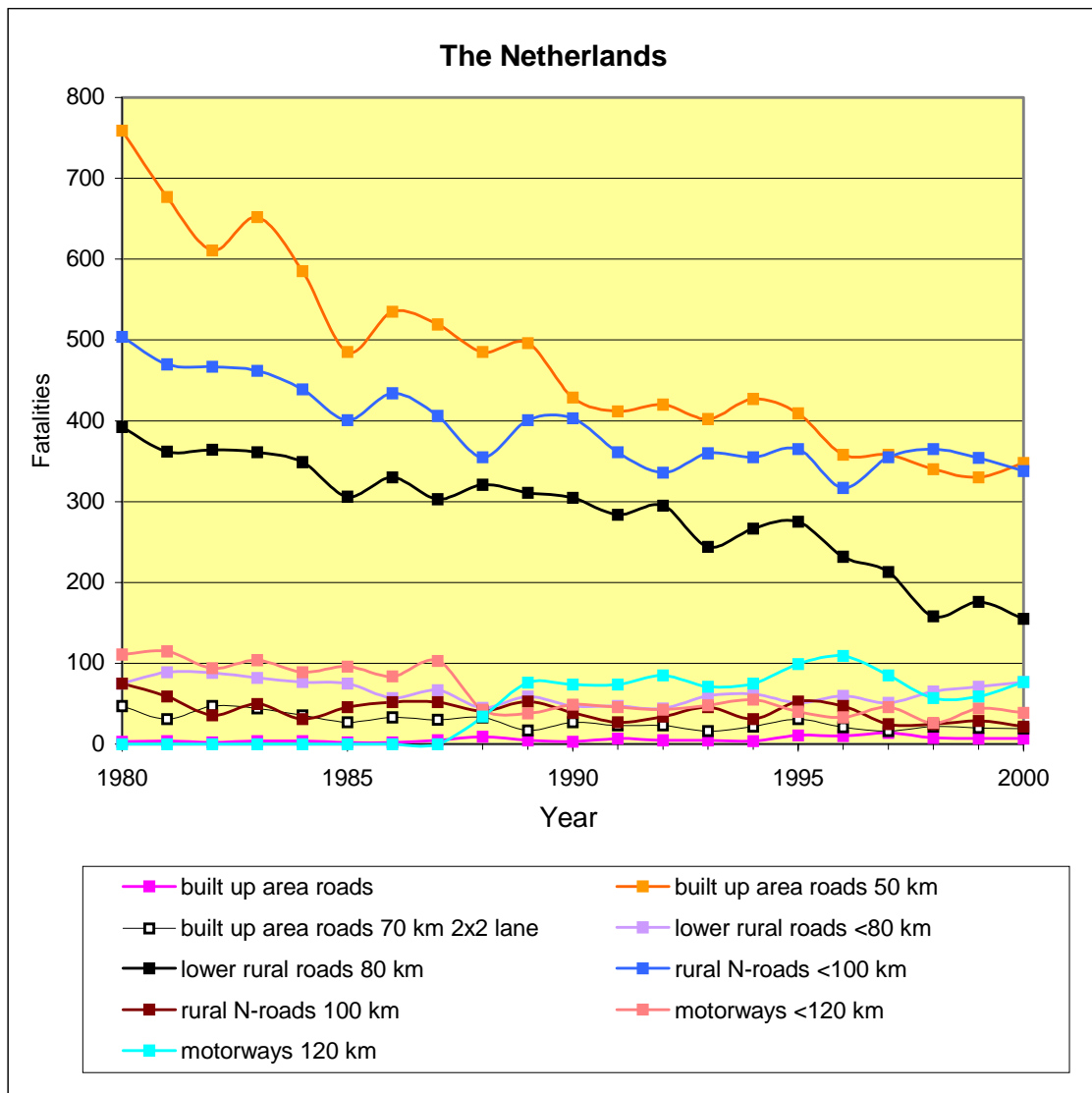


Figure 7.6 *Fatalities on different road types and speed limits 1980-2000 in the Netherlands*

The increase of traffic between 1980 and 2000 was 76%, but 157% on the Dutch motorways, and only 45% on other roads. The motorway share of the vehicle kilometres has markedly increased in the Netherlands from 27% in 1980 to over 40% in 2000. The traffic growth on the Dutch rural A-roads was 56%, thus its share decreased. The traffic shift to the relatively safe motorway system is estimated to have contributed 19% of the risk reduction in The Netherlands (compared to 9% in Britain). The relative traffic increase on motorways in the Netherlands was even higher between 1970 and 1980, which explains the steeper total risk reduction in the Netherlands than in the other two countries between 1970 and 2000. Without that shift, the annual average daily traffic (AADT) on the Dutch non-motorway roads would have been almost equal to the British AADT on non-motorway roads in 2000. If the same traffic growth had taken place without the shift to the motorways from the main other roads between 1980 and 2000 in the Netherlands, and taking 25% additional risk reduction for the hypothetically busier non-motorway roads, then about 165 more fatalities would have occurred in 2000.

Table 7.2. shows the fatality rates per motor vehicle kilometre on motorways, A-roads, and other roads, as well as the total fatality risk for the SUN countries in 2000. The total risk and all risks per road type are lower in the UK than in Sweden and the Netherlands.

	Motorways	A-roads	Other	All roads
Sweden	2.50	13.13	9.09	8.44
UK(GB)	2.01	9.68	7.16	7.28
Netherlands	2.27	15.53	11.17	8.47

Table 7.2. Road type and fatality rate (fatalities per billion vehicle km)

Motorways are by far the safest road type and A-roads have the highest risk in each country. The Netherlands has the highest risks on A-roads and other roads, but its total fatality rate is about the same as in Sweden. This is due to the much larger share of vehicle kilometres on the motorways in the Netherlands (40%) than in Britain (20%) or Sweden (14%). If the British risks are multiplied by the vehicle kilometres of Sweden and the Netherlands, then comparison of the resulting estimated and observed fatalities shows that the risk differences are not statistically significant for motorways. The risks on the A-roads and the other roads differ significantly between Britain, Sweden, and the Netherlands, with only the total risk being significantly lower in Britain than in Sweden or the Netherlands.

7.4. Speed limits and actual speeds

In Table 7.3 the speed limits and average speeds are presented for the three countries in rural areas or on motorways. Comparing the three countries in Table 7.3, it can be seen that Sweden has higher speed limits on two-lane roads and also higher speeds. Swedish motorways have lower speed limits than the motorways in the UK and the Netherlands (Dutch figures 1996), but the average actual speed in Sweden is higher.

Rural speed limit km/h	70	80	90	96.5	100	110	113	120
Sweden two-lane	82		95			106		
Sweden motorway			98			115		
UK two-lane				72				
UK motorway							113	
NL 1*1 all traffic		66						
NL 1*2 all traffic		73						
NL no mopeds/cyclists		75						
NL no slow mot. traffic		77						
NL motorway					96			114

Table 7.3. Average speed for cars on different rural roads in the SUN countries

The speed limits on motorways are 10 km/h higher in the Netherlands (120 and 100 km/h) than in Sweden (110 and 90 km/h). However, the average actual speed is higher in Sweden than in the Netherlands, probably due to the much lower traffic intensity on motorways in Sweden. Also the average actual speeds on the British motorways with a higher limit (113 km/h) are still lower than in Sweden due to the higher flows on

motorways in Great Britain. The actual mean speeds may partially depend on the level of speed limit enforcement on the inter-urban road networks, which is also definitely lower in Sweden than in the Netherlands or in Britain. The traffic-weighted averages of the limits and the mean speeds, as well as the ratios of that average of mean speeds and the average limit on the main road types of Table 7.3 (excluding the rural roads for all traffic in the Netherlands), are given for each country in Table 7.4., together with the ranking of their speed enforcement levels and traffic flow densities.

Main inter-urban roads	Sweden	UK(GB)	Netherlands
Average limit	92.0	101.5	97.0
Average speed	98.0	85.0	91.0
Average ratio of speed/limit	1.07	0.84	0.94
Speed enforcement level	Low	Moderately high	High
Traffic flow density	Low	High	Moderately high

Table 7.4. *Averages of speeds and limits and their ratio and the rank order of speed enforcement levels and traffic flow density on the inter-urban road networks of the SUN countries*

There are speed differences between the countries that seem to depend on the relationship between traffic intensity and speed. In Sweden where the average speed limit is the lowest and where the speed enforcement level, as well as the flow density, are also both the lowest, the average of the mean speeds is the highest, and 7% higher than the average speed limit. In Britain where the average speed limit and the flow density are both the highest, and where the speed enforcement level is moderately high, the average of the mean speeds is the lowest, and 16% lower than the average speed limit. For the Netherlands with the highest level of speed enforcement and a moderately high average speed limit, as well as a moderately high flow density, the average of the mean speeds is moderate, and 6% lower than their average speed limit. The averages of mean speeds thus have a perfectly reversed rank order correspondence with the flow density in the three countries. Also the deviation percentages of the average of mean speeds from the average speed limit have a perfectly reversed rank order correspondence with the flow density. The rank order of the averages of the speed limits also corresponds with the reversed rank order for the averages of mean speeds and for their deviation percentages from the averages of mean speeds. Thus differences between the mean speeds on the inter-urban road networks in the SUN countries seem not to be positively related to differences between speed limits and their enforcement levels, although this might be expected. They did relate as expected to reverse differences between flow densities. However, lack of comparable measures of speed enforcement mean that definitive conclusions cannot be drawn; further investigation of this area is likely to be helpful to future speed enforcement policies.

7.5. Traffic (re)distributions and bypasses

Sweden

In the 1950s it was still relevant to improve the through roads in cities so the traffic passed as close as possible to the city centre. Four big cities (Jönköping, Borås, Karlstad, Västerås) had motorways constructed through the city before society realised that the growth of the through traffic also created a lot of problems for the cities (noise, barriers etc.) , while the increase in sales in the city was less than expected. Since the 1960s almost all relatively large urban areas have been bypassed or had a new road

built outside the urban areas. In many cities where through traffic level was very high, a new motorway was built around the city or a new two-lane road with a 13-metre carriageway. At the same time the through roads were reconstructed. This development is still a priority, but the easy solutions have been achieved and the remaining urban areas, which need a bypass, have normally a lot of problems to solve, sometimes depending on lakes or mountains that make bypass solutions very costly. The bypasses or corresponding solutions have made the urban areas safer for pedestrians and bicyclists, and traffic accidents have been reduced in the urban areas. The through-traffic, which is moved to the bypass, is involved in more severe accidents on the bypass than it was in the city. This means that the expected decrease in fatalities in traffic cannot be related in a simple way to this measure. Since total fatalities did not decrease as much as the urban fatalities, the reduction in pedestrian or bicyclist fatalities in the city seems to be balanced, to some extent, by additional car occupant fatalities on the bypass. The bypasses are also on average longer than the through-roads. Most urban areas have a mixture of three generations of roads, the through-road/street, a former bypass that today is a ring road, and a new through-road of high standard outside the city. The European roads, with the exception of the north of Sweden, pass outside the urban areas. The urban areas have, however, grown and today the bypasses are often inside the urban areas although completely separated.

The UK

The British situation seems to differ from Sweden in that it has a denser population with many more and larger cities than Sweden, except in parts of Scotland and Wales. Although bypasses around cities and separated, high quality roads through cities are present, this is not as common as in Sweden and the Netherlands. There are still many towns with non-separated main roads which carry through traffic, especially in smaller cities and larger villages. However, Britain has the lowest fatality rates on all road types and is the only SUN-country where safety audits are required before new roads are built. Emphasis on bypass construction has changed over time. Between 1975 and 1990, some 150 bypasses were constructed, and in the early 1990s, bypasses still made up a quarter of the national road construction programme. The size of towns bypassed varied between 5,000 and 20,000 population. A major project was launched in 1990 to demonstrate how the urban roads relieved of traffic could be redesigned to make them more attractive to pedestrians and cyclists, and to discourage new car traffic from using them. But it was noticeable that the new bypasses carried about 50% more traffic than the old route, demonstrating the latent demand for travel once the bottleneck on the through route was removed. The current trunk road improvement programme includes a further 30 new bypasses. More attention is now being given to targeted improvement of existing roads – with 50 routes in the programme for treatment over the next two years. These treatments focus on cost effective low cost improvements throughout the route length, rather than major upgrades in standard.

The average traffic flow in Britain is more than three times higher on urban roads than in the Netherlands or Sweden and on all roads except motorways more than four times higher than in Sweden and 70% higher than in the Netherlands. Thus British pedestrians have to cross much busier roads, which may explain the high pedestrian fatality rate per amount of walked kilometres in Great Britain. On the other hand, the higher traffic levels are also an important factor in the relatively lower speeds than the speed limits on rural two-lane roads (72 km/h with a limit of 96.5 km/h). The latter partially explains the low British fatality rate for car occupants, which may also be partially explained by the traditionally large share of roundabouts. Also the motorway system in Britain has the highest traffic intensity (over 67,000 AADT) of the SUN countries (Dutch motorways have an AADT of just less than 62,000 and Swedish motorways only just over 17,000).

However it can be somewhat misleading to compare motorway kilometres in Britain with motorway kilometres in other countries. In addition to the 3,465 motorway kilometres, there are also 5,500 kilometres of other dual carriageway roads (than motorways) within the British inter-urban road network. But, these are of varying quality and only a quarter of their length having grade separated junctions, although a further proportion will have at-grade junctions with only merging movements allowed. The extent to which these merge only junctions have acceleration and deceleration lanes varies, but the major junctions are often fairly safe roundabouts.

The Netherlands

In the Netherlands with its dense population and high use of bicycles, the reconstruction of the built-up road networks is accompanied by main bypass roads and ring roads around cities and large villages. Separated high quality roads in and around large cities are also almost universally applied. In old cities (e.g. Amsterdam, Utrecht, etc.) motorised traffic is discouraged from entering city centres by all kinds of means (narrowing main urban roads, reducing speed limits of residential streets to 30 km/h, expensive parking, attractive public transport modes with a dense and well-connected bus, tram and/or metro, and train network), while through traffic is redirected to ring roads or surrounding motorways. In new cities (e.g. Zoetermeer, Almere, etc.) the main roads are almost completely separated from the slow traffic and have mainly grade separated crossings with the remaining city road network and cycle lanes. The process of reconstruction has been going on since the early 1970s and has been revived within the sustainable safety programme that aims to reduce the built-up speed limit to 30 km/h, except on main built-up roads and urban bypasses or urban express roads or motorways. As in Sweden the programme has reduced the fatalities on built-up area roads, but in contrast to Sweden, their replacement by more car occupant fatalities on bypasses and separated main roads is seldom observed. This is probably due to the simultaneous redistribution of traffic to the safe motorways that cater for 40% of the Dutch traffic in 2000 but only 14% of the traffic in Sweden.

SUN countries comparison

The much higher traffic intensity on British rural roads and the relatively empty rural roads in Sweden, partially explain the low fatality rate for car occupants in Britain and the high fatality rate for car occupants in Sweden. Also the traditionally high share of roundabouts in Britain may add to the explanation of this rate difference. A comparison of the traffic distribution over the road network with Sweden, where the roads are relatively empty, is not realistic. But a comparison of Britain and the Netherlands seems fair. Compared to the Netherlands, where 40% of the traffic is on motorways with almost as high flows as Britain along with less busy non-motorway roads than Britain, it might be considered that an enlargement of the motorway system would have been, and still might be, appropriate for Britain. However, taking the length of the motorway network alone for Britain does not provide a good comparison, for the reasons outlined above. If the length of the non-motorway dual carriageway roads is also included, then the size of the network in relation to population or area is similar to the other two countries. The difference, however, is in the quality of the non-motorway dual carriageway network. While some of it is near to motorway standard, a substantial proportion has crossing traffic at the same level, with little provision of side safety zones, and with many smaller side access points. The main junctions however are fairly safe due to the extensive use of roundabouts. If this network was improved to be similar to the motorway standard in the Netherlands and Sweden, substantial savings in fatal and serious injuries could be obtained. However, it is clear from bypass improvements, that there is still substantial latent demand for car travel in Britain. Although the improved routes would attract higher traffic flows, in general these improved routes are also likely to generate new trips, and

not transfer traffic from other roads. However, future traffic growth will take place anyhow, because future economic growth is expected. Growth of income per capita has been, and in the future probably also will be, accompanied by increased motorization and traffic growth. The expected future growth of traffic is better accommodated by increasing traffic shares on motorways and on dual carriageway A-roads with good safety standards, or on reconstructed dual carriageway A-roads to motorways. Moreover, future traffic growth can hardly be realised in Britain without enlarging the length and traffic share of the motorway system, due to the very high traffic flow densities on the main sections of the existing British road network.

7.6. Conclusions

- The number of fatalities on the inter-urban road networks of the SUN countries have been decreasing between 1980 and 2000, but relatively less than the fatalities on built-up area roads.
- The number of fatalities on the motorways in the Netherlands has hardly decreased due to the relatively steep increase of the Dutch motorway kilometrage, but the fatality rate on Dutch motorways has decreased in a similar way as in Sweden and Britain.
- The fatality rate for motorways is the lowest of all road types and does not differ significantly between the SUN countries; the lowest rate is in Britain and the highest in Sweden (24% higher).
- The fatality rate for A-roads is the highest of all road types and differs significantly between the SUN countries; the highest rate is in the Netherlands and the lowest in Britain (40% lower)
- The total fatality rates of the three countries are similar, despite the rates for roads other than motorways being much higher in the Netherlands than in Britain. This is explained by the different shares of vehicle kilometres on motorways in the three countries. The traffic share of the motorways is 40.1% in the Netherlands, 20.1% in Britain, and 13.6% in Sweden. If the Netherlands did not have 40% of the vehicle kilometres on motorways in 2000, but still had the 27% of 1980 on its motorways and the same total vehicle kilometre, then the Netherlands would have a 15% higher total risk, or more than 150 fatalities extra would have occurred in 2000.
- The motorways and A-roads have by far the highest flow densities in Britain, while the share of the motorway length in the inter-urban road network is relatively the smallest in Britain. If the larger non-motorway dual carriageway network in Britain is included in the comparison, the lengths relative to population or area become similar in the three countries. However the standard of the non-motorway dual carriageway is very variable, and future safety in Britain could be improved by bringing it up to the standard of the motorways, which would also contribute to the accommodation of future traffic growth.
- The speed limits on the inter-urban road networks (A-roads and motorways) are higher in Britain than in Sweden and the Netherlands, but the actual mean speeds on these inter-urban roads are highest in Sweden and lowest on A-roads in Britain.
- The flow density on the inter-urban road network is lowest in Sweden and highest in Britain, with the Netherlands only slightly lower than in Britain.
- The differences between the actual mean speeds on the inter-urban road network of the SUN countries seem not to be related to the differences between speed limits, but to the differences between speed limit enforcement levels, and dominantly to differences between traffic flow densities. However, the influence of speed differences on the safety differences between the countries requires further research.

8. Using past trends to inform future policies

The potential value of investigating past trends includes:

- understanding what has been achieved by specific road safety actions in the past, and how this has been achieved;
- assessing how much more might be achieved through further action on these policies, and the effect that would have on the overall safety performance of the country;
- the ability to continue past trends, taking into account:
 - benefits gained from past policies that cannot be repeated (e.g. introduction of seat belt wearing legislation),
 - potential impact of new initiatives in each policy area.

8.1. Past trends: how far can they be explained?

Ideally one would be able to track all the effective road safety measures in each country and show that these explained the reductions in numbers of casualties in each country, having also taken account of the changes in road user activity that occurred over the same period. Such an approach was briefly considered, but experience of trying to do this in Great Britain, as part of setting the casualty reduction target for 2010, suggested that this was unlikely to be achievable. Although the effects of some of the key safety measures are well researched and documented, there remains a very large number of smaller initiatives that collectively may change attitudes and behaviour significantly, for which separate measures of effectiveness cannot be assessed. The other major factor in tracking casualty changes is the change in exposure. In all three countries, overall traffic levels will have grown, with car traffic growth being particularly high. Whilst this can be allowed for, to some extent, by considering casualty rates, the link between vehicle kilometre growth and casualties is not necessarily proportional. For fatalities, the difference from proportionality is likely to be substantial if the traffic intensity also increases with the vehicle kilometrage growth. In addition, a substantial proportion of casualties involves vulnerable road users (pedestrians, cyclists, mopedists and motorcyclists). In this case, changes in numbers of fatalities will be affected by both changes in car traffic and any changes in flows of the vulnerable road user group.

The approach adopted here will be twofold. Section 8.1.1. looks first at the pattern of change in fatality rate by vehicle kilometrage over the period 1970 to 2000. It then looks separately at the change in numbers of fatalities by road user group in the three countries, and attempts to relate them to the overall change in traffic between 1980 and 2000, and the effect for those major policies for which some estimate of effectiveness can be made. The policies for which specific estimates of past effectiveness will be made are mainly those covered in the preceding chapters. In addition, an estimate is made of the effectiveness of improvements in vehicle safety, which will contribute to casualty trends in all three countries. The data available on which to make estimates of the effect of measures differs substantially between the measures, and some estimates will carry large potential margins of error. A baseline date against which to relate fatalities saved by various measures needs to be chosen. It would be ideal to look back to 1970 in order to demonstrate the greater casualty reduction in the 1970s in the Netherlands and to a smaller extent also in Sweden. But there is less consistency further back in time of data relating to individual measures, so the analysis is mainly based on 1980 to 2000.

8.1.1. Trends in fatality rate per head of population and per vehicle kilometre

These indicators are the ones most commonly used for international comparison. They show broadly the same pattern for the three countries, but closer examination indicates the interactive effect of changes in traffic growth and in safety programmes. As population distribution, road networks, and traffic distribution differ between the countries, these indicators will not necessarily take the same value in different countries, even where the same safety programmes have been followed.

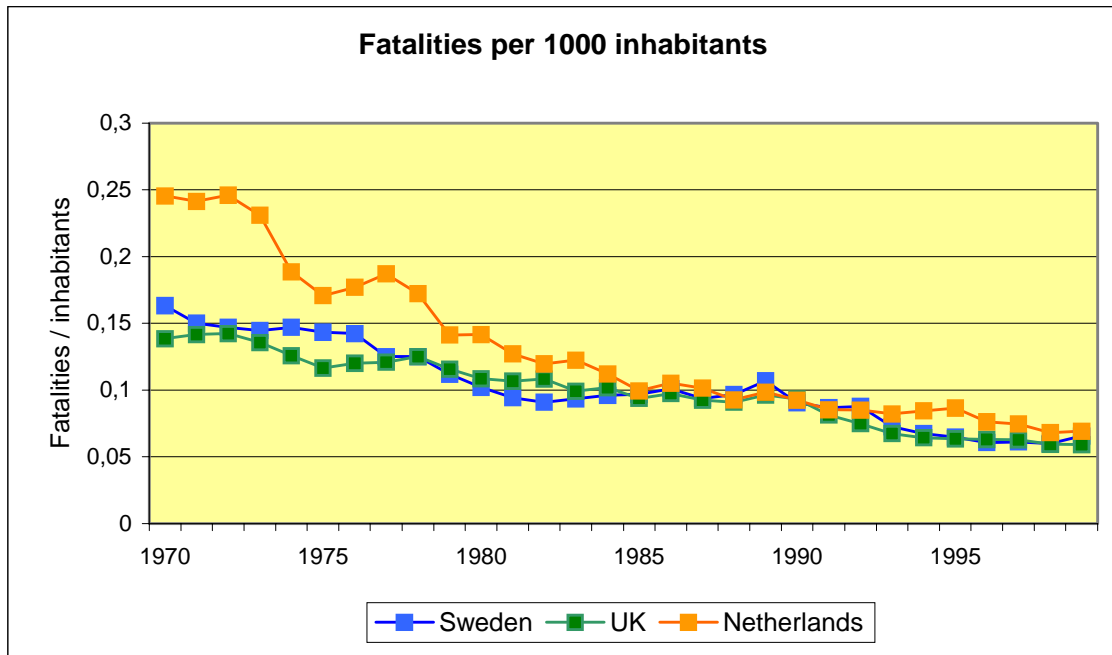


Figure 8.1. Trends in fatalities per head of population

Trends in fatalities per head of population (Figure 8.1) show that the 1970 rate in the Netherlands was some 50% higher than that in Sweden, with the British rate being slightly lower. A similar situation existed in the mid-1970s, although by this time British and Swedish rates were similar. But between mid-70s and mid-80s, rates in the Netherlands dropped much more quickly than in Britain: in Sweden an initial further drop during this period was followed by an upturn so that by the mid-1980s all three countries had similar rates. From the early 1990s, Swedish and British rates dropped more quickly than the Netherlands, although Swedish rates again appeared to rise at the end of the 1990s.

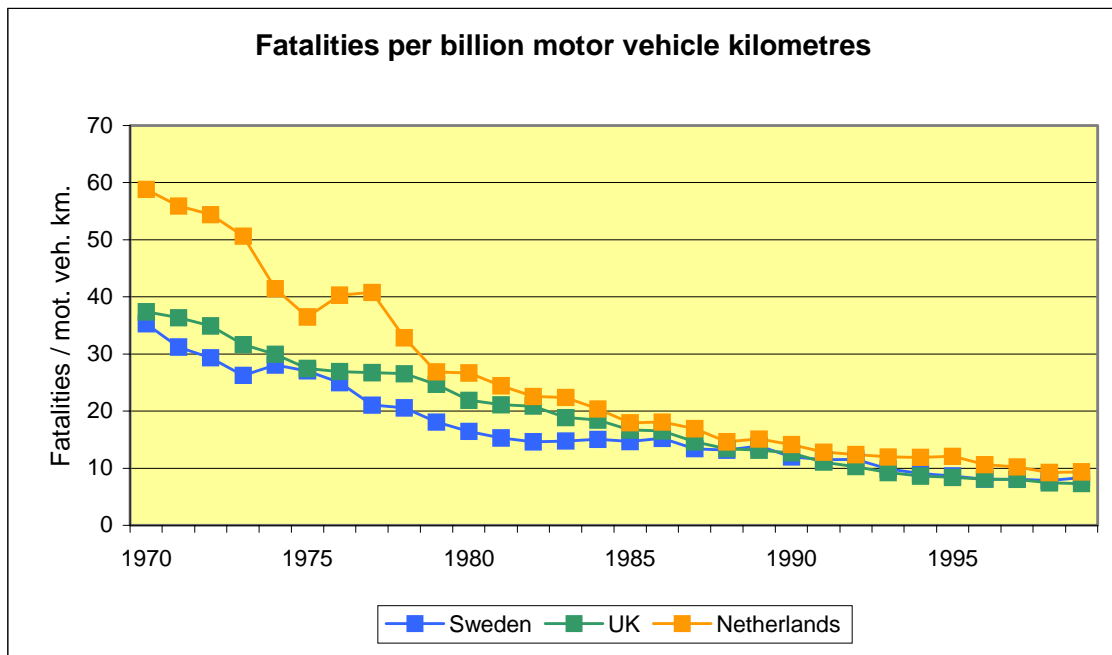


Figure 8.2 Trends in fatalities per motor vehicle kilometre

Plots of fatality rates per vehicle kilometre (Figure 8.2) for the three countries smooth out several of the variations due to differential traffic growth in the three countries, and the overall trends are more apparent. While the British trend shows a steady fall throughout the 30-year period, there have been clear periods in Sweden (early 1980s) and Netherlands (early 1990s) when the fall in their fatality rate has been arrested. There also is a period in the Netherlands (1970s) where the fatality rate reduced faster than in Great Britain. Understanding the reasons for these periods of lack of progress or excessive progress would greatly help assessment of the potential for continuing downward trends into the future.

It is well established that fatality rates decline more or less in an exponential way in the long run, despite the growth of traffic over time. Exponential rate decline means a constant annual percentage reduction. However, decreases in fatality rates based on vehicle kilometres may vary according to whether the decay is based largely on the introduction of more-or-less effective safety measures in periods of high or low traffic growth. Clearly, very effective measures in periods of low traffic growth leads to relatively large percentage reductions in fatalities, while less effective measures in periods of high traffic growth leads to relatively small rate declines.

Figure 8.3. shows traffic in GB has grown more rapidly in the late 1980s than in the other two countries, while GB had a relative low traffic growth in the early 1990s and Sweden during the whole 1990s.

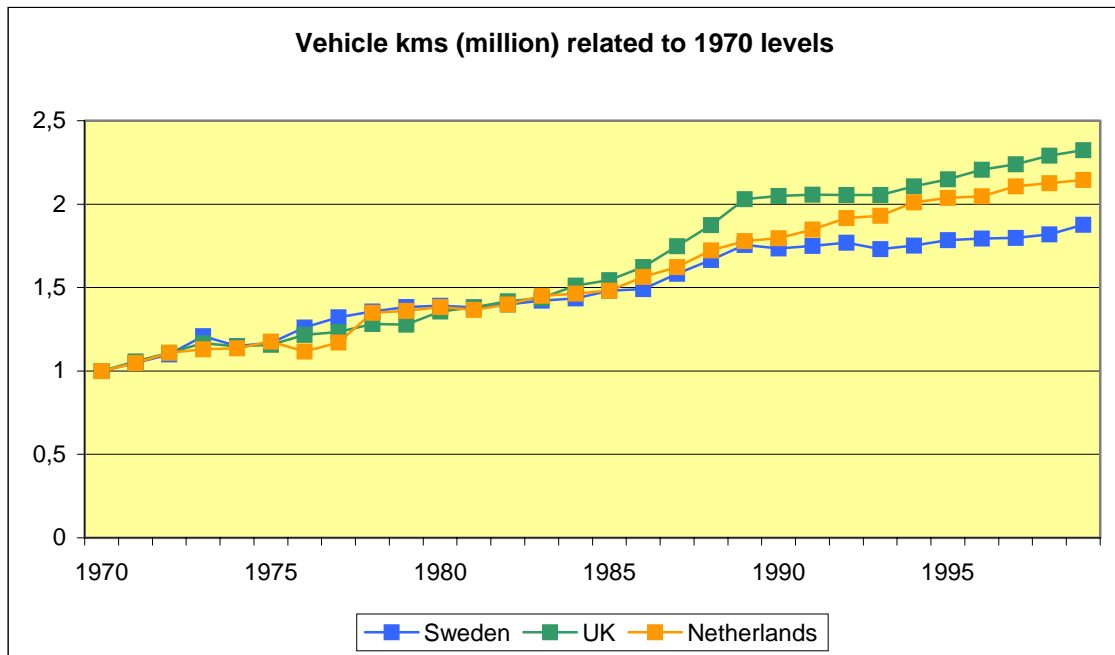


Figure 8.3. Trends in vehicle kilometres

8.1.2. Effect of vehicle safety improvements

In the course of a project that attempted to explain recent casualty trends in Great Britain (Broughton et al, 2000), a method was developed for assessing the benefits of improved car secondary safety. It analyses car driver casualty data for accidents occurring over a number of years, and finds that the proportion of drivers who are killed or seriously injured is lower in newer cars, i.e. cars that were registered more recently. A statistical model is used to separate the effect of 'year of registration' (which represents the results of improving secondary safety) from the effect of 'year of accident' (which represents the general level of road safety in the country). The cars that were originally registered in 1980-81 provide a convenient benchmark, i.e. the level of secondary safety of more modern cars is expressed relative to the average level that existed in that group of cars.

As part of the SUNflower project, data from another country, Sweden, was analysed, and the results compared with those found in Great Britain. The effects of vehicle safety improvements on fatality rates have been found to be extremely consistent between the two countries, although the effects for serious accidents show some differences. Two effects are clear from the analyses. The age distribution of cars in Sweden is older than that in Britain, resulting in greater delay before the newest models penetrate the whole fleet. But the changes of risk in the vehicle fleet for Sweden over time suggest that from the early 1990s (which is the time from which the Swedish data are available) the safety of vehicles was already higher in Sweden than in Britain. These two effects result in the overall fleet risk being similar in 2000. The overall effect of vehicle safety improvements over the two decades has produced a 15-20% reduction in occupant fatalities.

The results allow us to make some estimate of the effect that vehicle safety improvements have had on fatality rates in Sweden, relative to the more detailed calculations already made for Britain. For Britain, a saving of 650 fatalities has been estimated relative to 1980 casualty levels. For Sweden, a similar proportionate reduction

would have yielded a saving of 110 fatalities, but this estimate has been reduced by 20% to 88 fatalities, on the assumption that the Swedish car fleet had a higher level of car safety in 1980 but a relatively older vehicle fleet in 2000. We do not have similar data for the Netherlands, but in its absence, we will assume a pattern similar to the average of Britain and Sweden, suggesting a saving of 275 fatalities.

8.1.3. Effect of seat belt wearing policies

The dramatic increase in front seat belt wearing rates in 1983 in Britain allowed a very comprehensive assessment to be made of the effect of wearing rate on accident reduction. In principle, the overall effect of the policy on accidents is proportionate to the wearing rate, although it can be argued that those who adapt to regular wearing earlier will be the safer drivers, in relation to a range of other road risks. Increases in front seat belt wearing rates occurred more gradually in the other two countries, but estimates of the reduction in fatalities based on the same type of relationship should be reasonably accurate, providing account is taken of any major differences in traffic distribution and wearing rates on different roads.

From the extensive work in Britain, it has been estimated that about 500 fatalities were saved in 1983, when the wearing rate by drivers and front seat passengers increased from 40% to 95%. The relationship between wearing rate and fatality reduction is not linear. The relationship based on British wearing rates and fatalities is used here to estimate the savings gained as a result of the observed wearing rates in the other two countries. Using this relationship, we can estimate that savings in fatalities for the Netherlands (where wearing rates increased from about 68% in 1980 to 82% in 2000) and Sweden (where wearing rates increased from about 80% in 1980 to 91% in 2000), might be of the order of 150 and 75 respectively. There are less well-developed assessments of the effectiveness of rear seat belt wearing, but to an extent the same argument should hold. It is estimated that the savings in fatalities from rear seat belt wearing in Great Britain by the year 2000 are unlikely to be higher than 50 fatalities; the corresponding numbers for the other two countries might be 15.

8.1.4. Effect of drink drive policies

Numbers of drink drive related fatalities dropped from 1450 in 1980 to 530 in 2000 in Great Britain. These numbers need to be linked with the changes in proportions of alcohol related fatalities between years, to give an estimate of the saving from drink driving policies. The proportion of alcohol related fatalities is estimated to have been about 24% in 1980 falling to 15.5% in 2000. Thus the estimated saving in all alcohol related fatalities (related to 1980 fatality levels) is about 500. In Britain, most of these fatalities (84%) are car occupant fatalities. For the Netherlands the number of police-reported fatalities from accidents involving drinking and driving was about 300 in 1980 (15% of all fatalities) dropping to 90 for 2000 (8% of all fatalities). But the Dutch police under-reports these fatalities probably by about 50%, yielding an estimated saving of about 280 fatalities (at 1980 risk levels). In the Netherlands car occupant fatalities only contribute 50-60% of all drink drive related fatalities. A similar calculation shows that for Sweden alcohol-related fatalities dropped from about 100 in 1980 (14% of total of fatal accidents) to 55 in 2000 (10% of total of fatal accidents), yielding an estimate of about 30 fatalities saved.

8.1.5. Effect of infrastructure changes

The low cost engineering and 30km/h measures of chapters 6 suggest that the following savings in numbers of fatalities can be identified from these measures between 1980

and 2000, where about 40% of the totals for the saved fatalities concern vulnerable road users.

	Sweden	Britain	Netherlands
Low cost engineering	6	285	25
30km/h zones	8	12	48
Total (rounded)	15	300	75

Table 8.1. *Effect of infrastructure changes*

The figures for the Netherlands do not include programmes such as conversion of junctions to roundabouts which have not been directly monitored.

8.1.6. Effect of other measures

Several important areas of policy have been the subjects of investigation and initiatives over the past 20 years, but policies which make major changes in the casualty numbers in these areas still have to be developed. Examples are young drivers, speeding, safety of two wheeled vehicles, and pedestrian safety. The latter two are reflected separately in the calculations below as the aggregate effect of changes in exposure and of safety policies. We know that there have been reductions in the number of drivers acquiring licences during the 1990s in both the Netherlands and Britain. Research in Sweden also suggests reductions in young driver accidents following changes in training and testing procedures. These are not considered separately below, but form part of the “other vehicle occupant” changes.

8.1.7. Aggregated estimate of factors resulting in fatality reduction

This analysis makes extensive assumptions - some might be improved if better data can be found. But the aim is to reach a broad conclusion about the distribution of sources of fatality reduction; individual component estimates may contain significant errors. The basis of the calculation is:

1. estimate the additional fatalities that might have been expected in 1980 if traffic had been at 2000 levels. A proportional relation of car occupant fatalities with vehicle kilometres is assumed for motorways, and an exponent of 0.75 is assumed (based on previous accident studies) for the rate at which car occupant fatalities change with changes in vehicle kilometres on other roads, while an exponent of 0.6 is assumed for the relationship between changes in travel kilometres of vulnerable road user groups and changes in their expected fatalities. These additional fatalities are added to the observed differences in number of fatalities of vulnerable road user groups and car occupants between 1980 and 2000;
2. assess the difference in expected and observed fatalities for each vulnerable road user group in 2000 and assign that difference to “all measures” that had affected that group;
3. assess, using information in preceding sections 8.1.2. to 8.1.5., the fatality savings by the four policies that have been examined in detail and assign a proportion of the savings from the local engineering policy and the drinking and driving policy (see sections 8.1.4 and 8.1.5.) to vulnerable road users and the remaining saving to car occupants;
4. subtract the saving in vulnerable road users estimated in (2) and the car occupant saving by the four policies estimated in (3) from the expected total fatality reduction

between 1980 and 2000 estimated in (1), and assign the remaining difference in fatality numbers to “other car occupant measures”.

5. subtract the savings of vulnerable road users by the local engineering policy and the drinking and driving policy both estimated in (3) from the total saving in vulnerable road users estimated in (2) and assign the remaining difference to savings by “other vulnerable road user measures”.

8.1.7.1. Sweden

An estimate of the growth in car occupant fatalities that might have been expected due solely to growth in car traffic between 1980 and 2000 is shown below.

	Fatalities		Vehicle kilometres			Expected increase in fatalities
	1980	2000	1980	2000	% Motorways	
Car traffic	498	407	51	69	33	141

Table 8.2. *Expected change in car occupant fatalities due to traffic growth in Sweden*

Thus 33% of 1980 fatalities (164) are assumed to have increased proportionally by 69/51, an increase of 58. The other 67% of 1980 fatalities (334) are assumed to have increased by a power function 0.75 of 69/51, an increase of 83. This can be represented by the equation $334 \times [(69/51)^{0.75} - 1]$. A similar calculation is used for changes in vulnerable road user fatalities for their flow changes.

	Fatalities		Travel kilometres		Change in fatalities due to	
	1980	2000	1980	2000	Exposure	Measures
Motorcyclist	77	49	0.51	0.85	+ 28	- 56
Cyclist	112	47	Assume no change		0	- 65
Pedestrian	133	73	Assume no change		0	- 60
Total	322	169			+28	-181

Table 8.3. *Influence of modal exposure and safety measures on vulnerable road user fatalities*

The total number of fatalities on 1980 is 498 car occupants, plus 322 vulnerable road users, plus 28 “other vehicle” occupants. Traffic levels for “other vehicles” are assumed to remain constant over the period.

The reduction in fatalities (at 2000 fatality levels) that is expected to occur relative to 1980 flow levels is therefore 848 in 1980 minus 591 in 2000 plus the estimated 141 fatalities for car occupants and 28 fatalities for vulnerable road users that would have occurred through increased exposure, which is 426.

Changes in fatality number attributed to individual safety policies are:

Vehicle safety	88	(from section 8.1.2.)
Seat belt wearing	90	(from section 8.1.3.)
Drinking and driving	28	(from section 8.1.4.)
Local road engineering	15	(from section 8.1.5.)
The reduction in fatalities “explained” above is made up of:		
Vehicle safety, seat belt, drink drive measures	206	
Local road engineering measures	5	
Vulnerable road user measures	181	

The total is 402, but about 40% of the savings by local road engineering and by drinking and driving are assumed to overlap with the reduction for vulnerable road users, which overlap is 17 fatalities. Therefore, the estimated effect of “other measures” is $426 - (402 - 17) = 41$ fatalities for car occupants and $181 - 17 = 164$ fatalities for vulnerable road users. These “other measures” will include the safety effects of general road improvements outside the local safety budget as well as effects of education, training and publicity (ETP) measures that may have modified general road user behaviour to reduce risk.

8.1.7.2. Great Britain

The change in fatalities among car occupants that might have been expected between 1980 and 2000 due solely to growth in traffic is estimated initially, based on the changes in car kilometres.

	Fatalities		Vehicle kilometres			Expected increase in fatalities
	1980	2000	1980	2000	% Motorways	
Car traffic	2278	1665	227	380	33	1221

Table 8.4. *Expected change in car occupant fatalities due to traffic growth in Great Britain*

Changes in vulnerable road group fatalities can be compared similarly with the change that would be expected due to known change in travel activity of each group. The estimate of pedestrian activity is based on National Travel Survey data.

	Fatalities		Travel kilometres		Change in fatalities due to	
	1980	2000	1980	2000	Exposure	Measures
Motorcyclist	1163	605	77	44	-337	-211
Cyclist	302	127	51	40	-41	-134
Pedestrian	1941	857	Assume -26%		-320	-764
Total	3406	1589			-698	-1109

Table 8.5. *Influence of modal exposure and safety measures on vulnerable road user fatalities (GB)*

The total change in fatalities (at 2000 fatality levels) that are expected relative to 1980 flow levels is therefore 6010 in 1980 minus 3409 in 2000 plus the estimated 1221 car occupant fatalities that would have occurred through increased traffic levels minus 698 fatalities from reduced exposure of vulnerable road users, which is 3124.

Changes in fatality number attributed to individual safety policies are:

Vehicle safety	650
Seat belt wearing	550
Drink driving	500
Local road engineering	300

The reduction in fatalities “explained” above is made up of:

Vehicle safety, seat belt, drink drive measures	1700
Local road engineering measures	300
Vulnerable road user measures	1109

The total is 3109; 40% of the road engineering and 15% of the drinking and driving savings are assumed to overlap with reduction for vulnerable road users, which overlap is 195 fatalities. Therefore the estimated effect of “other measures” on car occupants is $3124 - (3109 - 195) = 210$ fatalities and on vulnerable road users $1109 - 195 = 914$. In chapter 7 it has been estimated that about 230 fatalities are saved in Britain between 1980 and 2000 due to the shift of vehicle kilometres to the motorway system. Since about 90% of the motorway fatalities concerns car occupants, the remaining measures of general road engineering and ETP have saved are $914 - 0.9 \cdot 230 = 707$ car occupant fatalities.

8.1.7.3. Netherlands

An estimate of the growth in fatalities that might have been expected due solely to growth in car traffic between 1980 and 2000 is shown below.

	Fatalities		Vehicle kilometres			Expected increase in fatalities
	1980	2000	1980	2000	% Motorways	
Car traffic	910	513	61.3	100.9	57	504

Table 8.6. *Expected change in car occupant fatalities due to traffic growth in The Netherlands*

Changes in vulnerable road user fatalities are examined below.

	Fatalities		Travel kilometres		Changes in fatalities due to	
	1980	2000	1980	2000	Exposure	Measures
Motorcyclist	323	196	3.4	2.7	-43	-84
Cyclist	425	198	10.6	14.5	+94	-321
Pedestrian	296	106	4.0	4.3	+13	-203
Total	1044	500			+67	-608

Table 8.7. *Influence of modal exposure and safety measures on vulnerable road user fatalities (NL)*

The total change in fatalities (at 2000 fatality levels) that is expected to occur relative to 1980 flow levels is therefore 1996 in 1980 minus 1082 in 2000 plus the estimated fatalities for 504 car occupants and 67 vulnerable road users that would have occurred through increased exposure, which is 1485.

Changes in fatality number attributed to individual safety policies are:

Vehicle safety	235
Seat belt wearing	165
Drink driving	280
Local road engineering	75
The reduction in fatalities “explained” above is made up of:	
Vehicle safety, seat belt, drink drive measures	680
Local road engineering measures	75
Vulnerable road user measures	611

This is a total fatality reduction of 1366. Again 40% of the 280 saved fatalities from drinking and driving policies and the 75 fatalities from local road engineering are

assumed to overlap with the reduction for vulnerable road users, which overlap is 142 fatalities. Therefore estimated effect of general road engineering and other measures (ETP) affecting car occupants is $1485 - (1366 - 142) = 261$ fatalities and affecting vulnerable road users is $611 - 142 = 469$ fatalities. The major part of the saved car occupant fatalities is saved by the substantially enlarged motorway system in the Netherlands. In chapter 7 it has been estimated that about 165 fatalities are saved in the Netherlands between 1980 and 2000 due to shift of vehicle kilometres to the enlarged motorway system from 27% in 1980 to 40% in 2000. Since about 90% of the motorway fatalities concerns car occupants, the remaining measures of general road engineering and ETP have saved are $261 - 0.9 \cdot 165 = 112$ car occupant fatalities.

8.1.8. Conclusions

The results of these comparisons are summarised in the Table 8.8. Although it is extremely difficult to identify the effects of individual policies with confidence, the fatality savings from vehicle safety, seat belt wearing, and drinking and driving seem rather reliable.

	Saving in fatalities between 1980-2000 attributed to each source		
	Sweden	Britain	Netherlands
Estimated total fatalities saved	426	3124	1455
Vehicle safety, seat belts,	48%	54%	46%
Drinking and driving			
Local road engineering	4%	10%	5%
Other vulnerable road users-related measures	38%	29%	31%
Other car occupant measures	10%	7%	18%

Table 8.8. *Summary of sources of fatality savings in the SUN countries*

- These comparisons suggest that 46% to 54% of the estimated savings in fatalities resulted from “headline” policies of seat belt wearing, drinking and driving, and improved car safety. Britain, with 54% saving, had the highest increase in seat belt wearing after 1980.
- A substantial part (29% to 38%) of the reduction in fatalities in each country is to be attributed to other measures for vulnerable road users (VRU). Alongside the effect of other direct VRU measures, a large part of the reduction in VRU fatalities in Britain is also associated with reduced VRU exposure. In Sweden and the Netherlands the effects of VRU-exposure increase would have produced some increase in VRU fatalities. This may partly explain the relatively smaller reduction in VRU fatalities in Britain.
- Correspondingly it appears that other VRU-related measures have had a larger effect for vulnerable road users in Sweden and the Netherlands, than in Britain. Part of this might be associated with the greater penetration of infrastructural treatment of residential areas and the lower speed limits adopted in built-up areas in Sweden and the Netherlands.
- Other measures (ETP and general road engineering) appear to have contributed 10% to the reduction of car occupant fatalities in Sweden. In the Netherlands their contribution is 18%, but 11% of this is attributed to the enlargement of the motorway system (see chapter 7). Thus only 7% remains for the reduction of car occupant fatalities by other general road engineering and ETP measures in the

Netherlands. Some of the estimated contribution from other car occupant measures in Britain and Sweden may also be due to major road engineering improvements. So it appears that changes in ETP between 1980 and 2000 (other than those linked with seat belts and drink drive education) may only have resulted in a reduction of around 5% in car occupant fatalities.

8.2. What can we learn from comparing recent trends by road user group?

A complementary approach is to examine the rate of change in fatality rate over a recent decade in the three countries. This is done by plotting the log of the fatality rate for each road user group in each country. This approach is similar to that adopted in the GB analysis which supported the adoption of the national casualty reduction target (Broughton et al, 2000). It differs from the original GB analysis in that the rate was plotted net of the three identified policy areas. In this analysis, it has not been possible to create annual estimates of the effects of these individual policies for all three countries. Nevertheless, it is of interest to examine the recent national trends in this way to assess the similarities and differences between the countries, and also to look at the projection of these trends in relation to the forward targets that each country has adopted. The results are shown below by figures of the logarithmic rates based on billions kilometres of all motor traffic or on travel kilometres of a specific road user group if explicitly mentioned.

8.2.1. All road users

British and Swedish rates for 1987 to 1997 correspond well, but rates for the Netherlands reduce less steeply. However, for both Sweden and Britain, there has been less rate reduction over the last 3 years. It needs to be established, over a longer period, whether this represents a change from the previous consistent trend. Trends for the individual road user groups are examined below to investigate this further.

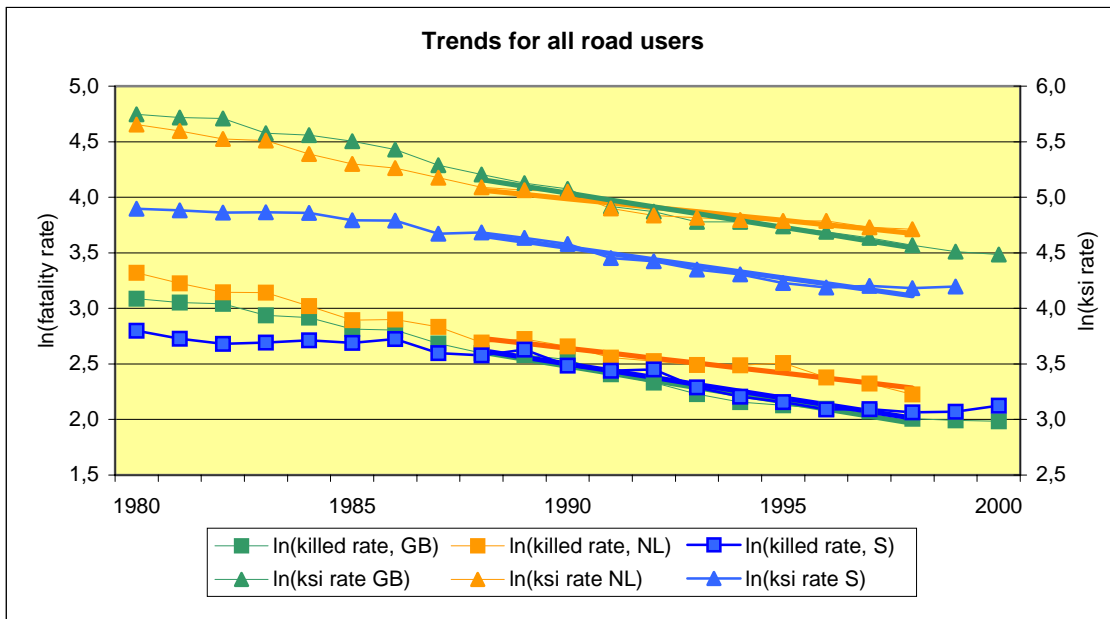


Figure 8.4. Trends for all road users

8.2.2. Pedestrians

The rates of reduction of pedestrian fatalities have also been very consistent over the period 1987 to 1997.

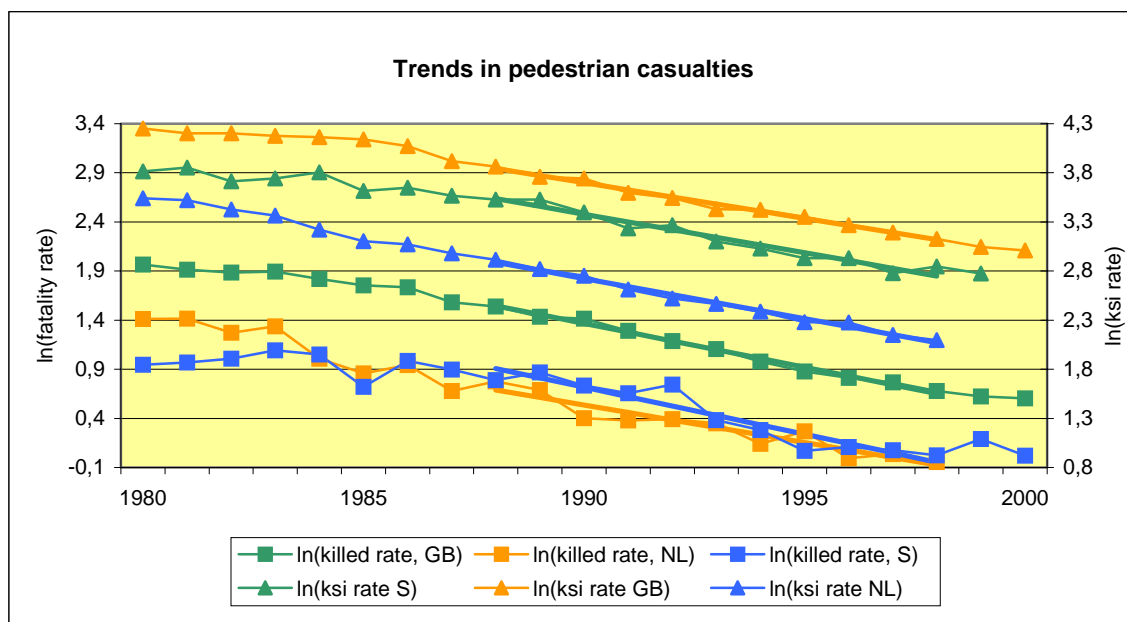


Figure 8.5. Trends in pedestrian casualties

8.2.3. Pedal cyclists

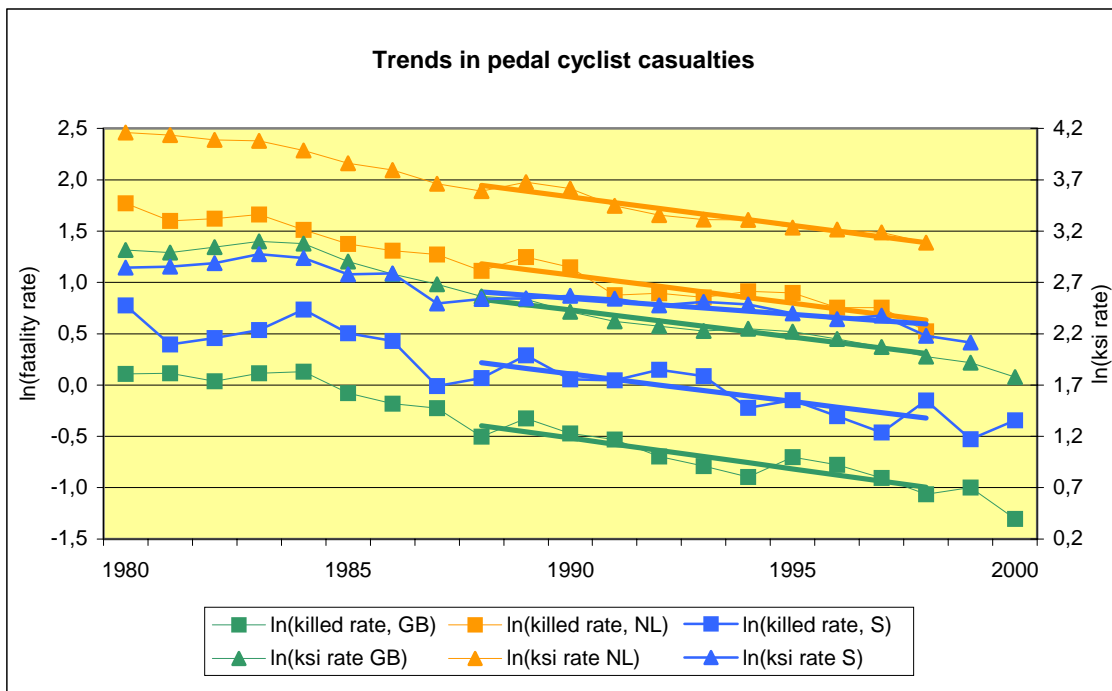


Figure 8.6. *Trends in pedal cyclist casualties*

These rates are the highest in the Netherlands, but when expressed as rates per amount of cycle kilometres, they are the lowest in the Netherlands.

8.2.4. Motorcyclists

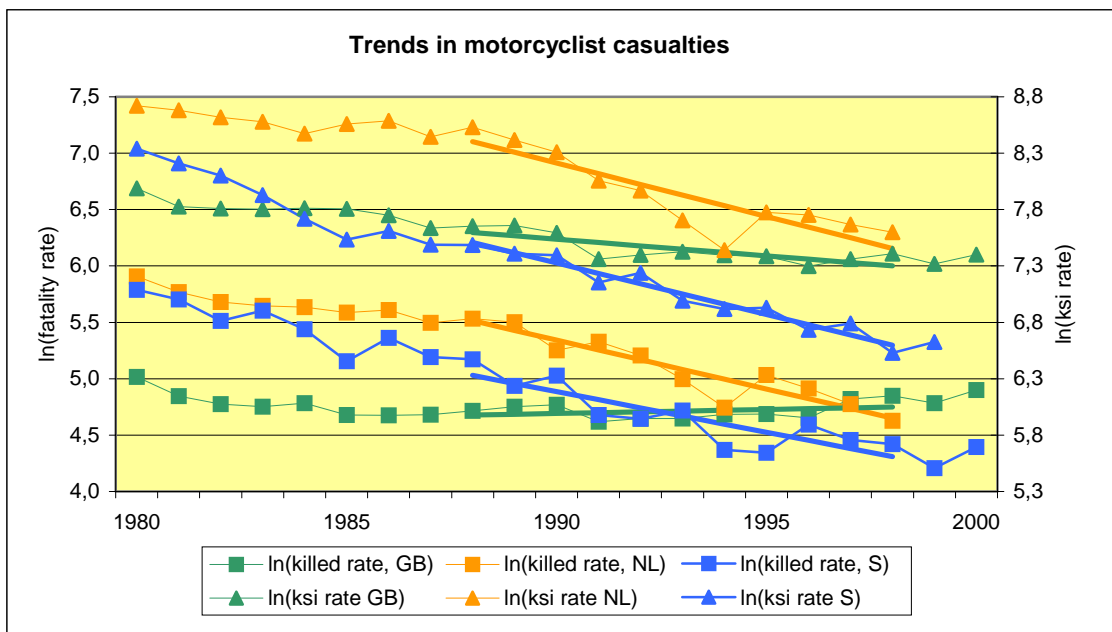


Figure 8.7 *Trends in motorcyclist casualties*

Rates in this case are rates per motorcycle traffic rather than based on all motor traffic. These motorcyclists rates vary substantially between Britain and the other two countries. In recent years the rate for Britain has been flat or even increasing (for fatalities and serious casualties), while the rates in the other two countries have continued to reduce. In Sweden, the rate appears to reduce even slightly steeper than before 1987.

8.2.5. Car occupants

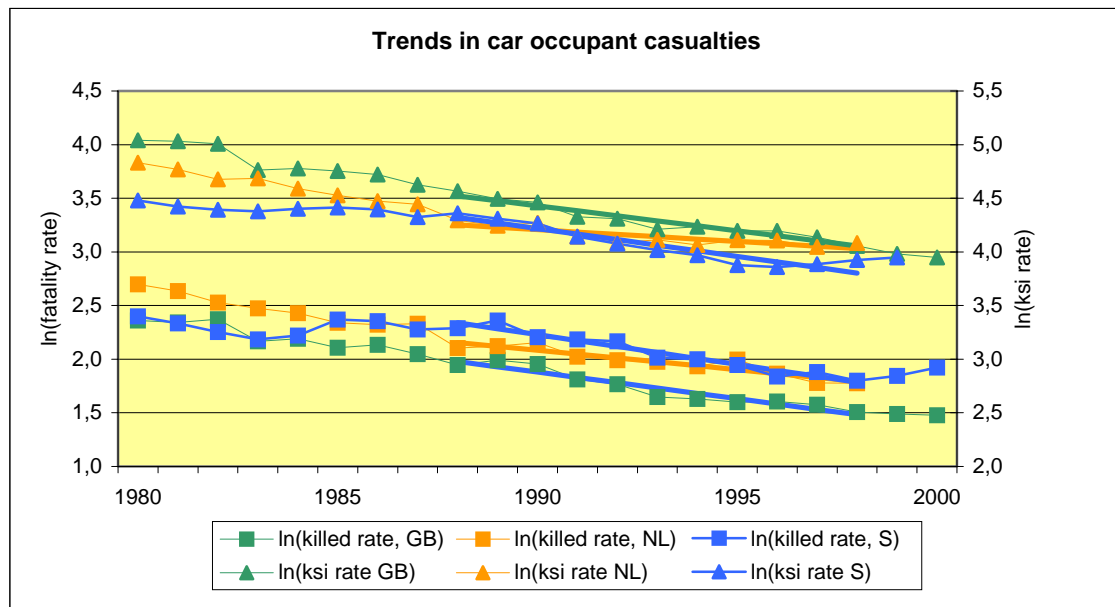


Figure 8.8. *Trends in car occupants casualties*

The rates for car occupants decreases similarly for Britain and Sweden, but slightly less steep for the Netherlands over the period 1987 to 1997. The British fatality rates for car occupants are the lowest. There is again an indication of an upturn in the Swedish rates over the last two years. The rates for the Netherlands over the last ten year period seem to decrease a bit less steeply than in the preceding period while the rate decrease for Sweden is steeper than in the earlier part of the 1980s.

8.2.6. Conclusions

- These figures allow the change in rate over recent years to be compared for each country. Generally the trends for fatalities and for serious and fatal injuries combined are similar in each country.
- The downward trend for all road users and the fatality rate in Sweden and Britain has been very similar; the rate for the Netherlands was similar in 1987 but has reduced less steeply since then. However, there is an indication of a much less reducing trend in Sweden over the last few years; the British trend has also flattened over the last two years.
- The slower reduction in Netherlands is mainly associated with a slower reduction in car occupant rate.
- The trend in motorcyclist fatality rate in Britain has been very different from the other two countries, with very little reduction over the ten year period. The fatality rate for Britain was the lowest in 1987 but is now the highest.
- The trends in pedestrian and cyclist rates are similar in the three countries although the cyclist fatality trend in Sweden is slightly less steep. The fatality rates vary

considerably with Britain having the lowest cyclist rate but the highest pedestrian rate, and vice versa for Netherlands, reflecting the different amounts of cycling and walking in the two countries. However, if these rates are expressed as rates per travel kilometres of its own mode than the cyclist rate is lowest in the Netherlands, while that pedestrian rate is still highest in Britain.

8.3. Do current targets and strategies reflect past performance and likely future potential?

We might first look at the implications of extrapolating the recent trends forward. Most of the effects of seat belt wearing and drink driving policies had been realised before the period (1987-1997) on which these trends were based. There were however reductions in vulnerable road user activity that were still occurring in Britain during this period and contributing to reduction in fatalities, which will not be repeated. Indeed for the motorcycle group, the trend has already reversed and the effect of this can be seen in the graphs above. Projecting recent trends forward in Britain is roughly in line with achieving the planned target. This means that new initiatives need to be found at a level that matches the extent to which the benefits from previous policies can no longer be sustained. Recent trends in Netherlands and Sweden have been more variable, but the flattening of the Swedish trend suggests that substantial new initiatives are need to achieve the current target for 2007. In the Netherlands, the target for 2010 will be achieved if the trend between 1995 and 2000 is maintained.

8.3.1. How have traffic growth and cost effectiveness been taken into account?

Traffic

When the Swedish target was set, a single central forecast of a continuation of about 1 per cent per year traffic growth was assumed. This reflected the relative stability of traffic changes in Sweden over recent years. Changes in traffic in Britain have been rather more variable, and future levels of traffic are less certain, so a range of different traffic scenarios, for both motorised traffic and pedestrians and cyclists, were tested in the development of the British target. For the Netherlands target, three alternative levels of traffic growth were considered; the target is based on the central forecast.

Costs

The cost of the programme required to achieve the Swedish and Dutch targets was assessed at the time that the targets were set. For the British target, the contribution expected from the different policy areas was defined, but costs were not assigned to the policies required to deliver these contributions. The British approach relies on a commitment to achieve the targets and on justifying the cost effectiveness of policies when they are implemented.

8.3.2. Do priorities for future measures differ between countries?

Although the same general policy areas are highlighted in all three national strategies, it is difficult to make direct comparisons, but the Table 8.9 gives a broad-brush illustration based on published plans.

	Percentage of total savings in each country		
	Sweden	Britain	Netherlands
Vehicle improvements	20 (including ITS contribution)	35 (including improved motorcycle helmets)	26 (including ITS contribution)
Road engineering, and speed management	59 (including traffic control)	44	50
Behaviour excluding speed enforcement	15 (novice drivers, enforcement)	16 (novice drivers, drinking drivers, high mileage drivers)	24 (novice drivers, enforcement)
Other measures	6 (emergency care)	5 (child safety)	-

Table 8.9. *Approximate distribution of policy areas expected to yield future casualty savings*

The range of measures proposed in the British strategy included a strong focus on speed management and an expectation of substantial benefits still to work through from vehicle secondary safety improvements. In comparison, in Sweden and the Netherlands, there is a much stronger focus on infrastructure redesign. There is also more emphasis in the latter two countries on changes in technology, and enforcement measures are more explicitly included.

8.3.3. What monitoring or revision processes proposed?

In Sweden, concerns already exist about the ability to meet the target, but the Government is keen to retain it. In Britain, the road safety strategy published with the target committed a three yearly formal review of progress towards the target and the strategy. The Transport Department reports to an advisory group at roughly six monthly intervals on progress in actions defined in the strategy. In the Netherlands, the National Traffic and Transport Plan was not accepted by the Dutch Parliament in 2001, and a revised plan will be prepared. Due to the reduced governmental budgets available, a revision of the national target for 2010 is also being considered (with perhaps a maximum of 950 fatalities instead of the current target of 750).

8.4. General conclusions

- Over the last 15 years the accident rates in the three countries have been relatively similar, although in the 15 years prior to that there was a much more substantial reduction in the Netherlands. Apart from motorcyclists, the trends in deaths and serious injuries among the different road user groups is also similar in the three countries, although over the last ten years there has been a slower reduction in car occupant casualty rates in the Netherlands. This may result from the different traffic distribution across the road network in the three countries.
- All three countries have benefited from substantial improvements in vehicle safety, and have increased their levels of seat belt wearing and compliance with drinking and driving. The means by which they have done so have differed between the countries, while there are some apparent further gains to be achieved on one or both of these latter policy areas. Especially in the Netherlands on belt wearing (due to lower wearing rates than in Sweden and Britain) and in the Netherlands and Britain on compliance with the drinking and driving law (due to higher percentage of alcohol-related fatalities than in Sweden). Over the last 20 years, these three policies have accounted for about half the reductions in expected fatalities. These

reductions are not repeatable, but significant further fatality reduction for car occupants will also result from penetrating 'best design' throughout the car fleet.

- Specific programmes for treatment of high risk sites, including the introduction of 30km/h zones, have made measurable but not substantial contributions to the reductions in fatalities over the last 20 years. But general engineering and other measures substantially reduced the fatalities among vulnerable road users in the Netherlands and Sweden, contributing to about a third of the total reduction in expected fatalities. About 45% reduction of vulnerable road user fatalities has been observed in Britain between 1980 and 2000, but about one third has been due to less walking, cycling, and motorcycling activity, leaving 29% effect from general engineering and other measures for vulnerable road users.
- There would appear to be a lot more scope to improve the safety of vulnerable road users in Britain. However, the result of this is likely mainly to be seen as an improvement in amount and quality of walking and cycling, rather than a further reduction in fatalities. Measures that reduce the traffic flow level and speed in built-up areas, which is part of the Dutch sustainable safety policy and the Swedish vision zero policy, could contribute to reducing British pedestrian fatalities.
- The Dutch sustainable safety policy also aims to redirect traffic from risky to safe roads by improving motorway capacity and by infrastructure changes and speed limit reductions on other roads that makes them less attractive to car drivers. Road traffic between 1980 and 2000 grew 156% on motorways and 45% on other roads (ratio 3.47) in the Netherlands, while in Britain that growth has been 180% on motorways and 70% on other roads (ratio 2.57). Today the Dutch motorways account for more than 40% of total vehicle kilometre, compared with 20% in Britain and almost 14% in Sweden. Clearly a larger traffic share on motorways which have 4 to 5 times lower fatality risks than other roads improves road safety. Sweden has such low traffic flows that measures to direct future traffic growth onto higher quality roads are not so important, but flows on British roads are high, and higher than in the Netherlands.
- But in addition to its motorway system, Britain has an extensive network of 2-lane dual carriageways. These are of varying quality. Improvements to the junction design and access restrictions on these roads to bring them nearer to motorway standard could result in a network of similar quality to the Dutch network.
- The targets and safety strategies in all three countries are well developed, although there are some differences in detail (e.g. allowance for traffic changes, intensity of enforcement, costing programmes, monitoring progress) that might be transferred between the countries. The targets are relatively similar; on the most recent trends, Sweden might have most difficulty reaching their target. In all three countries, new initiatives will be needed to achieve their targets. In the Netherlands and Sweden changes in infrastructure are planned to achieve this. In Britain, the focus is more on achieving better speed behaviour within the existing network, but this comparative study suggests that an improved high quality road network could also contribute both directly to fatality reductions, and to the acceptance of speed management on the lower quality roads.

9. Conclusions and recommendations

9.1. Conclusions

9.1.1. Road safety strategies and traffic backgrounds

- The SUN countries, Sweden, the United Kingdom and the Netherlands, are the countries with the highest road safety level in the world, as shown in Table 9.1, where the fatality rates per billion motor vehicle kilometres and per 100,000 inhabitants for 2000 are given for the SUN countries, the EU (all 15 countries together), the USA, Australia, and Japan.

Fatality rate 2000	Per billion vehicle kilometres	Per 100,000 inhabitants
Sweden	8.4	6.7
Great Britain	7.3	5.9
Netherlands	8.5	6.8
EU all 15 countries	13.6	11.0
USA	9.5	15.2
Australia	10.1	9.5
Japan	13.4	8.2

Table 9.1. *Fatality rates for SUN- and EU-countries, USA, Australia, and Japan (source OECD-IRTAD database and estimates for the EU from ETSC, to be published)*

- The rank order differences between risks per population and per vehicle kilometres are due to differences in numbers of motor vehicle kilometres per inhabitant, which are highest in the USA (16,000 kilometre) and lowest in Japan (6,100 kilometre), while the EU-value is in between (8,100 kilometre).
- The EU target, 50% reduction of road traffic fatalities in 2010 compared to 2000, means that the fatality rates have to be halved to 6.8 (per billion vehicle kilometres) or to 5.5 (per 100,000 inhabitants), which is just below the level of the SUN countries in 2000. Thus, it seems that an EU-wide application of the road safety measures taken in the SUN countries might almost achieve the EU-target for 2010.
 - Sweden and the Netherlands based their recent road safety policy on an explicit vision that aims to prevent in the long run virtually all serious outcomes of road accidents by reshaping their road transport system to an inherently safe system. The recent road safety plan of Great Britain aims to reduce the fatality and injury risks of all road users, with actions directed particularly towards high-risk road user groups. However, the actual strategies and measures for the improvement of road safety have been, and still are, quite similar in the SUN countries.
 - Each of the three SUN countries:
 - has adopted quantitative targets for the reduction of road traffic fatalities and injuries within a defined future period,
 - has integrated the road safety plan in the road transport plan,
 - has decentralised responsibilities for the national road safety plan to regional and local authorities under some central financial support, and
 - regards road traffic death and serious injury as to a large extent avoidable by road safety measures that have affordable costs and are professionally known to be effective.

These similar strategy characteristics, however, also distinguish the SUN countries from most other European countries. However, a few other European countries have adopted a similar approach recently .

- Although the total fatality risks and age distributions are little different in the SUN countries, it also became evident from the study that the relative safety levels of specific road user groups in the SUN countries differ markedly. These road user group differences depend strongly on the national differences between their traffic backgrounds with respect to traffic shares of road types in the road network, traffic densities on road types, and exposures of several road user modes. It is concluded from the SUN-project that:
 1. The traffic density on all road types and the traffic share of motorways in the SUN countries are both lowest in Sweden. Car speeds tend to be higher on roads with a low traffic density and motorways are the safest roads. Thus it would be expected that the car occupant risk in Sweden is higher than in the other two countries, which also is actually shown to be the case. Moreover, the speed enforcement levels are lower and actual speeds higher in Sweden than in the other SUN countries.
 2. The traffic density on all road types and the proportion of junctions with roundabouts are both highest in Britain. Car speeds are lower also related to the higher traffic densities speeds and are lower on roundabouts than on other 3- or 4-arm junctions, while the risk to pedestrians is higher due to the busier the roads they cross. Thus it would be expected that in Britain the car occupant risk is lower and the pedestrian risk higher than in the other two countries, which also is verified by the study of the SUNflower project. The penetration level of 30 km/h (20 m/h) areas in Britain is lower than in Sweden and much lower than in the Netherlands.
 3. The motorway share in the vehicle kilometres is the largest in the Netherlands, while the motorway is by far the safest road type. Thus it would be expected that the fatality risk per motor vehicle kilometrage is the lowest in the Netherlands. This is shown not to be the case, due to the higher risks on urban and rural non-motorway roads in the Netherlands than in the other two countries.
 4. The population density and the share of mopeds and cyclists in the total travel kilometres are by far the largest in the Netherlands. Thus the travel exposure of pedestrians, cyclists, and moped riders is relatively larger in the Netherlands than in Britain and Sweden. The Dutch mopedists have a much higher risk per moped kilometre than the other two countries, which has not been explained yet. But the Dutch pedestrians and cyclists have the lowest risk per amount of walking or cycle kilometres. This is probably due to the additional safety measures for pedestrians and cyclists (huge increases in 30 km/h areas and widespread separate cycle lanes). Nonetheless, the risks to pedestrians per walked kilometre and cyclists per cycle kilometre are still higher than for car occupants per vehicle kilometre, even when the risk of cars includes the car risk for other road users than car occupants. These higher risks and higher exposure of pedestrians, cyclists, and mopedists as well as the lower Dutch seat belt use than in Britain and Sweden, explain the higher Dutch fatality risks on urban and rural non-motorway roads than in the other two countries.
- An EU-policy on road safety and an EU-wide implementation of national road safety strategies that combine the most effective road safety strategies of the SUN countries might contribute to the achievement of the very ambitious EU-target on reducing road traffic fatalities by 50% in 2010 compared to 2000. However, the

actual selection of road safety measures and priorities in the road safety strategy of other EU-countries than the SUN countries also needs to take account of specific risks that are created by their national traffic patterns and the way these differ from the SUN countries.

9.1.2. The research methodology and design used

Usefulness of the research methodology

- The research methodology used has proven to be valuable for the comparison of the road safety levels in the SUN countries and probably also will be useful for safety comparisons of other countries.
- The comparisons of fatalities by the matrix of collision partner and the comparisons of fatality risks per vehicle kilometre and travel kilometre for each road user mode (see chapter 3) has been useful for the analyses of underlying risk differences between the countries.
- The difference of comparable road types in traffic share, traffic flow densities, and relative length per area, per inhabitant, and per motor vehicle (see chapter 2) have been important for understanding underlying risk differences.
- The more detailed analyses in the case studies on drinking and driving, belt and child restraint use, built-up and minor rural roads, and inter-urban roads (see chapters 3 to 7) have contributed to the understanding of risk differences, and the effectiveness of road safety measures.
- The disaggregation of the fatality savings with respect to the expected total of exposure-corrected fatalities between 1980 and 2000 into savings per type of measures (see chapter 8) has been important for an estimation of further achievable savings and for the evaluation of the targeted road safety plans in the SUN countries.

The limitations of the research design used

- The research has contributed to the explanation of the risk differences revealed between the SUN countries, but some risk differences are still not well understood and need further research.
- The higher pedestrian risk in Britain is partially explained by the higher urban traffic density and lower penetration of 30 km/h (20 mph) areas in Britain, but a further extension of the SUNflower project for a comparative case study on pedestrian safety differences is needed for a full understanding of the pedestrian risk differences in the SUN countries.
- A safety comparison of comparable rural regions and comparable cities in the SUN countries has not been part of the SUNflower project so far. It is felt with hindsight, however, that such a comparison could have contributed to better, more reliable, and more conclusions on the understanding of risk differences. An extension of the SUNflower project for the safety comparison of comparable rural regions and comparable cities seems needed, also for the better understanding of the pedestrian risk differences.
- The higher risk of motorcyclists in Britain and the higher risk of mopedists in the Netherlands remained both unexplained and need an extension of the SUNflower project for a detailed risk comparison of motorised two-wheelers in the SUN countries.
- The safety measures for novice drivers and the risk differences for the young and inexperienced drivers have not been researched in detail. In order to estimate more reliably the effectiveness of the different measures for novice drivers in the SUN countries (so far estimated to be relatively small) these topics need more detailed research in an extension of SUNflower project.

- The differences in speed limits and actual mean speeds on comparable road types have so far been only partially covered in the SUNflower project, and the data gathered so far did not allow a comparison of speed enforcement effects. A full understanding of these matters requires an extension of the SUNflower project directed to a detailed analysis of speed behaviour in the SUN countries;
- The SUNflower study has not covered in detail the institutional, organisational and management arrangements in the SUN-societies, nor the influences of cultural differences in perception and attitudes towards road safety (the bottom-layer in the pyramid from chapter 1.2). However, some topics (drinking and driving, motorised two-wheeler risks, and speed behaviour) have indicated that such safety culture differences may be important. The influence of safety culture differences also should be researched further in an extension of the SUNflower project, because the acceptance of effective road safety strategies can be expected to depend on the national safety culture of the country.
- The SUNflower-study did not pay specific attention to the problems related to funding of road safety policies and to rational decision making, using information on expected effects and costs, to support policies. This very important topic requires focussed attention in the proposed extension of this study.

9.2. Recommendations

9.2.1. Recommendations for further road safety improvements in the SUN countries

Sweden

1. The SUNflower project has shown a lot of similarities between Sweden on one side and the UK and the Netherlands on the other side. Sweden had its main “traffic safety improvement” period in the seventies, after the change from left hand traffic to right hand traffic in 1967. During that period the inhabitants were re-educated and the infrastructure was reconstructed, which led to a high traffic safety level in those years compared to other industrial countries. On the traffic safety research field, the tradition is somewhat older in the UK and Sweden than in the Netherlands.

2. The main difference between Sweden and the other two countries are the low traffic volumes on roads in Sweden. This is to some extent depending on the climate during the winter period, the low density of the population, and the long distances between urban areas. This has resulted in a higher standard of roads, in relation to the amount of traffic, than in the other two countries. This is both good and bad for safety as it means lower number of accidents but increased severity as speeds are higher on the higher standard roads. In spite of lower speed limits the actual speed is higher than in the other countries. As the road network is extensive and the traffic density is low, enforcement by the police will be costly and thereby have little impact on individual drivers.

3. The low fatality rate of three countries does not mean that this is valid for all road user groups. The car drivers (and of course the cars) in Sweden have a higher fatality rate than the car drivers in the other countries. That means that it is per kilometre more dangerous to drive a car in Sweden than in the UK and the Netherlands. Higher road standard, lower traffic level and higher speeds result in more severe accidents. The fatality rate for vulnerable road users is not different from the other countries, except for moped riders in the Netherlands and motorcyclists in the UK.

4. As the use of cars is higher in Sweden and the fatality rate of car drivers is lower than for vulnerable road users, the total fatality rate is on the same level as the two other

countries. The high use of cars is a result of the long distances between urban areas, the low density population and the winter climate. Traffic safety efforts in Sweden ought to be strengthened and concentrated on car drivers and their speed behaviour.

5. Sweden has in relation to the other two countries a limited alcohol problem. It is a long tradition in Swedish society to be against improper alcohol use, especially in traffic. Existing restrictions concerning the accessibility of alcohol are now less severe and the same seems to be valid concerning the sanctions.

6. Seat belt use is a field where neither the car manufactures nor the police have taken full responsibility during the last years in Sweden. The law has, however, gradually changed to include all road users in motor vehicles and sanctions will be increased after having been unchanged since 1975.

7. The Parliament of Sweden has introduced the "Vision Zero", aiming at no fatalities or severely injured casualties from road traffic accidents. The strategy in the traffic safety work, however, mainly corresponds to the strategies in the other two countries, especially to the Dutch Strategy, even if there are some differences.

8. The missing items in the study are to some extent a result of difficulties in comparing the three countries. The study has raised a lot of questions, which put demand not only on the presentation of the accident statistics but also on common exposure data. As the investigation problems are of a multi-dimensional character some efforts are needed to obtain the corresponding data from the three countries. Among the questions raised is the safety effect of car development and how the transportation systems in urban areas influence the transportation safety. Speed management, including police enforcement, has not been fully compared. Missing parts are the annual variation of fatalities to judge "the winter problem in Sweden" and an analysis of the different "practice" of the police accident reporting procedure in the three countries.

9. Motorway management in the three countries is also an item which is an interesting research field and will show the differences in the road planning procedures between urban, semi-urban and rural areas, number of lanes, the separation of vulnerable road users, capacity problems in time and space, fog warning systems to avoid serious multi-rear-end accidents etc.

Great Britain

1. The process of setting national casualty targets in Britain utilised a process similar to that used in the SUNflower report. Obtaining parallel data from two other countries with similarly good overall safety records provides additional insight into those areas where some indicators differ. It is important to understand how much of the differences relate to basic road network and cultural differences, and then consider both whether some of these factors can be changed, particularly in those areas where the other countries have achieved more successful safety outcomes.

2. One interesting difference that may have shaped different views in the three countries to date, is that during the last 20 years of tracking progress against targets, Britain has maintained a steady and regular downward trend in fatal and serious casualties. Both the other two countries have had periods of several years during these two decades when numbers of fatalities have remained constant. This perhaps makes them consider it more necessary to look for major steps forward in rethinking safety policy. In this context, it is interesting that a recent trend has been identified in Britain for much slower reduction in fatality numbers than in previous years.

3. It is clear from the comparisons that an important factor in achieving low fatality rate per vehicle kilometre in Britain is the higher traffic level; this leads to both lower speeds and also to risks being distributed among more road users. This tends to hide the fact that in several respects Britain is performing less well than the best in Europe. Several road user groups, particularly pedestrians, have higher risks per distance travelled than in the other two countries.

4. Although British front seat belt wearing rates are relatively high, there is still scope to save casualties among both front and rear non-seat belt wearers. The increased fatality risk from not wearing seat belts is similar to that from driving and driving or from travelling at 20% above average speeds. In this context, both fines and level of enforcement are low for this offence. Sweden has just increased its level of fine, and Britain could consider a similar increase; all three countries could gain from higher levels of enforcement.

5. The percentage of fatalities from drinking and driving in Britain is higher than in the other two countries, both of which have higher levels of enforcement and lower alcohol limits. The higher penalties in Britain for those who are prosecuted compensate to some extent, but it is likely that a better overall outcome would be achieved if there was a lower limit, more tightly enforced with some relaxation of penalties for lower offence levels. There is still an important need to target high risk offenders, but a more structured penalty system going down to lower levels of offence would be better tailored to the overall problem.

6. Although fatality rates on British urban roads are low, the roads are not so well engineered to cope with cyclists and pedestrians as roads in the Netherlands. A higher proportion of fatalities in Britain occur on these lower speed roads than in the other two countries. Britain can gain further substantial reduction in casualties by extending 30 km/h-zones to a greater proportion of residential roads. Although an increase is targeted, it is a long way short of the 50% of residential urban street in the Netherlands. High traffic flows may make this target difficult to achieve in Britain, but the Netherlands have also been extremely effective in treating more major urban roads, to reduce both cyclist and pedestrian casualties. Britain needs to find engineering solutions and speed and traffic management policies that will enable pedestrians and vehicle traffic to co-exist at lower casualty levels on these streets.

7. Britain has a much lower proportion of roads designated as motorways than the other two countries. However, it also has a large network of dual carriageways that, at their best, are almost as safe as the motorways in the other countries. But the quality of this dual carriageway network varies considerably. Britain needs to give much greater emphasis to developing a high quality network of a relative density similar to the other two countries. Much of this could be achieved through improving junctions and restricting access on the existing dual carriageway network. Flows are also relatively high on British single carriageway roads, which form the next tier in the network. Better application and enforcement of speed management on these roads would provide a clearer separation from the high speed network. At present relatively safe conditions are maintained on much of this network, compared with other countries, despite the poorer quality of the road alignments and the extensive interaction with roadside development, because the quality of network and the high traffic flows inhibit high speeds for most of the time.

8. Problems where further comparison between the three countries might be instructive for Britain include pedestrian safety, safety of two wheelers, speed management, novice

drivers, traffic policing and enforcement, and the extent of illegal driving (eg without a licence).

The Netherlands

1. The methodological approach, as used in the SUNflower-report cannot be fully applied in the Netherlands due to a low profile of an integral monitoring instrument (all layers in the so-called road safety target hierarchy) and consequently a lack of relevant data. It is recommended to build a model to describe and explain the past trends and based on that to learn for future policies. For the Netherlands, periods can be detected with a different speed of fatality rate reduction (minimum of about 4% per year, a maximum of more than 9% per year). It is recommended to research the explanations for these differences.

2. With a combination of road safety targets and targeted road safety programmes, Dutch road safety policies is of high quality. Improvements can be made in two directions. First to answer the question which fatality rate reduction will be observed with 'business as usual'. And secondly making better estimations of the safety effects, the costs and the financing of road safety programmes.

3. The comparisons with Sweden and the UK make clear that for one transport mode further activities for improvements should be implemented: the moped. The fatality rate for this category is twice as high in the Netherlands than in Sweden and the UK. A more detailed analysis should be made to understand this difference as a basis for further actions.

4. Drinking and driving remains an important road safety problem in the Netherlands and the last years no substantial further improvement is observed in this field. Although higher enforcement levels are expected to be effective, drinking and driving seems to be a problem to be tackled broader. A more detailed analysis of policies and measures from Sweden and the UK is needed before lessons could be learned from these countries. The effects of more severe sanctions (including a disqualification of driving) should be included in this analysis.

5. Seat belt wearing rates in the Netherlands are significantly lower than in Sweden and the UK. Both these countries accomplished higher wearing rates in a very short period of time related to the introduction of seat belt legislation. This was not very successful in the Netherlands. This leads to the conclusion that the Netherlands has to develop its own strategy to increase wearing rates. But a combination of a mass-media campaign and higher police enforcement activities, organized as a blitz-campaign, should result in wearing rates of 95% or higher in only a few months time. If the experiences from Sweden and the UK are applicable in the Netherlands as well, not a lot of effort is needed to attain such a high level. Special attention should be given to wearing of seat belts in the back seats. Fines for not wearing seat belts are relatively low in the Netherlands and higher fines should be considered.

6. The Netherlands made quite good progress in making urban roads and streets safer. Especially the large scale introduction of 30 km/h-zones and the construction of bicycle facilities is impressive. However, fatality rates on urban streets are still much higher than in the other two countries. It is recommended that the reasons for this should be studied.

7. Due to the high population density, the density per square kilometer of roads and motorways in the Netherlands is relatively high. The expansion of the motorway network in the Netherlands resulted for example in a relatively high proportion of kilometres

travelled on motorways and a relatively large reduction of the fatality rate. However, it is not very clear what to recommend from this for future developments. From another perspective - the development of a sustainable safe road transport system - these future developments are very clear and the SUNflower comparisons did not result in new options to explore. It is recommended to continue with the implementation of a (sustainable) safe network approach and taking into account the already planned increase of roundabouts, safety improvements of road sides and safer cross-section design of rural roads, etc).

8. Several important items have not been dealt with so far in the SUNflower-study and from a Dutch perspective it is worthwhile to include them in a follow-up. The most important ones are: young and inexperienced drivers and speed management. Furthermore it is interesting to compare several intervention types in the SUN countries: police enforcement, education/training and publicity campaigns. Creating a higher public awareness of the problem of road crashes and creating a higher public acceptance of road safety measures is only mentioned in this report but not really elaborated. Also the mechanisms to 'deliver' high quality road safety programmes needs further study.

9.2.2. Recommendations for the road safety strategies of the EU and member states

- The Commission of the European Union is planning to set an EU target of 50% road traffic fatality reduction in 2010 compared to 2000. This target has to be considered as a very ambitious one. The total fatality saving of the targets of the SUN countries for 2010 is 34% compared to 2000, while the total fatality reduction of other EU member states derived from trend extrapolations of risk decline and traffic growth is less than 40% in that period. Therefore, the Commission of the EU should find suitable ways to ensure that the application of effective road safety measures is intensified in EU member states.
- The 50% fatality reduction of the EU-target has to come mainly from national road safety measures in addition to vehicle safety measures in the EU. Additionally, a rapid EU-wide large-scale implementation of infrastructural road safety improvements, speed management measures, and intensified enforcement on speeding, drinking and driving, and belt and child restraint use could certainly contribute in achieving the EU-target. The potential fatality reduction in 2010 compared to 2000 from all these measures together could be higher than is planned in the SUN countries, if more is invested in these measures. This is most probably also the case for other EU member states. Decisions on these measures mainly or exclusively concern the competence of the individual member states, while the EU is required by treaty to support transport safety subject to the principle that its actions deliver added value to member states actions. It is recommended that the Commission of the European Union consider creating a fund for road safety subsidies assigned conditionally to enlarged national investments in road safety measures. Such conditional road safety investment subsidies of the EU are actions that can deliver the required added value to national actions.
- The contribution to the total saving of fatalities and serious injuries from vehicle secondary safety has been about 1% per year between 1980 and 2000 in the SUN countries, but is expected to diminish in the coming years unless more vehicle safety improvements become implemented. Motor vehicle requirements concern the exclusive competence of the commission of the EU, and an increased future contribution from vehicle safety is an important requirement for the achievement of

the EU road safety target. Therefore, we recommend that Commission of the European Union gives an enhanced priority to directives on further improvements of vehicle safety. Directives on car front impact reductions for vulnerable road users, on side impact reduction, on improved compatibility between cars, vans, lorries, and trucks, on enhanced vehicle conspicuity such as automatic daytime running lights, reflective contour marking of trucks, etc., and in-vehicle systems for driver assistance or control such as speed limit adapters, collision prevention devices, etc. can ensure that the necessary larger fatality saving from further improved vehicle safety will be achieved. Greater enforcement of seat belt use may not ensure their full use by all car occupants, because sometimes car occupants just forget to use them. Higher seat belt use can be achieved when all cars have an automatic seat belt warning device (audible seat belt warning devices which detect when a belt is not used and then give out increasingly loud warning signals until the belt is used). Installation of seat belt warning devices would contribute considerably to the achievement of the EU-target. Therefore, we recommend that the Commission of the EU brings forward as soon as possible a directive on automatic seat belt warning devices in new cars. Effective national enforcement of drinking and driving requires a legal BAC-limit of 0.05% (in Sweden and most probably for novice drivers in the Netherlands it is 0.02%). That maximum limit is not applied in all countries of the EU, although intensified enforcement together with the 0.05% BAC-limit has the potential to save substantially more fatalities in EU-countries which currently have a higher limit and/or lack of intensive enforcement on drinking and driving. Therefore, we recommend that the commission of the EU looks for ways to install the 0.05% BAC as maximum limit for drinking and driving in all countries of the EU (Britain has recently rejected a proposal for lowering their limit).

- The results from the SUNflower study (see 9.2.1) and from similar research projects on the road safety comparison of countries are expected to be of great importance for the improvement of national road safety strategies in other countries and for the measures that can most effectively reduce their road traffic deaths and injuries. The most effective road safety strategies and measures available are urgently needed in the countries of the EU in order to realise the very ambitious EU target of 50% road traffic fatality reduction in 2010 compared to 2000. Therefore, we recommend that the Commission of the EU organise and support financially similar research projects on the road safety comparison between the SUN countries and other EU-countries. We recommend that these research projects should follow the proven analysis methods used in the SUNflower study. We recommend that these studies are carried by a consortium of research institutes that includes at least one partner from the other EU country being compared, and one of the partners involved in the SUN-project in order to optimise the transfer of the methodological knowledge.
- Large under-reporting percentages and large differences in reporting of accidents and serious and slight injuries are not only present in SUN countries, but in other EU-countries as well. Some under-reporting of fatalities is shown to be also present. The often unknown levels of under-reporting and their differences as well as the absence of exposure data or definition differences in available national exposure data may make it difficult to compare the road safety risks of SUN countries with other EU member states and to evaluate the effects of their road safety measures. Therefore, we recommend that the EU promotes comparative road safety research to investigate and understand the differences in definitions and reporting practices of road traffic accidents, injuries and fatalities.

9.2.3. Recommendation for further research on the risk differences between SUN countries

- The marked risk differences between pedestrians, mopedists, and motorcyclists are not fully explained by the research undertaken so far. Therefore, it is proposed that the SUNflower project is extended by a second phase for more detailed risk analyses of these road user groups in the SUN countries.
- The data gathered in the SUNflower project has not been detailed enough to determine in a reliable way the speed differences on all comparable road types, the factors that cause speed differences, and the safety differences that are to be attributed to speed differences. Therefore, the proposed second phase of the SUNflower project should also include a more detailed analysis of these matters.
- The research so far has also not investigated in detail the risk differences between novice car drivers, although the national procedures for getting access to car driving are quite different in the SUN countries. Measures that ensure that access to driving is achieved safely, although probably not contributing a substantial percentage of total fatality saving (novice drivers only form about 6% of the road user population), are socially and economically important. They affect the safety of young adults who are educated mostly at public costs and who are expected to contribute with about 40 years of work to the welfare of their country. Therefore, the proposed second phase of the SUNflower project should also include the risks and measures for novice drivers.
- The SUNflower project compared the road traffic risks in each of the three countries, but the comparability of countries as whole nations turned out to be difficult due to large road transport-related background differences. There would have been more valid evidence for the conclusions and recommendations as well as possibly additional conclusions and recommendations if the risk differences between comparable regions and comparable cities within the countries had also been studied. Therefore, the proposed second phase of the SUNflower project should include the investigation of possible risk differences between such comparable regions and cities.
- The SUNflower project did not include the investigation of possible cultural differences that may relate to road safety differences. However, it is likely that the public acceptance of measures to improve behaviour (with respect to speeding, drinking and driving, motorised two-wheelers, and novice car drivers) may be highly dependent on national perceptions, attitudes, and beliefs with respect to safety in general, and road safety measures in particular. Therefore, it is proposed to have a second phase of the SUNflower study that also includes the comparison of the potentially relevant culture differences.

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Appendix A: Closing address of SUNflower congress

April 17 2002, Amsterdam by Professor Richard E. Allsop on behalf of the European Transport Safety Council

A.1 Some ways of following up the SUNflower project

The SUNflower project has compared road safety policies, programmes and performance in Sweden, The United Kingdom and The Netherlands in order to develop new policy concepts, provide a methodology for use in other comparative studies, and provide outcomes of potential value to the European Union, other Member States and the Accession Countries. Some possible ways of following up the project are discussed in terms of the European context, identifying several lines of action at the level of the European Union itself, and in the social and political context. The need to create a new sense of urgency among opinion formers and decision makers is advocated in relation to the disproportionate level of death and serious injury in using the roads, the scandal of tolerance of this level, and the giving away of lives that stems from delay and failure in implementing known and affordable safety measures. In addition to further research into engineering and behavioural measures and their cost-effectiveness and transferability between countries, new lines of research into the reasons for tolerance of death and injury on the roads and the obstacles to acceptance and implementation of safety measures are called for.

A.2 Introduction

It should be taken for granted that the three countries participating in the SUNflower project, Sweden, the United Kingdom and The Netherlands, will each be looking at what they in particular can learn from this sharing of knowledge and experience with the other two countries, and the author certainly looks forward to taking part in this process in Britain and hopes that the results can be successfully communicated to opinion-formers and to Ministers. The author has, however, been invited to make this contribution as a representative of the European Transport Safety Council (ETSC)* – though the views expressed here are his own and not necessarily in every respect those of the ETSC – and therefore begins by setting out the wider European context of the study and its findings. The contribution goes on also to discuss the wider social and political context for the current toleration of disproportionate levels of death and injury on the roads of Europe, and its implications for following up the SUNflower project.

A.3 The European context

The ETSC takes it as axiomatic that safety should receive at least equal consideration with environment and access or mobility in transport policy. The European Union (EU) is required by treaty to promote transport safety subject to the principle of subsidiarity, that is wherever its actions can deliver added value compared with action at national or more local levels, and to deliver a high level of protection in the harmonisation process to which the Member States of the EU are committed. It is good that the 2001 White Paper on transport policy of the Commission of the European Communities (CEC, 2001)

* ETSC is an international non-governmental organisation dedicated to reducing the number of transport-related deaths and injuries in Europe by providing an impartial source of advice on identifying and promoting effective transport safety measures with due consideration for cost, practicality and public acceptability. The author is grateful to Jeanne Breen, Executive Director of the ETSC, for this opportunity to contribute to the SUNflower Congress.

identifies road safety as one of 13 key policy areas and sets a challenging aspirational target to halve the annual number of deaths on the roads of the existing EU between 2000 and 2010. But the actions at the EU level envisaged in the White Paper are minimal in relation to the target. It is thus left to the Member States and their regional and local authorities to rise to the challenge of the target by mobilising the whole range of involved professions in

- reducing the risk of accidents,
- reducing the severity of injury when accidents occur, and
- reducing the long-term consequences of injury to those who incur it.

It is of course still to be hoped that the EU's proposed Third Road Safety Action plan for the years 2002-2010 will fill some of the gaps left by the White Paper. The Directorate-General for Transport and Energy's consultation paper (DG-TERRN, 2001) concerning this action plan identified 8 key problem areas, which are endorsed by the ETSC and are broadly consistent with the outcome of the SUNflower project, namely:

- excess and inappropriate speed
- impairment by alcohol, other drugs and fatigue
- failure to use seat belts and helmets
- failure to treat high-risk sites, routes and areas
- high accident-involvement of novice drivers
- high risk to pedestrians and users of 2-wheeled vehicles
- insufficient protection afforded by vehicles and roadsides
- lack of conspicuity.

Before considering the contribution of Member States, it is useful to recall three ways in which the EU and the CEC can themselves contribute, as mentioned by Dimitrios Theologitis in his opening of the SUNflower Congress:

1. *Legislation in its areas of competence* – the transparent way to regulate across the EU evenhandedly and subject to Parliamentary scrutiny and Ministerial approval.
2. *Research and information* including projects like SUNflower and databases like CARE (CEC, 1997) – to which researchers and interested members of the public look forward to more open access than is yet available for the taxpayers who have funded it.
3. *Provision of good practice guidelines* – welcomed by many road safety professionals as a potentially powerful aid to the transfer of experience and expertise among Member States and between them and the Accession Countries.
4. To these ways of contributing can be added
5. *Exchange of personnel* between local road safety administrations with high casualty levels that are ready to adopt new approaches to casualty reduction and counterpart administrations in other Member States where lower casualty levels have already been achieved.
6. *Use of financial instruments* to create incentives to adopt good safety practices and create elements of a market in safety measures – perhaps learning from experience in the USA.
7. *Sustained advocacy of the 1M€ criterion* correctly interpreted, not as an estimate of the social benefit of prevention of one death and a proportionate amount of injury and damage (which it underestimates by a factor of 3 or 4 at valuations currently accepted in the SUN countries (ETSC, 1997)) but as a threshold for actual spending on implementation of safety measures to yield benefit/cost ratios of at least 3 or 4 – a similar threshold to that which applies to major road construction expenditure in Britain (DETR, 1998).

To reach the EU target in terms of deaths means bringing the existing EU average for deaths/million person-years (about 110 in 2000) down to about 55 by 2010, that is to about 10 per cent below the year 2000 level in the SUN countries. This in turn involves

the SUN countries reducing their rate to about 30 deaths/million person-years, and will involve counterpart reductions in the Accession Countries if the target is extended to embrace them as they join the EU. This need not be impossible, but it calls for a formidable communication of sense of urgency to opinion-formers and political leaders, which is also almost certainly a precondition for effective transfer of experience from the SUN countries to their neighbours in central and southern Europe and to the Accession Countries, and indeed for accelerated further progress in the SUN countries themselves. Herein lies the relevance of the social and political context

A.4 The social and political context

Much current death and injury on the roads is known to be avoidable at affordable cost and with only modest moderation of individual behaviour. Appropriate investment in casualty reduction is known to yield returns that are very high by both commercial and public sector standards. This has been said loudly and clearly for some time, but with only limited penetration of the thinking of opinion formers and decision makers. What more can be done to bring this message home in ways that will create a new sense of urgency and readiness to press for and accept road safety policies and measures among opinion formers, and through them in the media and the minds of the public and of Ministers of Justice as well as Transport Ministers?

- 1 Recognise the *disproportionate* level of death and serious injury in using the roads compared with other everyday activities in which large proportions of the population engage for appreciable proportions of their time. It is not the job of government to remove all risk from everyday life – and to try to do so would be to stifle life itself – but even in Britain as a SUN-country, risk of death per hour while using the roads is *at least 7 times* the risk in the rest of everyday life, so it does call for special attention.
- 2 Recognise the *scandal of tolerance* of current levels of death and injury. The main ways in which we can harm ourselves and each other in our everyday lives as individuals (that is aside from organised crime or commercial or political exploitation) in Europe today are the following.
 - *Misuse of guns* – which is scarcely tolerated at all in Europe
 - *Behaviour that spreads disease* – which evokes very low levels of tolerance and a strong demand for countermeasures
 - *Crime against the person and against property* – which evokes low levels of tolerance and high demand for countermeasures among better-off people, but may be more widely tolerated by some of the less well-off
 - *Misuse of substances* – for which there is a wide range of levels of tolerance and attitudes to countermeasures, in which there have been substantial changes in either direction within a generation (for example in relation to alcohol, tobacco and cannabis)
 - *Misuse of motor vehicles* – for which there is widespread tolerance and only selective demand or support for countermeasures

Only the misuse of substances affects life and health on a comparable scale to misuse of motor vehicles, and it is almost certainly easier to reduce these effects in the case of motor vehicles, if only the level of tolerance can be reduced.
- 3 Recognise that *giving away lives* and condemning badly injured survivors to lifelong disability is the direct consequence of delay or failure in implementing known and affordable casualty-reducing measures. It is inconceivable for a health minister to announce that an inexpensive new treatment that would save 50 lives per year among mid-life cancer patients had been found, but that it would not be made available through the national healthcare system. It is inconceivable for the directors of a pharmaceutical company to be told how to reduce by 20 per cent certain very occasional fatal side-effects of a widely used and beneficial company product at an increase in price that is within the noise of year-on-year inflation and then decide not

to improve the product in this way. Yet one road safety minister has recently done the equivalent of the first, and car manufacturers have been doing the equivalent of the second for a decade. Conditions need to be created in which decisions like these would be reported in the media for what they are – *giving away people's lives* – so that Ministers and firms would come under fire for failure to implement measures, instead of coming under fire for implementing them, as is often the case at present.

4 Implications for following up the SUNflower project

In terms of further research it should go without saying that the results of the SUNflower project should inform and help to guide further research into engineering and behavioural safety measures and their cost-effectiveness and transferability between countries. But in addition, the social and political context seems to indicate the need to research

- the underlying reasons for tolerance of current levels of death and injury in road transport, and
- the obstacles to acceptance and implementation of demonstrably cost-effective safety measures and to the transfer of experience between countries, and ways of overcoming these obstacles.

This may well mean bringing to bear research skills from hitherto uninvolved disciplines, which may, in the first instance, require relatively high-risk research investment. But the payoff could be to open up new routes to accelerated reduction in avoidable death and injury on the roads.

Appendix B: Some considerations on the effectiveness of road safety improvements in the future

The effectiveness of road safety measures in the SUN countries is discussed in chapter 8 and again summarised here in Table B.1, where percentages attributed to fatality savings between 1980 and 2000 from vehicle safety, seat belts, child restraints, and drinking and driving measures are specified separately. It is of interest to discuss several possibilities for further improvements in the SUN countries and to get some ideas about the potential for further casualty reduction. This appendix offers a first insight in this.

	Fatality saving % between 1980-2000 attributed to each source		
	Sweden	Britain	Netherlands
Vehicle safety, seat belts/child restraints and drinking and driving	48%	54%	46%
Other VRU-related measures	38%	29%	31%
Other car occupant measures	10%	7%	18%

Table B.1. *Percentage fatality saving attributed to measures in the SUN countries 1980-2000*

B.1 Vehicle safety

The vehicle safety contribution to the total saving of expected fatalities in 2000 compared to 1980 has been about 20% in the SUN countries, that is about 1% a year. Also in the future further improvements may be expected. Further improvements of vehicle secondary safety include a higher penetration of safer vehicles and expected future contributions from intelligent vehicle systems. For Britain also from improvements in the field of motorcycle helmets are expected. Although about 10% has been achieved per ten years in the past two decades, it is not very clear whether the speed of improvements can be continued in the future and what to expect from the introduction of ITS. We recommend scenario-research in this field, but an expectation of about 10% fatality reduction from vehicle safety between 2000 and 2010 seems realistic for each SUN-country.

B.2 Speed limits and speeds

The road safety contribution from speed management measures has not been quantified separately in this report, but general fatality reduction effects of lowered average speeds and reduced speed deviations from average speed are well known. Several research results are available on this. For example, from Swedish research it can be concluded that fatalities tend to change proportionally with the proportion change of average speed in a double quadratic way. For example, an average speed reduction by a factor .95 gives an expected reduction of fatalities by a factor $(0.95^2)^2 = 0.815$ or 5% reduction of average speed gives 18.5% reduction in expected fatalities. Changed upward deviations from average speed have a similar effect, but generally the standard deviation of free flow speeds is a fixed percentage of the average speed (e.g. about 10% of the average speed on motorways). Thus, it is sufficient to estimate the effect on fatalities from average speed changes only. Since differences in average speeds on comparable road types in the SUN countries are, to some extent, investigated (see

chapter 7), the differences in safety effects from average speed differences in the SUN countries can also, to some extent, be estimated.

It was shown (Table 7.4.) that the average speed on the inter-urban network (motorways and A-roads) is 98 km/h in Sweden, 85 km/h in Britain, and 91 km/h in the Netherlands, while car speeds on other main roads are probably differing in the same way proportionally. On the basis of the relationship between average speed and expected fatalities it can be estimated that the fatality rates per vehicle kilometre on inter-urban roads will be 57% lower in Britain and 25% lower in the Netherlands than in Sweden. In Britain about 20% of the vehicle kilometres is driven on motorways and in Sweden this is about 14%, but in the Netherlands it is about 40%. Risks on inter-urban and other main roads concern mainly car occupant risk, while their risk on motorways is by far the lowest. Thus the observed 34% lower British risk and 24% lower Dutch risk for car occupants than in Sweden are well explained by the speed differences on inter-urban and other main roads and the higher Dutch traffic share of safe motorways.

It also is well known that the collision outcome probabilities of a pedestrian or cyclist fatality increase exponentially with the impact speed of motor vehicles. For example a change in impact speed from 40km/h to 20 km/h reduces the probability of a fatal outcome for a pedestrian or cyclist from about .50 to about .05. Clearly lowering speeds on built-up roads (e.g. 30 km/h zones), enlargements of separate cycle lanes, traffic calming measures, and speed-reducing pedestrian crossing facilities, contribute highly to the reduction of pedestrian and cyclists fatalities. These contributions are speed management results from infrastructural measures that are more often applied in the Netherlands and Sweden than in Britain. It may explain the higher proportion of vulnerable road users saved in Sweden and the Netherlands than in Britain. However, Britain has recently decided that 30 m/h (48.6 km/h) should be the maximum speed in built-up areas, no longer allowing the 40 m/h (64.8 km/h) limit in villages.

Without indicating exactly which potential measures are to be taken, it is evident from these figures that further safety improvements may be expected from speed management. A particular problem to tackle is the fact that existing speed limits are not obeyed by many motorists. We consider speed management as an important item of future road safety policies in the SUN countries and recommend to include this item in a proposed follow-up of this study.

B.3 Police enforcement

The role of speed enforcement also has not been quantified separately, because this requires rather detailed information on enforcement levels, road user behaviour and fatalities. This needs to be further researched, but the safety effects of intensified speed enforcement could be derived if we accept a generalised relationship between intensity of police enforcement and level of traffic law violation, illustrated in figure B.1.. This relationship has been tentatively derived by Koornstra (1993) and is illustrated here by belt wearing and drunk driving data on enforcement and violation levels in the SUN countries, as discussed below (whether we do have one curve for all violations is not yet clear, but for this purpose we start from that assumption). This attempt should be considered as an approach to get more insight about which enforcement level is needed in order to change road user behaviour and fatality risks.

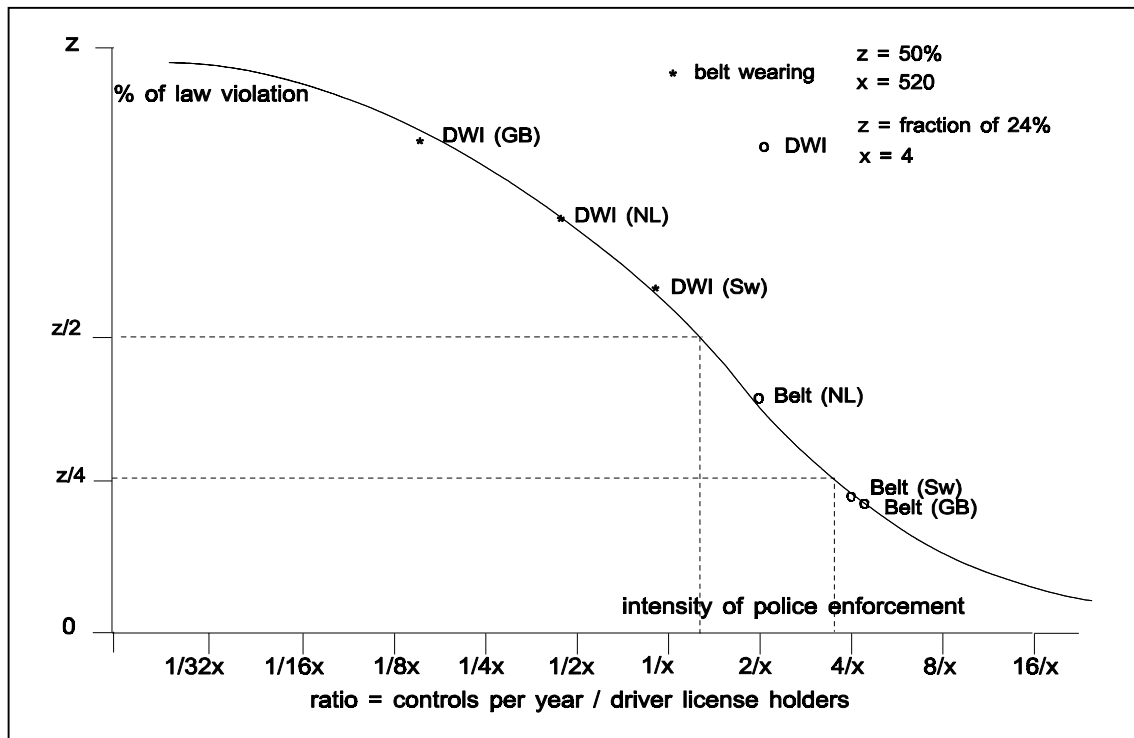


Figure B.1 Relationship between enforcement intensity and law violation levels

The violation level on belt use by drivers in the Netherlands is 20% and their control level is 27,000 driver fines in 2000 for about 7 million license holders, thus 1 in about 260. For Britain the belt law violation level by drivers is 9% and their annual control level is 200,000 fines for about 24 million vehicles in use (perhaps 32 million license holders), thus about 1 in 120. For Sweden, 10% drivers are unbelted and their annual control level is 30,000 fines for about 4 million license holders, thus about 1 in 130. This is consistent with the curve in Figure B.1. for about $x=520$ and $z=50\%$ as level of unbelted drivers for a belt law without controls, because the data then fit approximately that curve (Sweden: $10\% \rightarrow 1/130=4/x$, Britain: $9\% \rightarrow 1/120=4.3/x$, and the Netherlands: $20\% \rightarrow 1/260=2/x$), as shown by the plotted observations. This suggests that more than 95% belt use would be obtained if the level of control becomes higher than $8/x$ for $x = 520$ license holders per year. Thus, if the control level is higher than 1 in 65 drivers per year or rather higher than 1 in 3 not restraint car occupants annually then further fatality savings from increased belt and child restraint use to 95% seem still achievable, especially in the Netherlands, but also in Britain and somewhat in Sweden.

The limits for the drinking and driving laws are different. However, comparable drunk driving levels can be deduced from the percentages of fatalities of drivers above 0.1% BAC, because the drunk driving level will be a factor of the percentage of killed drivers above 0.1% BAC. In Sweden, 14% of the killed drivers have a BAC over 0.1%, while the annual control level of screening tests is 1 in 4 license holders. For Britain, 20% killed drivers are over 0.1% BAC and the annual screening level is 1 in 26.5 license holders. For the Netherlands, 17% killed drivers are over 0.1% BAC and the annual screening level is 1 in 8.7 license holders. This is consistent with Figure B.1. If about $x=4$ and z relating proportionally to about 24% killed drivers over 0.1% BAC if the BAC-limit law is not controlled (comparable to almost 40% fatalities in alcohol-related crashes), because the data for Sweden ($14\% \rightarrow 1/4=1/x$), Britain ($20\% \rightarrow 1/26.5=1/6.6x$), and the Netherlands ($17\% \rightarrow 1/8.7= 1/2.2x$) then fit approximately the curve of Figure B.1., as shown by the plotted observations. Since effective drinking and driving controls are

performed from early evening to very late night hours it means that approximately $x=9$ for drivers in these hours. Referring to the Netherlands where alcohol use by drivers over 0.05% BAC is measured to be 4.5% in these hours, probably the uncontrolled level becomes $z=12.5\%$ for drivers over 0.05% BAC in these hours.

This suggests that a reduction from 14% to 12% killed drivers over 0.1% BAC in Sweden would require that their DWI-enforcement level becomes intensified by a third from 1 in 4 to 1 in 3 drivers per year ($1.33/x$ for $x=4$) or to about 1 in $6\frac{3}{4}$ drivers during evenings and nights ($1.33/x$ for $x=9$). This would not only save 2% Swedish drivers over 0.1% BAC, but also other alcohol-related fatalities, whereby together at least to 3% of the Swedish fatalities would be saved. A 33% higher intensity of DWI-enforcement seems quite achievable in Sweden and then could save 3% fatalities in 2010 compared to 2000. A screening test intensity of 1 per 3 drivers annually would require an almost 9-fold intensified DWI-enforcement in Britain and an almost 3-fold intensified level in the Netherlands. For the Netherlands, it is rather difficult to intensify 3-fold the DWI-enforcement, but together with the corresponding reduction from 17% to 12% killed drivers over 0.1% BAC also other alcohol-related fatalities would be saved – amounting to at least 7.5% saving of the Dutch fatalities. For Britain the 9-fold intensified DWI-enforcement to 1 fine per 3 drivers annually seems rather unrealistic, unless random breath testing would become legally allowed and the British BAC-limit would be lowered to at least 0.05%. Nonetheless, if the British DWI-enforcement would be 9-fold intensified, then together with the corresponding reduction from 20% to 12% killed drivers over 0.1% BAC, also other alcohol-related fatalities would be saved, which would amount to at least 12% saving of the British fatalities.

Assuming that this general curve for enforcement effectiveness also applies to speed violations, while about half of the drivers tend to drive over the limit when speed enforcement is relatively low, it can be assumed that approximately $z=54\%$ for speed violations. In the Netherlands the level of speed violations was about 33% on main urban and inter-urban roads in 2000, while the level of speed control on these roads in 2000 was about 3 million speeding fines for 7 million license holders. For $z=54\%$ it is indicated by the curve in Figure B.1. that 33% coincides with about $1.2/x$, while $1.2/x=3/7$. Thus x will be about 2 when the curve applies to speed enforcement. In order to reduce the speed violations to 10% with an additional percentage in a small tolerance range above the limit, as aimed in the Dutch road safety strategy, the curve of Figure B.1. for $z=54\%$ indicates that an intensity of approximately $3/x$ is needed. For $x=2$ it means about 3 speeding fines per 2 license holders per year. If this level would be achieved in Sweden, where the level of speed violation on main urban and inter-urban roads is about 60% in 2000, then the mean and standard deviation of speeds on these roads would probably reduce by about 10%. The total fatalities in Sweden then could reduce by about 17%, because almost 50% of the Swedish fatalities occur on these roads and 17% is 50% of the expected reduction proportion of $1-(0.9^2)^2=0.344$. It means that a manifold intensified speed enforcement can contribute considerably to the improvement of road safety in Sweden and obviously also elsewhere, but this requires intensified surveillance and the extensive use of visible and unobtrusive speed cameras.

If in Britain and the Netherlands the level of speed control may become intensified to about 3 fines per 2 license holders ($3/x$ in Figure B.1) on main urban roads and the inter-urban road network, a fatality saving of approximately 10% is indicated by Figure B.1. Thus 10% fatality saving from intensified speed enforcement thus seems quite well achievable in the Netherlands and Britain between 2000 and 2010. An intensified speed control level in Sweden that approaches 3 speeding fines per 2 license holders on main urban and inter-urban roads could achieve a fatality saving of about 17%.

It is of interest to validate this curve (or these curves) with research results. Because then we can answer the question which enforcement levels are needed to effectively change road user behaviour. Because of the complexity of that research when it comes to differentiating police enforcement efforts (combined with publicity!) and the complexity of data-collection, we recommend carrying out an international orchestrated research programme.

B.4 Seat belts and child restraints

The 21% contribution of seat belt wearing and the use of child restraints to the total fatality saving between 1980 and 2000 in Sweden is higher than in the other SUN countries. Also the seat belt use in front and back seats (94% and 81%) as well as the proper use of child restraint systems (> 95%) are higher in Sweden. Next comes the contribution of 18% fatality saving in Britain, where the seat belt use in front seats increased the most since 1980 due the late belt law acceptance in 1983 (to > 90%). However, the British belt use in back seats (now 64%) and their use of child restraints (now 90%) are both lower than in Sweden. For the Netherlands the 11% contribution is lowest, due to their lowest use increase since 1980 and lowest present levels of seat belt use in front and back seats (now 80% and 44%) and child restraint use (now 94%) Further savings could still be achieved especially in the Netherlands and also in Britain, but only slightly in Sweden. For Sweden and Britain, by raising the wearing rates of seat belts in the back seats, and for Britain also by raising the (appropriate) use of child restraints. Both hold the more for the Netherlands, where also the rate of belt wearing in the front seats should be increased.

Increased use rates can be achieved by increased enforcement levels on seat belt use and child restraint use, perhaps sustained by higher fines (now raised to €65 in Sweden) and publicity, but 100% belt use can't be achieved. Some small percentage of car occupants who are not willing to use their belt or just forget sometimes to do so unless drastic devices are installed (self-enforcing belts or 'belt-locks'). Without these devices, an increase to 95% of belt use in the front and back seats and child restraint use seems achievable by intensified enforcement. If we accept the results of section B.3 this requires 1 fine per 65 license holders or to 1 fine per 3 unbelted car occupants and unrestrained children. This means a considerable increase compared with existing enforcement levels: in 2000 it was for unbelted car drivers 1 per 11 in Sweden, 1 per 10 in Britain, and 1 per 48 in the Netherlands. If we accept an effectiveness of 60%, its fatality savings can be estimated. This means that an additional 2% fatality reduction in Sweden, for Britain the fatality saving would be about 4%, and for the Netherlands it would be about 8%.

B.5 Drinking and driving

The reduction of drinking and driving contributed 10% to the fatality saving between 1980 and 2000 in Sweden, where today the limit (0.02% BAC) and the percentage of alcohol-related fatalities are lowest. In Britain, that contribution to the estimated saving of fatalities between 1980 and 2000 is 13% and for the Netherlands it is 19%. The Swedish contribution is lower than the British and much lower than the Dutch, because their existing percentage of alcohol-related fatalities in 1980 was already about the half of that in Britain or the Netherlands in 1980. The lower British saving than in the Netherlands is probably due to a) the higher British limit of 0.08% BAC than the Netherlands with a limit of 0.05% BAC and b) the lower British level of enforcement on drinking and driving than the Netherlands. The intensity level of DWI-enforcement corresponds with the level of the BAC-limit in the SUN countries, because the annual number of screening tests in 2000 are 1 in 4 car drivers per year in Sweden, 1 in 26.5 in

Britain, and 1 in 7.0 in the Netherlands (see Table 4.2.). DWI-enforcement is limited in Britain by the legal impossibility of random breath testing and the limit of 0.08% BAC, but Britain also has the highest penalty levels for drinking and driving. The percentages of alcohol-related fatalities with drivers over 0.1% BAC is 14% in Sweden, 20% in Britain, while 17% is estimated for the Netherlands. These comparable percentages have the same rank order as the national BAC-limits and as the national intensity levels of DWI-enforcement. This probably also indicates that the national concern about drinking (and driving) is reflected in the level of the BAC-limit and the level of DWI-enforcement, because the concern about drinking (and driving) has been traditionally higher in Sweden.

If the driver fatalities over 0.1% BAC could be reduced to 12%, then correspondingly 2% of the Swedish driver fatalities over 0.1% BAC or in total about 3% of the Swedish fatalities would be prevented, in comparison to 2000. A reduction to 12% driver fatalities over 0.1% in Britain would save 8% driver fatalities over 0.1% BAC, or in total about 12% of the British fatalities. For the Netherlands this saving would be 5% driver-fatalities over 0.1% BAC, or in total, about 7.5% of their fatalities. If we accept the figures of section B.3., fatalities reductions might be achieved if the police enforcement intensity on drinking and driving would be increased to 1 screening test per 3 drivers per year (probably if also the BAC-limit is at least not higher than 0.05%), because 12% driver fatalities over 0.1% BAC corresponds with 1 screening test per 3 drivers annually, as earlier derived in section B.3. Increasing the intensity of DWI-enforcement and eventually lowering the BAC limit seem to depend on the level of national concern about the drinking (and driving) problem. Although there seems to be some growing concern about the drinking and driving in SUN-countries, the 3-fold and 9-fold intensified DWI-enforcement for the abovementioned reduction of alcohol-related fatalities in respectively the Netherlands and Britain seems to be an enormous investment, if it is accepted by the general public. If only between 2- to 3-fold intensified DWI-enforcement for the Netherlands and Britain will be realized, and the British BAC-limit will not be reduced from 0.08% to 0.05% (unless adopted by the next government or 'forced' by the EU) we estimate the reduced fatality savings from an intensified DWI-enforcement. Not 12%, as indicated before, but about 4% for Britain, not 7.5%, but 5% for the Netherlands, and still 3% for Sweden.

B.6 Education, training and publicity (ETP)

It is estimated in chapter 8 that less than 5% fatality saving of car occupants between 1980 and 2000 is to be attributed to ETP (excluding policy fields assessed separately such as drinking and driving, seat belt wearing etc.) in the SUN countries. Except in Sweden, driver training and licensing has hardly been changed since 1980. At the end of the 20th century a graduated licensing system has been introduced in Sweden with an evaluated effect of 18% less novice driver fatalities. Because the share of corresponding fatalities in the total fatalities is about 6%, it has contributed to a total fatality saving of about 1%. Therefore, a total contribution of about 2% fatality saving for car occupant fatalities by ETP is a fairly optimistic estimate for each SUN-country. Compared to before 1980 there also have been hardly new additional or improved ETP-measures for vulnerable road users. It may also be assumed that no more than 2% of the total fatality saving is to be attributed to savings of vulnerable road users by ETP, because there are no plausible reasons for different percentage than that for car occupants.

Although uncertain it yields in a total an estimate of only 4% fatality saving from ETP-measures between 1980 and 2000. Only if more and intensified ETP-measures were applied can higher reductions be expected in the future. These relatively small

percentages do not imply that ETP is ineffective, but we face the problem of unknown safety (in terms of fatality reduction) effects. Moreover, a certain level of ETP is a prerequisite for any road safety policy that needs parliamentary approval and thus acceptance by the public. Public acceptance is certainly doubtful without ETP.

It is of interest to develop new initiatives for the reduction of fatality risks for novice drivers by better training, because there is room for further improvements in novice driver fatality rates. However the Swedish example indicates that only a limited number of fatalities may be reduced.

B.7 Road engineering

The contribution of local road engineering to the fatality reductions between 1980 and 2000 are estimated to be 4% for Sweden, 10% for Britain, and 5% for the Netherlands. The higher percentage for Britain is due to the broader scope of their monitored local road engineering programme, while the estimated contribution of local engineering measures of the two other countries is restricted to 30 km/h area treatments and re-constructions of junctions to roundabouts (for Sweden).

The fatality savings between 1980 and 2000 for vulnerable road users (VRU) by other measures than local road engineering and drinking and driving measures are estimated as 37% for Sweden, 27% for Britain, and 32% for the Netherlands. However, the savings must be mainly attributed to general road engineering and speed management on other roads than motorways (except for motorcyclists), because 2% saving from ETP was estimated for VRU-fatalities. Furthermore, the reduced exposure may be an explanatory factor. It is estimated that speed management and other road engineering measures than local road treatments, may have contributed to the fatality saving of vulnerable road users by 35% in Sweden, 25% in Britain, and 30% in the Netherlands.

The same reasoning applies to fatality savings of car occupants from other measures than vehicle safety, seat belt and child restraint use, drinking and driving, and local road engineering, which other car occupant measures were estimated to have saved 10% fatalities in Sweden, 7% in Britain, and 16% in the Netherlands. Here also, no more than 2% saving by ETP should be subtracted from the total estimated percentages in order to obtain the estimates for the percentage fatality saving of car occupants by general road engineering and speed management. It thus follows that the attribution of fatality savings for car occupants to general road engineering and speed management is 8% in Sweden, 5% in Britain, and 14% in the Netherlands. For the Netherlands, it has been concluded that 10% car occupant saving is due to the general road engineering that enabled the traffic share shift to the safer motorways from 27% in 1980 to 40% in 2000.

Most road engineering measures in built-up areas are infrastructure measures that sustain lowered speed limits or force speeds to be lower on average and reduce over-speeding on roads with unchanged speed limits. These measures thus overlap with speed management measures, while speed management measures sometimes are accompanied by road re-constructions. The expected future savings from road engineering and speed management in the road safety plans, with respect to the achievement of their targets in the SUN countries, are 57% in Sweden (including traffic control), 44% in Britain, and 50% in the Netherlands. In term of percentages of the targeted total savings between 2000 and 2010, it means that these planned savings from road engineering and speed management are 19% in Sweden, 16% in Britain, and 15% in the Netherlands, where about 5% from speed enforcement is included for Britain. Combining the sources of fatality savings that are attributed to all kinds of road engineering and speed management measures (without speed enforcement), it follows

that the attributed shares of fatality savings from all road engineering and speed management measures (without speed enforcement) between 1980 and 2000 have been about 44% in the SUN-countries. If we accept that road engineering and speed management measures are judged to remain as effective as in the past and the speed of improvement will be the same, these savings can realistically be extrapolated for the future. This suggests that a fatality saving of 16% in Sweden, 19% in Britain, and 28% in the Netherlands could be achieved by road and traffic engineering and speed management (without speed enforcement).

B.8 Achievable and planned future improvements in the SUN countries and the EU

Table B.3 below summarises the possibly achievable saving percentages of fatalities between 2000 and 2010 by the road safety measures discussed for the SUN countries, as estimated in the previous subsections of this section.

Saving % by	Sweden Achievable	Britain Achievable	Netherlands Achievable
Road engineering and speed management (excl. speed enforcement)	16%	19%	28%
Speed enforcement	17%	10%	10%
Vehicle safety	10%	10%	10%
Belt/child restraint use/enforcement	2%	4%	8%
Drinking and driving enforcement	3%	4%	5%
Intensified ETP	2%	2%	2%
Achievable total (multiplied prop.)	43.5%	40%	49.5%
Extrapolated exposure increase	-10%	-8%	-12%
Resulting total	33.5%	32%	37.5%

Table B.2. *Achievable fatality saving percentages from road safety measures in SUN countries.*

The estimates of the achievable saving percentages from the sections above yield proportional reduction factors that are multiplied to obtain the achievable total reduction percentages (not using the added total, because then double counting the saved fatalities from one source that are already saved by other sources). These achievable total fatality savings relate to fatality reductions within a certain time period, where these reductions counteract the expected increase of fatalities from exposure increases (the estimations of increase in exposure are expected to take place between 2000 and 2010). Therefore, the total estimate of the achievable total fatality savings must also be reduced by the percentages of the expected increases of fatalities from exposure increases between 2000 and 2010. These fatality increases are initially estimated by half the percentages for the exposure-related fatality increases between 1980 and 2000 in chapter 8. Because exposure increases are uncertain these fatality percentages from exposure increases have additionally been averaged with the average for the SUN countries. These last percentages from exposure increases are entered in the next-to-last row in Table B.2.

Of course, these estimations do have a rough character, because we cannot derive fatality reductions from actual road safety programmes and investments. These

estimations also have a conservative character because they do not take into account new, innovative, yet unknown measures. These estimations build on experiences in the past and assume that still further improvements can be expected in the well-known fields as engineering and enforcement. If we accept all the assumptions made, then it becomes clear that more has to be done in order to reach the EU-target (minus 50% in 2010) in the SUN countries.

The commission of the EU proposes 50% fatality reduction to 20,000 fatalities in 2010 compared to the 40,000 in 2000 as EU-target. However, the estimate of the achievable fatality saving for the SUN countries is about 35% between 2000 and 2010. This seems to be no problem if the achievable fatality savings could be lower for the SUN countries because the other countries within the EU implement more ambitious improvements than the SUN countries. But if we assume that all individual EU Member States have a target of minus 50% and we accept that only about 35% fatality saving in 2010 compared to 2000, are feasible in the SUN countries, additional efforts need to be made, either by the SUN countries themselves and/or by support from Europe.

Appendix C: Road Safety Activities 1970- 2000 in SUN countries

National traffic safety activities (decisions, measures or campaigns) between 1970-2000 are presented below. Local activities are not presented.

C.1 Road safety activities in Sweden

- 1972 Differentiated speed limits
- 1975 Mandatory seat belt use by front seat occupants in passenger cars
Motor cycle helmet
- 1976 Driving test for motor cycle
School transport sign
- 1977 Daytime running lights
Random breath tests allowed
- 1978 Moped helmet
- 1979 Cycle light in nighttime (not needed in daylight)
- 1980 Vehicle width allowed from 2.5 to 2.6 metre
Campaign: " The accident risk is highest in x-county"
- 1981 Driving practice allowed on motorways.
New 30 km/h-sign as recommended speed in areas with the speed limit of 50 km/h as a warning for "speed humps, etc."
Campaign: "Children in traffic".
- 1982 All slow moving vehicles shall have a warning sign.
- 1982 Traffic Safety Official Report 1982. Qualitative target for the traffic safety work.
Campaign "Soft Children. Hard Cars".
New driving licence system
Traffic Safety Proposal refused
- 1983 Mandatory use of seat belt in front passenger seat of taxi
- 1984 C-certificate in stead of B-certificate for heavy lorries (460,000 new licences)
Campaign: " Alcohol and traffic".
- 1985 Campaign: "School and Traffic "
- 1986 New traffic rules: 1) road shoulder driving allowed, 2) priority to secondary traffic merging into motorways, 3) reflectors on cycles (front, back and in the wheels) etc..
Campaign: " Seat belt in back seat"
Mandatory use of seat belt of adults in the back seat
- 1987 The first traffic safety programme to the government for three years
Campaign: "Slow down". Speed fines increased.
- 1988 Mandatory use of restraint system for children.
Prohibition to produce, have, give or use radar indicators
- 1989 Speed limit of 110 km/h reduced to 90 km/h during the summer. 90 km/h after the summer on motorways around the big cities.
- 1990 New driver licence. New theory test has to be passed before the driving test.
The licence is provisional the first two years.
The limit for drinking and driving is lowered from 0.05 to 0.02% blood alcohol content.
Trials with automatic speed enforcement starts
Tyre pattern 1.6 mm

- Taxation change and increased fuel price.
- 1991 Certificate of fitness for drunken drivers with more than 0.15 percent
- 1992 110 km/h on all motorways. The trial with automatic speed enforcement is finished.
- 1993 The Road Safety Office disappears and the Swedish National Road Administration is now responsible for the traffic safety.
Driving practise from 16 years of age
- 1994 New law for drunken driving. Limit for serious intoxicated 0.10 percent
Number of random breath tests doubled
Laser instrument introduced for speed limit enforcement
The National Traffic Safety Programme for 1995-2000. Less than 400 killed 2000.
- 1995 Speed limit for passenger cars with trailer and heavy lorries increased from 70 to 80 km/h
Increased fuel price
Steel wire barrier in the median of motorways
- 1996 The "Zero Vision" presented
Airbag "standard" on new passenger cars
The length of lorries from 24 to 25.25 metres
- 1997 Some roads will have reduced speed limit from 110 to 90 km/h
The "Vision Zero" is taken by the Parliament
- 1998 Steel wire barriers in the roadside are introduced
Local communities got the right to decide on the speed limit of 30 km/h
The first 3-lane road with a middle steel wire barrier is open
- 1999 Seat belt law expanded to taxi drivers and lorry occupants if seat belts are installed.
Winter tyres mandatory at winter conditions, December to March
Trials with winter speed limits, 110 to 90 km/h and 90 to 70 km/h
- 2000 Some winter speed limits were kept
High fuel price at the end of 2000
Priority for pedestrians on pedestrian (zebra) crossings. Decreased number of pedestrian crossings.

C.2 Road safety activities in the UK

- 1970 HGV driving test and registration of driving instructors becomes compulsory.
New regulations on lorry and PSV driver hours of work
- 1971/72 16 years olds are limited to riding mopeds only. Rear markings and long vehicle signs are made compulsory for HGVs.
- 1972 Start training engineers in accident reduction techniques
- 1973/74 Safety helmets are made compulsory for two-wheeled motor vehicle users.
Temporarily 50 mph maximum speed limit due to the energy crisis. Vehicle lighting regulations.
- 1975/76 Vehicles required to be lit when daylight visibility is seriously reduced. Mini-roundabouts introduced. Minimum age of trainee HGV drivers reduced to 18.
- 1977 New standard for safety helmets. Mopeds redefined to 30 mph maximum design speed. MOT test widened to include windscreen wipers and washers.
- 1978 New edition of the Highway Code. 60 and 70 mph speed limits are made permanent. New maximum number of hours to be worked by goods vehicle drivers is introduced. Rear fog lamps become mandatory to most vehicles manufactured after 1 October 1979 and used from 1 April 1980.

- 1979 Use of tachograph accepted by Government. Code of practice issued on vehicle safety defects.
- 1980 Institution of Highways & Transportation produce guidelines on accident reduction. Higher standards for crash helmets.
- 1981 Reduction in minimum driving age of invalid car drivers to 16.
- 1982 Two part motorcycle test introduced. Provisional motorcycle licences restricted to two years. Tougher written examination for entrants to driver instructor registration scheme. Tougher braking standards for new buses, coaches and lorries.
- 1983 Seat belt wearing becomes law for drivers and front seat passengers of cars and light vans. Learner motorcyclists only allowed to ride machines of up to 125 cc. Tyres must have 1 mm tread depth, etc. First road hump regulations made.
- 1984 Stiffer driving tests for entrants to driver instructor registration scheme. Tougher internal checks on tuition given by qualified driving instructors. New pedal cycles are required to meet British Standards. Revised Code of Practice on safety of loads on vehicles is issued. Spray reducing devices required to be fitted to lorries and trailers.
- 1985 New safety package (improved audible and visual warnings and minimum pavement widths) for pedestrians at modernised level crossings. Both load and speed performance to be marked on new car tyres. Regulations allowing the use of traffic cones, warning lamps, and triangles in the event of breakdowns come into force.
- 1986 Uniform construction standards to apply to minibuses first used from April 1988. Seat belt legislation is made permanent. Tyres now required to support maximum axle weights at vehicle maximum speed.
- 1987 DoT sets national target of 33 % reduction in road casualties by the year 2000. All newly registered cars to be fitted with rear seat belts or child restraints. Use of amber flashing lights on slow moving vehicles is made compulsory. Zigzag markings extended to Pelican crossings.
- 1988 Close proximity and wide-angle rear view mirrors become a legal requirement on new HGVs. All coaches first used from 1 April 1974 must have 70 mph limiters by 1 April 1992.
- 1989 Penalty points increased for careless driving, without insurance, and failing to stop after or to report an accident. Accompanied motorcycle testing becomes mandatory. Seat belt wearing by rear child passengers becomes law in cars where appropriate restraints have been fitted and are available. Local Authorities Associations (LAA) produce Code of Good Road Safety Practice.
- 1990 High risk Offenders Scheme for problem drink-drivers extended and accompanied by the introduction of a charge for medical examination required before return of licence. Compulsory basic training for motorcyclists introduced. New regulations require those accompanying learner drivers to be at least 21 years old and to have held a licence for 3 years. From 1990 and continued, central government funding for local safety schemes. Guidelines on Road Safety Audit
- 1991 The first twelve 20mph zones were introduced. Safety Audits become mandatory on trunk roads and motorways. Seat belt wearing by rear adult passengers became law in cars where belts are fitted and available. First edition of "Car and Driver: Injury Accident and Casualty Rates" published giving information on comparative accident involvement and injury risks of popular makes and models of car.
- 1992 Traffic Calming Act 1992 receives Royal Assent. All new good vehicles over 7.5 tonnes fitted with 60 mph speed limiters. Speed enforcement cameras and retesting of dangerous drivers introduced.

- 1993 New edition of Highway Code published. Consolidation of seat belt wearing regulations. Traffic Calming Regulations enable highway authorities to introduce a wider range of traffic calming features. The MOT test for cars extended.
- 1994 Speed limiter settings lowered to 65 mph for new buses and coaches and to 56 mph for HGVs.
- 1996 Safer City-project launched in Gloucester on safety engineering measures. Driving theory test introduced for car and motorcycle learners.
- 1997 Road Traffic (New Drivers) Act 1995 comes into force, withdrawal of licence and compulsory retesting for new drivers who accumulate 6 or more penalty points within 2 years of passing their driving test. New Zebra, Pelican and Puffin crossing regulations introduced. DETR review road safety targets post 2000.
- 1998 Transport white paper published: A New Deal for Transport: Better for Everyone.
- 1999 Revised edition of "The highway Code" published.
- 2000 The government announced a new road safety strategy and casualty reduction targets for the year 2010 in "Tomorrows Roads - Safer for Everyone". A review of speed policy was conducted and reported in "New Directions in Speed Management".

C.3 Road safety activities in the Netherlands

- 1970 Introduction of emergency telephones alongside motorways.
- 1971 Mandatory presence of seat belts on front seats in newly sold cars.
Head rests on front seats of cars.
- 1972 Mandatory helmet for driver and passenger of motorcycles.
- 1974 Speed limit on motorways for cars and motorcycles of 100 km/h.
Speed limit on other rural roads for cars and motorcycles of 80 km/h.
Speed limit on all rural roads for lorries and cars with trailers of 80 km/h.
Training demands for driving instructors.
Introduction of alcohol legal limit (Blood Alcohol Content) of 0,05 %.
- 1975 Mandatory helmet for mopedists and passengers.
Mandatory seat belt use (if present) on front seats.
- 1976 Cars; children on laps in front forbidden.
Cars; children younger than 12 years old have to sit on rear seats.
Cars; children 6-12 years old on front seats with lap belt.
Introduction of light-moped ('snorfiets'). No requirement for helmet wearing and a speed limit on urban and rural roads of 25 km/h.
"Woonerf" (home-zones) is legally introduced
- 1977 Cars; children of 0-3 years old in approved child seat in front.
For children from 12 years all seat belts are allowed.
Only low beam headlights are allowed on urban roads.
Low beam headlights are allowed during daytime in bad weather conditions.
Lorries (rear end); trailers and semi-trailers must have reflective markings.
Lorries; long loads that stick out must have red/white striped board instead of flag.
- 1978 Bicycles; approved red/yellow rear reflector
For lorry drivers a tachograph is introduced.
For long motor vehicles, trailers & semi-trailers approved orange side reflectors are required.
Cars; yellow licence plates

- 1979 Fog lamps (one or two) are permitted when visibility is less than 50 metres.
Mopeds; reflectors on pedals
Mopeds; red reflectors
Bicycles; orange or yellow reflectors on pedals
- 1983 30 km/h-zones are legally introduced
- 1985 For cars older than 10 years a periodic vehicle inspection test is required.
- 1986 Theory examination for motorcars made possible from the age 17 years.
Driving licence for motorcars valid till holder is 70 years old.
- 1987 For cars older than 3 years a periodic vehicle inspection test is required.
Mopeds, light-mopeds and bicycles; side reflection/reflecting circles on wheels.
Introduction of Evidential Breath Testing.
- 1988 Differentiated speed limits on motorways for cars and motorcycles of 100/120 km/h.
- 1990 Cars; seat belts on rear seats of new cars.
- 1991 Review of Highway Code and Administrative Requirements for road authorities concerning road traffic.
- 1992 Mandatory use of seat belts (if present) in lorries and vans.
Cars; seat belt use on rear seats (if present)
- 1993 Adapted training demands for driving instructors
- 1995 Speed limiters for lorries (new) > 12 ton and buses >10 ton (not for those before 1988).
Motor vehicles; changes and extensions of driving instructions
Lorries, trailers & semi-trailers (new); open side protection
- 1996 Speed limiters for lorries > 12 ton and buses > 10 ton for all vehicles registered after 1.1.1988.
Mandatory theory exam for mopedists and light-mopedists (theory certificate).
Introduction of administrative sanctions for alcohol above the legal limit in addition to and independent of court sanctions.
- 1997 Brommobiel= (4-wheeled moped) that can drive at 45 km/h; allowed to drive 50 km/h (was 40 km/h) on trunk roads. Therefore not allowed on motorways and roads closed for slow traffic.
Lorries; time-determined overtaking prohibition on parts of motorway network
- 2000/01 Mopeds are no longer obliged to use a cycle paths in built-up areas, but have to use the carriageway (exceptions are allowed).
- 2002 Mopeds, light-mopeds, and cyclists have right-of-way coming from the right.
Prohibition of holding handheld mobile phones while driving a motorvehicle or moped.

Appendix D Members of the SUNflower advisory panel

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