ASSESS

Assessment of the contribution of the TEN and other transport policy measures to the mid-term implementation of the White Paper on the European Transport Policy for 2010

FINAL REPORT

ANNEX XI

ESTIMATED ROAD SAFETY EFFECTS OF THE WHITE PAPER ON EUROPEAN TRANSPORT POLICY

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Preface

This is ANNEX XI of the final report for *'Assessment of the contribution of the TEN and other transport policy measures to the mid-term implementation of the White Paper on the European Transport Policy for 2010'*.

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Scope

Scope of the ASSESS project

The ASSESS study is about the ***"Assessment of the contribution of the TEN and other transport policy measures to the mid-term implementation of the White Paper on the European Transport Policy for 2010"***.

The European Commission's White Paper of 12.9.2001 "European transport policy for 2010: time to decide" aims to promote a sustainable transport policy. The White Paper proposes to achieve sustainability by gradually breaking the link between transport growth and economic growth, principally in three ways: changing the modal split in the long term, clearing infrastructure bottlenecks and placing safety and quality at the heart of the transport policy.

As foreseen, the White Paper on Transport undergoes in 2005 an overall ***assessment concerning the implementation of the measures it advocates and to check whether its targets*** - for example, on modal split or road safety - ***and objectives are being attained or whether adjustments are needed.***

ASSESS provides technical support to the Commission services for the above mid-term assessment of the White Paper.

The analysis accounts for the economic, social and environmental consequences of the proposed measures and their contribution to sustainable development objectives. It provides also a detailed analysis of those effects of enlargement likely to affect the structure and performance of the EU transport system.

The study takes a three pillar approach based on the use of analysis, indicators and models. National transport policies are reviewed for compatibility and coherence with the White Paper objectives. The models used allow a detailed analysis of the freight market, the passenger market and their infrastructure networks under a number of scenarios.

Scope of this Annex

This report represents an estimation of the road safety effects of the White Paper on European Transport Policy , for 4 implementation scenarios. The White paper measures and interesting additional measures are described. The last chapter gives recommendations.

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ANNEX XI Estimated road safety effects of the White Paper on European Transport Policy

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XI.1. Introduction and method used

XI.1.1. Introduction

In this document, the effect of White Paper measures on traffic safety is estimated for 2010 and 2020. This is done along the following lines.

In chapter 1, the applied method is explained. The four scenarios, including the proposed extra road safety measures for the E-scenario, are described in chapter 2. The safety effects of both the safety measures described in the White Paper and the additional measures proposed for scenario four are given in chapter 3. Finally, in chapter 4 the results are presented.

XI.1.2. Method used

Prediction of traffic safety development is an almost impossible task. This is due to several reasons. In the first place the number of casualties or fatalities depends non-linearly to major changes in the use of safe or unsafe vehicles. In the second place there may be a large effect of new infrastructure. In the third place, the effect of safety measures is not easily assessed. Last but not least, we ignore the indirect effects of measures that influence mobility through e.g. congestion taxes.

1. As for the relation with changing mobility: e.g. a raising popularity of motorized two-wheelers decreases traffic safety. So unless, for instance, the use of motorcycles or mopeds in the forthcoming years either does not change or is very accurately known, it is hard to be accurate on the expected number of traffic fatalities in 2010, and even more so in 2020. Similar arguments hold for a raise in the expected use of lorries or small vans, especially for the new EU countries. These vehicle types may be related to an increase of casualties among vulnerable road users. In the case of an increasing number of e.g. trucks, there are equally many less experienced lorry drivers, which may give rise to less safety during the period that traffic increases. Needless to say that a strong increase in the use of cars, with many relatively inexperienced drivers, leads to less safety as well (illustrated by the sudden rise of the number of fatalities in Germany after the unification in 1993).

2. As for the relation with infrastructure: countries that use their money to build highways, will gain in traffic safety. Other examples of safe infrastructure are separated roads for slow and fast traffic in urban

areas. In short, if the infrastructure is made safer, there will be less casualties. Especially for the new EU countries, it is hard to predict how mobility will influence the development of safe infrastructure.

3. As for the effect of safety measures, their effects are not easily calculated. In chapter 3 the specific difficulties with and subtleties of calculating the effect of each measure are discussed. An additional problem with combining the effects of measures is that the effects of two measures may be either mutually independent, overlapping, or complementary. In this report we had to assume that all measures are mutually independent.

4. In the extended scenario, measures are being taken to influence congestion, by means of congestion taxes. Such measures may well lead to a modal shift, of which the safety effects may be substantial. To compensate for this, additional safety measures may be necessary.

To achieve more accurate results, the development of the mobility/exposure over the years for each relevant traffic mode (e.g. pedestrians, bicycles, mopeds, motorcycles, cars, small vans, trucks, buses) should be known for each country. Also, the development of (newly built) infrastructure should be known. In addition to this, the number of fatalities has to be known with respect to the traffic modes involved, and differentiated for the different road types, also for each country. Finally, the interference of each measure with all other developments and all other measures should be carefully taken into account.

The conclusion is clear: for an accurate prediction, the necessary data are not available. For the EU 15 countries, accurate data of traffic mode usage are quite hard to get. Even without these mobility data, assessment of future traffic fatalities would still be more accurate when the number of fatalities for each combination of traffic modes (fatalities among cyclists in an accident with a lorry). were available. Most Member States do not have these data. This became clear in a small recent study (OECD, 2006).

Although there may sometimes be a strategic planning of highway infrastructure, the development of urban infrastructure is a local matter, and development planning is not available. For the new EU countries this data is virtually impossible to get.

As a consequence we had to make use of a more straightforward, but far less accurate approach. We made use of a common relation between the (time dependent) number of fatal crashes $N_f(t)$, the mobility M(t) and their ratio, the fatality rate $r_f(t)$.

$$N_f\,(t) = r_f\,(t) \cdot M\,(t) \qquad (1)$$

We assume that $r_f(t)$ shows a smoother trend than $N_f(t)$. Therefore we use time series for M(t) and $N_f(t)$ to achieve a time series of $r_f(t)$. Values of N_f in 2010 and 2020 are achieved by assessing values of M and r_f in 2010 and 2020, and multiplication (using equation (1)). More precisely, we have followed the next six steps:

1. Obtain data for M(t) and $N_f(t)$ from the past (for as many years as there is data available). We have done this for each EU country separately. For most countries, data up to 2003 was used, mainly because the data of 2004 were not available yet at the time of our analysis (and for some countries 2003 was not available). The sharp decrease of the number of fatalities in some European countries is therefore not used. However, for the long term trend, this would not make a serious difference. Only if it would turn out later that 2004 happened to be the beginning of a major trend break., this would influence the long term estimates. At this moment, it is far from clear

that this is the case. If it so happens that there actually is a trend break, achieving the goals would prove to be easier. It is now too early to cash this effect.

2. Calculate $r_f(t)$ from $M(t)$ and $N_f(t)$.
3. Extrapolate $r_f(t)$ to $r_f(2010)$ and $r_f(2020)$ using (Ecorys 2005). These are the reference values, that are directly used for the P-scenario (the most likely scenario, when the most likely White Paper measures are taken).
4. For the N-scenario (pessimistic scenario: no White Paper measures are carried out), the F-scenario (all White Paper measures are carried out) and the E-scenario (some interesting additional measures are also carried out, on top of the P-scenario), the reference values for r_f are adjusted. This way, we achieved a table of values for r_f in 2010 and 2020 for each of the scenarios and each of the EU 25 countries.
5. The expected mobility is achieved by using results from Scenes extrapolations for the four different scenario's
6. The number of fatalities is calculated from the results of step 3, step 4 and step 5, using equation (1).

XI.2. Scenarios

XI.2.1. Scenario definition

Four scenarios will be used to assess the road safety effects of the measures in the White Paper:

(i) a 'do nothing' or null scenario (*N-scenario*): assumes that none of the White Paper measures have been implemented, neither at the European level nor in the Member States;

(ii) a partial and most likely implementation (*P-scenario*) on the basis of the difficulties encountered: includes all follow-up activities already implemented or planned to be implemented before 2010 by the EC or by Member States;

(iii) a full implementation of the White Paper (*F-scenario*): includes all measures introduced in the White Paper;

(iv) a extended scenario (*E-scenario*): includes both the measures in the White Paper and an additional set of interesting measures.

The effects of these four scenarios will be estimated for both 2010 and 2020.

XI.2.2. Null scenario (N-scenario)

In this scenario we assume that none of the White Paper measures have been implemented.

For this scenario, the predictions of the number of fatalities in 2010 and 2020 are based upon autonomous changes (but excluding the effects of the measures with high or very high likelihood in Table 1) in the relative fatality rate of road users and on changes in mobility rates.

Table 1: Likelihood of the road measures being implemented by 2010, as estimated by SWOV

Nr.	Measures	Likelihood
47	European Road Safety Action Programme	Very High
48	Harmonization of rules on checks and penalties	Very low
49	Black spots on TENs list	Low
50	Seat and head restraints	Very High
51	Training and education	Low
52	Independent technical investigations	High
53	Driving licences	High
54	Speed limitation devices	High
55	ITS e-Safety	Low
56	Safety for vulnerable road users	High

XI.2.3. Partial and most likely implementation (P-scenario)

This scenario assumes that only the measures that are already implemented or are very likely to be implemented are implemented.

For this scenario, the predictions of the number of fatalities in 2010 and 2020 are based upon autonomous changes (including the effects of the measures with high or very high likelihood in Table 1) in the relative fatality rate of road users and on changes in mobility rates. The assessment of the future development of the fatality rate is based on our work for the mid term review of the Road Safety Action Programme (Ecorys, 2005).

XI.2.4. Full implementation scenario (F-scenario)

All measures in the White Paper are implemented.

For this scenario, the predictions of the number of fatalities in 2010 and 2020 are based upon autonomous changes in the relative fatality rate of road users, on changes in the relative fatality rate of road users caused by all measures contained in the White Paper, and on changes in mobility rates.

XI.2.5. Extended scenario (E-scenario)

In the E-scenario, the extended scenario, all the measures stated in the White Paper are implemented. Also, additional measures are included in the scenario. These are measures that comply with two criteria: first, effects have been established by prior studies and second, it is possible to make a quantification of these effects of the proposed measures. The additional measures are listed below.

Table 2: Additional measures for the extended scenario

Proposed measures for the extended scenario
Daytime Running Lights (DRL) for cars and motorcycles
Safer design of roads in urban areas
Safer design of roads in rural areas
Measures aimed at trucks and vans
Helmets for cyclists, moped riders and motorcyclists

For this scenario, the predictions of the number of fatalities in 2010 and 2020 are based upon autonomous changes in the relative fatality rate of road users, on changes in the relative fatality rate of road users caused by all measures contained in the White Paper, on changes in the relative fatality rate of road users caused by the additional measures in the above table, and on changes in mobility.

XI.3. Estimated reductions in fatality rate due to the measures

XI.3.1. How to assess the effectiveness of a certain road safety measure

A policy measure is beneficial for road safety if for road users it leads to a reduction of the number of fatalities per distance driven (fatality rate) or a reduction in the number of kilometres driven (exposure). Without any road safety measures taken the relative fatality rate is 1, and thus to be effective the relative fatality rate for a certain road safety measure must be less than 1. The relative fatality rate for a road safety measure is calculated as follows:

$$relative\ r_f(t) = r_f(t, \text{with measure } x) \ / \ r_f(t, \text{without measure } x) \qquad (2)$$

If the relative fatality rate of a certain measure can be assessed and the number of kilometres driven for the group that is exposed to the measure in a certain year can also be assessed, then the reduction of the number of crashes as a result of the measure can be estimated. It is assumed that the proposed safety measures in the White Paper have no impact on the amount of kilometres driven in a certain country. For the formula presented above this means that the estimated 'kilometres of driving under the condition of measure X' is equal to the estimated 'kilometres of driving without measure X' in place. For an estimate of relative fatality rate it is important that all other factors affecting crash involvement are as similar as possible in the groups of drivers that are compared with respect to being subjected to the measure.

Underneath, the relative fatality rates associated with each measure in the White Paper are assessed. We have assumed that the several measures are mutually independent, in other words we have assumed that the effect of one measure will not influence the effects of the others. In practice, this will most probably not be the case. The described estimated effect of all measures together, will, in reality, be less than stated in this document.

XI.3.2. Measure 47: European Road Safety Action Programme

Measure 47 sets the target for the EU of having half as many fatalities due to road crashes by 2010 compared to the number of fatalities in 2001.

Target setting has proved to be a valuable means to get, and to keep, traffic safety on the political agenda (Koornstra et al., 2002). The target in the White Paper has to be achieved with the other proposed road safety measures in the White Paper. The question here is whether the very fact of having a clear target has a safety benefit on its own. The intrinsic value of having a target depends on the quality of the vision that accompanies the target and the perceived feasibility of the target. A clear vision on road safety such as 'Vision Zero' in Sweden or the idea of 'Sustainable Road Safety' in the Netherlands would help to achieve the goals. Most proposed road safety measures in the White Paper are not specific, and not all of them are based on scientific evidence. Moreover the quantitative target is not subdivided into specific targets for EU Member States, which makes it difficult to estimate a realistic effect for separate countries. The target (having half the number of fatalities in 2001 by the year 2010) is not meant to be equally applicable for all individual EU Member States. For countries that have already accomplished a high road safety level, the target of halving the number of fatalities is far more difficult to achieve than for countries with a poor road safety record. Therefore the effect of an over-all target is very hard to assess.

Because of the mentioned difficulties, it is estimated that the relative fatality rate for European road users will not be lowered directly by the very fact of having the EU target of having half the number of the fatalities (as compared to 2001) by the year 2010.

XI.3.3. Measure 48: Harmonization of rules on checks and penalties

Measure 48 is to have the same BAC limit(s), the same speed limits, and the same chance of getting caught per kilometre driven when exceeding these limits in all EU Member States for international commercial drivers in the year 2005. When getting caught, the penalties for exceeding these limits will also be the same for all international commercial drivers in all EU Member States in 2005.

The measure is on harmonization. It is not proposed to lower BAC and speed limits, or to intensify police enforcement and to raise fines. If all these aspects are harmonized *on the European average*, the measure will have safety impacts for individual Member States (countries with a good safety record will get worse and poorly performing countries will get better) but will have no impact on the safety record of the EU. In order to make a realistic assessment on the safety effect of the measure, some additional assumptions have to be made. In this report, *harmonization* is interpreted as harmonization such that the speed limits etc. are set to a safe value. It is unclear to us if harmonization is meant to leave room for individual Member States to use a more strict regime (i.e. if some current speed limit in a certain Member State is lower that the proposed level for harmonization). We assumed that limits are really meant to be strictly harmonised.

As a consequence in some countries harmonization, the way we interpreted it for assessment reasons, has a negative effect in some countries.

XI.3.3.1. Same BAC limits

Speeding and driving under the influence of alcohol are both factors that increase the relative crash rate progressively. For driving under the influence of alcohol the relation between the degree of impairment and the relative crash rate is well established. This relationship is presented in Figure 1.

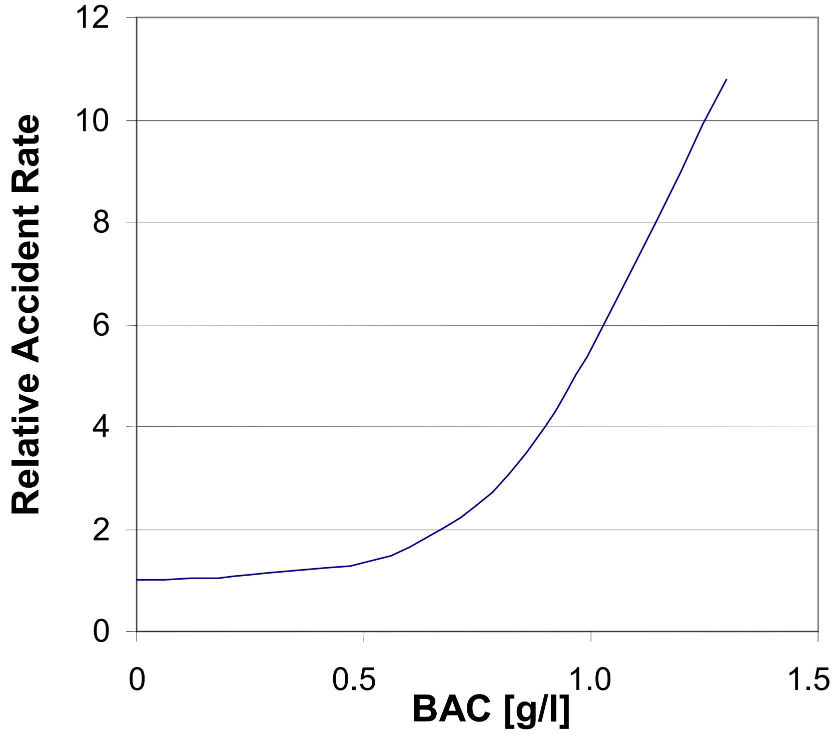

Figure 1: The relation between relative accident rate and the grams of alcohol per litre blood (Borkenstein et al., 1974)

Considering the prevalence of drunk driving in many countries it will be enormously effective if drunk driving could be stopped, especially driving with a BAC of 0.5 g/l or more.

The first assumption we make is that the BAC-limit will be set on 0.5 g/l. From Figure 1 it can be concluded that the relative crash rate rises sharply for BACs higher than 0.5 g/l. One can argue that a BAC-limit of zero (or 0.2 g/l as people can have some alcohol in their blood without ever having consumed alcohol) is better, because of its clear message that drinking (not even the smallest amount of alcohol) and driving do not go together. On the other hand it is estimated in the Netherlands that a reduction of the BAC-limit from 0.5 g/l to 0.2 g/l will lead to more crashes if the police enforcement is not substantially intensified (Mathijssen, 1999). This is so because with a zero BAC-limit the police will spend too much time on people that have no increased crash risk (drivers with BAC levels from 0.2 g/l to 0.5 g/l) at the cost of time spent to catch the dangerous drivers (with BAC-levels over 0.5 g/l).

We assume that setting the European BAC-limit at 0.5 g/l will only have a safety effect in countries with a BAC limit above 0.5 g/l. These countries are: Ireland (0.8 g/l), the United Kingdom (0.8 g/l) and Luxembourg (0.8 g/l). Because of the very limited increase in relative crash rate from 0.2 g/l to 0.5 g/l, setting the European limit on 0.5 g/l will probably have no negative safety effects in counties with a lower limit like Sweden and many of the new Member States. It is hard to determine the safety effect of lowering the BAC-limit from 0.8 g/l to 0.5 g/l without taking into account the amount of police enforcement and the efficiency of the police enforcement. In very many countries in the EU there are no accurate figures available about the annual number of fatalities associated with drinking and driving. The reason for this is that in most countries drivers involved in fatal crashes are not tested for alcohol systematically. Koornstra et al. (2002) assess that the level of drinking and driving fatalities in the UK (BAC-limit = 0.8 g/l) is only slightly higher than in the Netherlands (BAC-limit = 0.5 g/l) and they assess that the annual number of fatal crashes in the UK is somewhat over 400.

We assume that the number of fatal crashes by lowering the BAC-limit from 0.8 g/l to 0.5 g/l in the UK will lower the number of the drink driving related fatal crashes by around 5%. This means 20 fatal crashes less. Thus when reducing the BAC-limit from 0.8 g/l to 0.5 g/l this will lead to a relative fatality rate of around 0.95 for crashes caused by drunk driving. Assuming that these crash types make up about 20% of total crashes, the relative fatality rate for all road users due to harmonizing BAC-limits is **0.99**.

XI.3.3.2. Same speed limits

It is obvious that the severity of a crash increases when the speed increases, but the relation between the deviation from the speed limit and the crash rate is not so clear. Much research on the relation between speed and the crash rate has been carried out (Baruya, 1998; Kloeden et al., 1997; 2001; Maycock et al., 1998; Nilsson, 1982; Quimby et al., 1999; Finch at al., 1994). The results differ substantially. From a methodological point the studies of Kloeden et al. (1997, 2001) seem to be the most reliable, because they are case-control studies based on empirical evidence (and not self report). These studies also make a distinction between the crash rate of speeding on urban roads and speeding on rural roads and motorways. The relation Kloeden et al. have measured between deviation from the mean speed and the relative crash rate is presented in *Figure 2*.

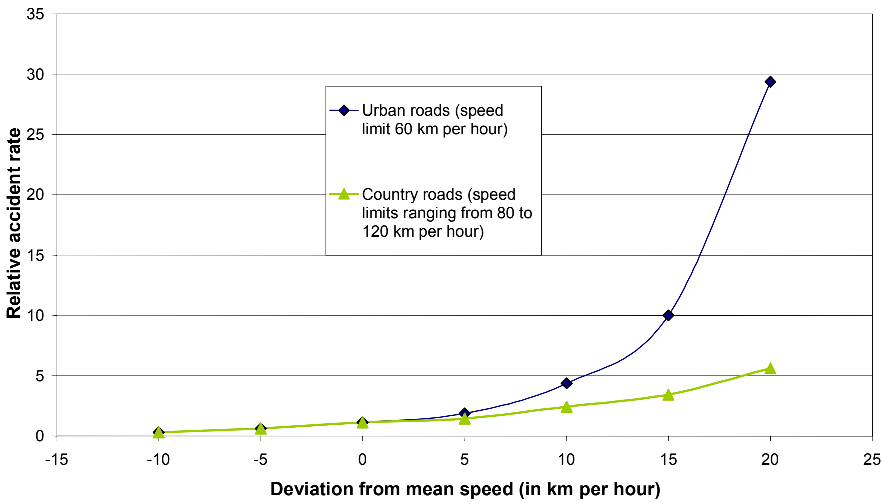

Figure 2: The relation between the relative crash rate and deviations from the mean speed for urban roads (60 km/hour) and country roads (80 to 120 km/hour).
Source: Kloeden et al. (1997, 2001 and 2002)

Considering the prevalence of exceeding the speed limit in very many countries, it will be enormously effective if, by one way or another, drivers do not exceed speed limits by more than 5 km/hour, especially on urban roads. The proposed measure however is not to prevent individual motorists driving faster than the speed limit, but to have the same speed limits all over the EU. Nilsson (1984) has studied changes in speed limit. He evaluated the safety effects on Swedish rural roads after changing the speed limit from 110 km/h to 90 km/h and vice versa. Roads with an unchanged speed limit of 90 km/h were used as control locations. It was found that a speed limit reduction was accompanied by a reduction in average speed as well as a reduction in crash frequency. To describe the change in the number of police reported crashes due to changes in speed; Nilsson adapted the formula for kinetic energy ($E_k = \frac{1}{2}mv^2$) with the notion that only speed changes and the effect of mass can be eliminated. This led to the following equation:

$$A_2 = A_1 \left(\frac{v_2}{v_1} \right)^2 \qquad (3)$$

Subsequently, Nilsson reasoned that the number of severe crashes would increase faster with an increase in speed than the overall crash frequency and thus had to be estimated with a larger power. He used the following equation to describe the relationship between changes in speed and fatal crashes:

$$F_2 = F_1 \left(\frac{v_2}{v_1} \right)^4 \qquad (4)$$

As an example: the speed limit on Dutch motorways is 120 km/h and in 2003 there were 76 fatal crashes on Dutch motorways with a speed limit of 120 km/h. According to the equation of Nilsson on fatal crashes the number of fatal crashes would have been:

$$F_2 = 76 \left(\frac{110}{120} \right)^4 \qquad (5)$$

equals 53.7 fatal crashes if the speed limit would have been 110 km/h and the same level of compliance. A regression meta-analysis of a large number of before-after and cross-sectional studies (Nilsson, 2004; Elvik et al., 2004) showed that the outcomes of both rural and urban roads could be very well described by the formulated power functions. What must be kept in mind is that the equations of Nilsson are rules of thumb and not scientific principles. They are also based on the effects in changes in speed limit ranging from 90 km/h to 110 km/h in one country only. One should be very cautious to use the equations of Nilsson for speed limits outside the mentioned range. An increase of the speed limit for instance on most Danish motorways from 110 km/h to 130 km/h had no influence on the crash rate.

There are a lot of speed limits and the quality of roads can differ substantially. It can be rather safe to drive around 50 km/hour on a certain type of country road in EU Member State 1 and due to aspects of the terrain (e.g. hills) and other aspects, it can be totally unsafe to have a speed limit of 50 km/hour for such a kind of roads in EU Member State 2. We propose to harmonize speed limits for international commercial vehicles only. For the overwhelming part of their trips these drivers drive on motorways and motorways are not so very different in the various EU Member States. We will only calculate the safety effects for harmonized speed limits on motorways. There are very many different speed limits for motorways in EU Member States and in most countries there are different speed limits for various vehicle types. An overview is presented in Table 3.

***Table 3:* Overview of speed limits on motorways in EU Member States**

Vehicle type			km/h		
	Car	**Caravan**	**Coach**	**Light Truck**	**Heavy Truck**
Austria	130	130	100	110	80
Belgium	120	100			90
Czech Rep.	120	100			90
Cyprus	100	?	?	?	?
Denmark	130/110	80	80	80	80
Finland	80/100/120	80	80/100	80	80
France	110/130	130		110	90
Germany	no limit	80	100	80	80
Greece	120	120	90	90	80
Hungary	120	80	80	80	80
Ireland	112(70 mph)	96(60 mph)	112 (70 mph)	112/96 (70/60 mph)	96 (60 mph)
Italy	130	80		130	80
Lithuania	110	110	100	90	90
Luxembourg	120	90			90
Netherlands	100/120	80	80	80	80
Poland	130	70		80	80
Portugal	120/110	90/100	90	90	90
Slovakia	130	80	110	80	80
Slovenia	120	80	80	80	70
Spain	120	80	100	100	90
Sweden	90/110	70	90	80	80
UK	112(70 mph)	96(60 mph)	112 (70 mph)	112/96 (70/60 mph)	96 (60 mph)

Motorways do not exist in Estonia, Malta, and Latvia.

The double values in some of the cells mean· lower speed limits in wintertime than in summer for cars (Finland). In Denmark some motorways have a speed limit of 130 km/h and some of 110 km/h.

· higher speed limits for buses and coaches with special equipment (Finland)
· lower speed limits for commercial cars (Portugal)
· different speed limits for cars on motorways of different quality (Sweden).

To have any safety impact at all the harmonized speed limit must be lower than the mean speed limit in The EU. We will calculate what the safety effects will be if for cars the speed limit is set on 110 km/h (68 mph) for cars, 90 km/h (56 mph) for lorries (both light and heavy), and 100 km/h (62 mph) for coaches. The chosen speed limits for lorries and coaches is in line with another proposal in the White Paper to have mandatory speed limiting devices set on these speeds in lorries and buses.

The equation of Nilsson on fatal crashes has been used for calculating the effects. The gaps in the above table with speed limits were filled with estimates and the cells with multiple speed limits were averaged. The resulting relative fatality rates for users of motorways were converted to relative fatality rates for all road users by using data on the percentage of deaths on motorways from IRTAD. The resulting relative fatality rates ranged from **0.91** (for Austria) to **1.02** (for Finland and Sweden).

The estimates on road safety calculated in this way are not very accurate, but they are the best we can do. It is not possible to be sure that the very fact of having the same speed limit on motorways in all EU Member States will have any road safety benefit. Although motorways may look the same all over the EU, they are not the same and the design speed may vary substantially. Also the traffic volume and (weather) conditions (e.g. low speed limits in Finland during wintertime) may differ substantially. A speed limit of 130 km/h may be safe on one stretch of motorway but completely unsafe on another stretch of motor-way.

XI.3.3.3. Same penalties

The active ingredient in the proposed measure on harmonization of limits (both on alcohol and speed) and the height of the fines is deterrence (by means of police enforcement). The effect of deterrence is largely based on the subjective impression of drivers on 'the chance of getting caught' and when only financial punishment is considered, to a small extend on the amount of the fine.

The effect of fixed penalties on crashes is not known to our knowledge. Although we believe that within certain limits the deterrence caused by a rather low fine (and not imprisonment or suspension of the driving licence) is almost the same as the deterrence caused by a rather high (financial) fine. The subjective chance of getting caught is of much more importance. Redelmeier et al. (2003) discovered that after being caught and received a certain penalty, a driver changes his/her driving style for about one month in such a way that on average the fatality rate drops by around 35% (during the first month after the penalty only). However when the penalty was merely financial and was not combined with demerit points, the drop in fatality rate in the first month after being caught was statistically not significant. Elvik & Vaa (2004) cite a study by Nilsson & Åberg (1986) that in Sweden in 1982 after the fine tariff for speeding was doubled, the number of speeders did not decrease. Even a new increase in the tariff in 1987 did not lead to discernable changes in speed (Andersson, 1989). We assume that fixed penalties, as long as they are only financial in the EU will have too little impact on road safety to be calculable.

XI.3.3.4. Same chance of getting caught

It is also proposed to harmonize the density of police enforcement in EU Member States. By far the most deterrent effect will be reached when police enforcement on speeding and on driving while intoxicated in the EU is increased. One of the most effective means to prevent drivers to drink and drive is random roadside breath testing. In an ESCAPE working paper (Elvik, 2001) a meta-analysis of 26 evaluations on drink-driving law enforcement was carried out. The declining marginal effects of successive increase in enforcement were also taken into account. The study leads to the conclusion that an increase of random roadside breath testing by a factor 2 will yield to a 20% decline in drunk driving. An increase of random roadside breath testing with a factor 3 will yield to a reduction of 30%, a factor 6 will lead to a decline of 45% in drunk driving, and a factor 10 will yield to a reduction of 60%. This implies that the effectiveness of random roadside breath testing decreases with the amount of random roadside breath testing. In some countries the jurisdiction in that country doesn't allow for random roadside breath testing. We assume that in 2010 the number of random roadside breath tests will be twice the number as in 2003 and that random roadside breath testing will be possible in all Member States. The doubling will lead to a decrease of 20% in drunk driving and also 20% less fatal crashes caused by drunk driving. Assuming again that these crashes make up 20% of total crashes, the relative fatality rate for all road users is **0.96**.

Without the use of speed cameras the chance of getting caught for speeding is very low. Elvik & Vaa (2004) cite a study by Nilsson & Engdahl (1986) in which it is estimated that in Sweden (in 1986) only around three out of every 10,000 incidences of speeding are detected by the police. In a meta-analysis on the use of (stationary) speed cameras Elvik & Vaa (2004) also come to the conclusion that in areas where they are used, the number of injury crashes drops with 17% on average. In rural areas (including motorways) however the reduction is only 4%, but in urban areas it is 28%. The increase of speed cameras is expected to be the most in countries where police enforcement on speeding is low.

We assume that in 2010 there will be 10% less fatal crashes due to increased use of speed cameras. Thus, the relative fatality rate is **0.90**.

XI.3.4. Measure 49: Black spots on TENs list

Measure 49 is to have 'black spots' properly and uniformly signposted in all EU Member States.

Especially in urban areas traffic crashes tend to cluster at specific places. These places are often intersections. Black spot treatment most of the time consists of the improvement of road design or improvement in traffic control (e.g. the installation of traffic lights). Before the impact on road safety can be assessed, a definition of a black spot is needed. In their meta-analysis Elvik & Vaa (2004) define a black spot as a place with a maximum length of 100 meters, where at least 4 injury crashes have been reported to the police in the course of 4 years. On the basis of a meta-analysis they assess that treatment on black spots on average will reduce injury crashes on these spots with 14%. However when the effect of regression-to-the-mean is controlled for, the reduction of injury crashes on these treated spots is only 5% and is not statistically significant.

In the proposed measure, treatment is rather basic. No redesign of the spot and no improvement in traffic control, only better signposting. In the USA road signs in towns were upgraded in accordance with the 'Manual on Uniform Traffic Control Devices' (MUTCD). This upgrading was not only on black spots. Lyles, Lighthizer, Drakopoulos and Woods (1986) did a before-and-after study and they came to the conclusion that MUTCD had lead to a 15% decrease in the number of injury crashes. This result should be interpreted with some caution because it is not known how representative it is and it is not known what was precisely corrected in the signposting. We assume that the effect of the proposed measure in the White Paper will be a reduction of about 2% in fatal crashes on black spots when they are properly and uniformly signposted. In order to assess the safety effects we must know how many black spots (4 injury crashes in a stretch of 100 meters in 4 years) there are in all EU Member States and how many of these are not properly and uniformly signposted. It is unknown how many of the fatal crashes in EU Member States happen on black spots. In a Norwegian study mentioned by Elvik & Vaa (2004), 14% of all injury crashes happened on black spots. We assume that in the EU 14% of all fatal crashes happen on black spots. The effect of listing and properly and uniformly signposted all black spots in Europe (14% of 2%) is so small, that we assume it to have no significant effect with respect to achieving the goal of halving the number of fatalities in 10 years.

XI.3.5. Measure 50: Seat and head restraints

Measure 50 is to have seatbelts in coaches.

In a study by ETSC (1996) it is stated that an occupant of a car involved in a road crash has around 50% more chance of death when he/she is not wearing his/her seatbelt. In their 'handbook of road safety measures' Elvik & Vaa (2004) report only one study on the safety effects of seatbelts in buses. This is an evaluation study on the effects of making seatbelts compulsory in school buses in Florida. In this study it was assumed that seatbelts (both lap belts and three-point belts) could reduce the probability of injury by 0-20%. Even if wearing a seatbelt in a bus offers the same kind of protection in a bus as in a car (50% reduction of the fatality rate in crashes) the safety effect is small. Every once in a while we can read in the newspapers about tragic road crashes with coaches in which several people died. This media attention is understandable (since several people died in one crash) but because of this media attention people tend to overestimate the risk of being involved in a crash as bus passenger. In the Netherlands (were almost none of the buses have seatbelts and the use of seatbelts is not compulsory in buses) on average only one bus passenger dies in a road crash yearly. The estimated total amount of annual kilometres by bus passengers in the Netherlands is about 11 billion kilometres. If all bus passengers in the Netherlands start to use seatbelts and the safety effect is 50%, not 1 passenger will die annually but 0.5 passengers. Therefore, we will assume that measure 50 has no effect.

XI.3.6. Measure 51: Training and education

Measure 51 is to have more driver improvement courses, in particular driver improvement courses for young drivers

The crash involvement per kilometre driving for young drivers between the age of 18 and 24 is about four times higher than that of drivers between 30 to 60 years of age. In some countries not only young drivers, but drivers of all ages have to attend special courses when they have been caught for a serious offence (e.g. drunk driving) or when they have a certain number of demerit points. If they do not attend the course, their driving licence will loose its validity. In most of the cases the drivers that have to attend the course must pay the costs themselves. The training objectives are not so much on the improvement of skills but on the improvement of attitudes. These mandatory courses for drivers that have been seriously at fault are called 'driver improvement courses'.

The effectiveness of driver improvement courses has been widely debated. The problem is that good evaluation studies most of the times cannot be carried out because a reliable control group is missing. Besides this the effect of the course can also be confounded by the effects of deterrence (the course is the last chance to keep your driving licence). There have been some studies (without proper control for confounding factors) on the effects of driver improvement courses for drunk drivers that show a decline in recidivism. This decline in the first two years after the course can be up to 50%.

For other types of driver improvement courses (e.g. those on speeding or on aggressive driving) a clear reduction in recidivism due to the course has not been found. In Germany young drivers have to attend a driver improvement course only after being convicted for one serious offence or two minor offences. The effect of this measure has been evaluated by Meewes & Weisbrodt (1992). The very fact of the existence of the measure (its deterrent effect) reduced the fatality rate of young male drivers by 5% but it didn't reduce the fatality rate of young female drivers. This effect was not caused by the content of the course but by the deterrence it had on all young drivers. In a recent meta-analysis including 21 studies (Ker et al., 2005) on the effects of post-licence driver education for the prevention of road traffic crashes, no evidence was found that post-licence driver education is effective in reducing the fatality rate. In this meta-analysis the studies were evaluated and weighted on their methodological rigor. Their conclusion is that post-licence driver courses, including driver improvement courses for drivers that have been convicted, have no effect on the fatality rate. On the basis of the mentioned recent meta-analysis we assume that driver improvement courses for young drivers that have committed offences do not improve road safety.

XI.3.7. Measure 52: Independent technical investigations

Measure 52 is to have a European organization that carries out independent in-depth analyses of the most serious road crashes in the EU in order to learn from these crashes (how they can be prevented in the future).

Some EU countries like Denmark (the Havarikommissionen for Vejtrafikulykker/Road Accident Commission) and the Netherlands (the Onderzoeksraad voor de Veiligheid/Research Council for Safety) have independent organizations that carry out in-depth analyses of serious road crashes. The intention of these studies is not to find out who is guilty, but to comprehend the underlying causes of particular types of crashes. That way, evidence based measures can be formulated that help preventing those types of crashes from occuring in the future. As an example in 2001 in Denmark, an in-depth analysis was carried out on 32 serious single vehicle crashes with drivers between 18-25 years of age and in the Netherlands in 2005 the crashes on some rural express roads with a high fatality rate were investigated. The advantage of independent organizations that investigate disasters in transportation is that in some cases these organizations can have access to information that 'normal' research institutes on road safety do not have. A disadvantage is that those organizations tend to be 'disaster triggered'. Very serious road crashes in which several people die are rare. Too much focus on these types of crashes may draw the attention away from the more 'common' type of road crashes. From a road safety point of view it may be much more beneficial to have effective countermeasures for the more common type of road crashes that are less serious than for the very serious crashes that are rare. Good cooperation between the more 'traditional' road safety research institutes and the independent organizations for in-depth analyses on disasters in transportation is necessary. Because it is very important for those safety research councils that they act independently, joint activities with the 'traditional' research institutes most of the times are difficult to achieve.

The effect on road safety of a supra national independent road safety research council for the investigation of serious road crashes, will largely depend on the access it can get to information about the underlying causes of crashes and the possibilities for such an organization to work together with the more traditional road safety research institutes. An advantage of a supra national organization is the better dissemination of the results. The results and recommendations of a national organization of independent research on disasters in transportation are normally not known in other EU Member States. It is impossible to make an accurate assessment about the effects of having a supra national independent road safety research council on the relative fatality rate of road users. In Denmark the results of the in-depth analyses of single vehicle crashes involving young drivers Havarikommissionen for Vejtrafikulykker were complemented with the knowledge of the traditional research institutes. This has resulted in the Danish road safety action plan 2001-2012 to have 40% less fatalities in 2012 than in 2001. We estimate that the effects of a supra national organisation for the independent analysis of road disasters that meets the above mentioned criteria (access to information and cooperation with 'traditional' road safety research institutes), is still very limited in 2010 but can be very substantial in 2020. However, we will assume that this measure has neither effect on road safety in 2010 nor in 2020.

XI.3.8. Measure 53: Driving licences

Measure 53 is the introduction of an electronic driving licence, the harmonization of categories for certain types of driving licence and the duration of their validity in The EU, and to raise the health requirements on eyesight.

There are three criteria for obtaining and keeping a driving licence: age (e.g. in most countries the age limit for acquiring driving licence B (cars) is 18), health (physical and mental fitness tested during a medical examination) and driving capabilities (the theoretical and practical driving test). The proposal is not only to combat fraud with driving licences (the introduction of a electronic driving licence) and to harmonize the categories for certain types of driving licence and the duration of their validity in The EU, but also to raise the health requirements on eyesight (mandatory eyesight testing each time the driving licence has to be renewed after the age of 45).

Several studies (Levy, 1990; Maycock et al., 1991; Gregersen & Bjurulf, 1996, Sagberg, McCartt, Shabanova & Leaf, 2003; Vlakveld, 2005) have been carried out on age, experience, and fatality rate. An example that is illustrative for these studies is presented in Figure 3.

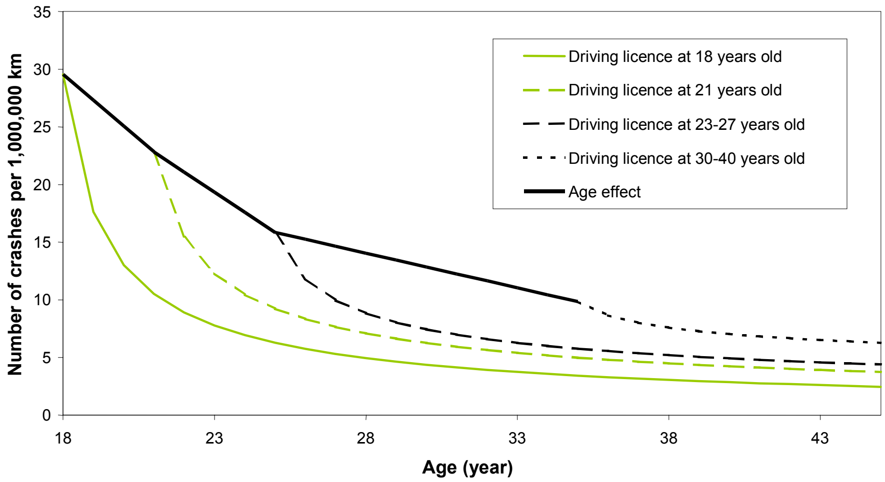

Figure 3: Reduction in the crash rates of motorists who began at 18 years old and those who started later (Vlakveld, 2005)

The older the driver is when he/she starts to drive, the lower the crash risk is at the start of his or her driving carrier. For the harmonization of age to have a positive effect on road safety this means that the age limits should be as high as possible and for car drivers (Licence category B) it should certainly not be lower than 18. Almost all the EU Member States have set their age limit for the full driving licence for cars at 18. Therefore, harmonization on 18 will only affect the UK (age limit in the UK is 17).

Although most chronic impairments reduce the driving skills (as measured in laboratories and simulators) considerably, their effect on the fatality rate (as measured in epidemiological studies) most of the times is quite moderate. A recent meta-analysis of both chronic and acute impairments is presented in Deliverable R1.1 of the EU IMMORTAL project (Vaa, 2003). Not meeting the eyesight standards of Council Directive 91/439/EEC only leads to a relative fatality rate of 1.09. The reason for this very low increase in fatality rate probably is that drivers automatically compensate for their impairment (lower speeds, longer headways). In Deliverable P2 of the same IMMORTAL-project (Vlakveld et al., 2005) it is concluded that despite the high prevalence of poor visual acuity in older drivers, mandatory eyesight testing from the age of 45 is not cost beneficial for most EU Member States.

A more stringent practical driving test (but not the theory test) for obtaining the driving licence will have a modest positive effect on road safety, provided that the practical driving test is valid (Elvik & Vaa, 2004). A test is valid when it is proven that the test measures what it is supposed to measure (in this case the ability to drive safely). To test the driving skills each time the driving licence has to be renewed, will probably have no effects on road safety. On the basis of a comprehensive literature study (Christensen, Glad & Pederson, 1974) in Norway (cited in: Elvik & Vaa, 2004) taking the driving test each time the driving licence had to be renewed was abolished. No effect on road safety of abolishing the renewal test in 1975 was found in Norway.

When driving licences are hard to obtain (costly, stringent tests, stringent medical examinations) and can be lost easily (after having committed a serious offence, after having too may demerit points, when not meeting the medical criteria at renewal of the driving licence), fraud becomes attractive. In France the police thinks that because of more police enforcement and the demerit point system, the number of false driving licences has increased enormously. Another aspect is that drivers that have lost their driving licence in one country try to do the driving test in another country. These fraudulent activities will have some impact on road safety, but not very much so. The reason for this is that fraudulent drivers do not want to attract the attention of the police and thus will stick to the rules of the road as much as possible.

We estimate that the complete package of the driving licence measure will lead to a relative fatality rate for all road users of **0.9**.

XI.3.9. Measure 54: Speed limitation devices

Measure 54 is a) the installation of speed-limiting devices in new lorries from 2005 and in all lorries registered after October 2001 in 2008 with a weight between 3.5 and 12 metric tonnes so they can't drive faster than 90 km/h and b) the installation of speed-limiting devices in new buses from 2005 and in all buses registered after October 2001 in 2008 that can carry 8 or more passengers and have a weight of maximum 5 metric tonnes so they can't drive faster than 100 km/h.

Low average speed especially on rural express roads (not motorways) and urban roads and little difference in speed between vehicles is very beneficial for road safety. The proposed measure will only reduce the speed of some vehicle types (lorries and buses) on motorways. Very little is known about the effects on road safety of speed-limiting devices. In 1988 speed-limiting devices (80 km/h) became mandatory in the Netherlands for lorries of 12 metric tonnes and more. In the year after implementation there were more crashes between cars and lorries than in the year before introduction. This rise in crash type can have had very many causes and the conclusion that speed-limiting devices are not beneficial for road safety cannot be drawn, but it is an indication that the effects on road safety are probably not too strong. In 1991 NHTSA in the USA published a report on speed control devices in commercial motor vehicles (NHTSA, 1991). The conclusion was that because of the small crash problem size (lorries in the USA were not involved in very many crashes on motorways due to speeding and lorries did exceed the speed limit but mostly they drove only just a little bit faster than the limit), mandatory speed-limiting devices for lorries and buses would have a very limited safety effect.

Mandatory speed-limiting devices for some vehicle types lead to a low average speed and small differentiations in speed for these vehicle types. This effect only applies on roads with speed limits above the speed limit of the speed-limiting device in the vehicle. The low average speed of the vehicle type on these roads and the small differentiation in speed of these vehicle types is beneficial for road safety. This is more so for lorries and buses because of their heavy mass, crashes are more severe. What is probably not so good for road safety is when on the same road the difference in average speed between lorries and buses on one side and cars on the other, becomes large. Old studies (Solomon, 1994; West & Dunn, 1971) indicate that diversion from the mean speed on a certain type of road is U-shaped. This implicates that if on the same road speed of various types of vehicles differs substantially (high speeds for cars and low speeds for lorries) the fatality rate will increase. However from the recent studies of Kloeden et al. (1997, 2001) it can be concluded that lower speeds than the average speed do not lead to an increase of the relative fatality rate (see Figure 3). In § 3.3.2 we have suggested an average speed for motorways in Europe of 110 km/h and the speed-limiting devices will be set for lorries on 90 km/h and for buses on 100 km/h. If this will be the case, no negative road safety effect can expected of the differences in average speed on motorways between lorries, buses and cars. We estimate that the very fact that lorries and coaches cannot exceed the speed limit on motorways will lead to a relative fatality rate for users of motorways of **0.95**. It is converted to relative fatality rates for all road users by using data on the percentage of deaths on motorways from IRTAD, leading to relative fatality rates ranging from **0.99 to 1,00**.

XI.3.10. Measure 55: ITS e-Safety

Measure 55 is promoting the development (by the automotive industry and the telematics industry) and use of ICT-applications that enhance road safety.

Among scientists there is a strong consensus that ITS-applications have an enormous potential to enhance road safety. In the OECD report 'Road safety: impact of new technologies' (2003) it is estimated that ITS-applications can lead to 40% reduction in injuries and fatalities. These applications include: automated collision avoidance systems (e.g. Adaptive Cruise Control (ACC)), in-car driver status warning systems (e.g. systems that warn a driver when he/she is drowsy), speed control (e.g. Intelligent Speed Adaptation (ISA)), and automated enforcement (e.g. speed cameras). Other already existing ITS-applications are: EDR's (Event Data Recorders), alcohol lock, navigation systems and Lane Departure Warning Systems (LDWA). The ITS-applications can be vehicle-based (e.g. in-car systems that warn drivers that they are drowsy), infrastructure-based (e.g. sensors in the road that can detect ice or snow) and be a combination of the two (e.g. in-vehicle navigation based on GPS and electronic maps and ISA also based on GPS and electronic maps). There are however certain drawbacks. One of these drawbacks is the way drivers adapt to these new systems. They may become less attentive to the driving task and they may take more risk. When the human machine interface is not well designed, the use of these applications may also lead to distraction. Another drawback is that the same technology that can be used to enhance road safety can also be used to deteriorate road safety. ITS enables drivers to use their cars as offices (cell phones, wireless internet, etc.) and as places of entertainment (DVD, games, etc.). These activities will distract the driver. The commercial development of ITS-applications that will enhance road safety may be hampered by their costs to develop them, lack of interest by consumers (too expensive, no fun, not necessary) and because of liability issues (who is responsible when a system that takes over a part of the driving task, fails). Finally development can also be hampered by lack of standardization and existing regulations. The aim of the proposal is to minimize the mentioned drawbacks as much as possible. This is done by:

- Support to the e-Safety Forum, to facilitate co-operation of all stakeholders;
- Inclusion of safety goals and priorities for further Research and Technological Development (RTD) under the 6th framework Programme;
- Action required on Human machine interaction;
- Promotion of an harmonized, pan-European in-vehicle emergency call (e-Call) service that build on the location-enhanced emergency call E-112;
- Monitoring of the progress made in the provision of Real-Time Traffic and Travel Information (RTTI) in The EU;
- Removal of legal barriers to the use of 24 GHz UWB short-range radar;
- Review of the relevant parts of existing EC vehicle type-approval legislation;
- Promoting the needed standardization in ISO, CEN and ETSI; and
- Assessment of the socio-economic benefits.

How the mentioned activities will speed up the penetration of ITS-applications that are beneficial for road safety, is difficult to predict. When there is a market demand and the system not only enhances road safety but also promotes driver comfort, penetration will be very quick and no support from the EU is needed. If this is not the case, the systems will not be implemented without legislation. We guess that due to ITS-applications in 2010 the relative fatality rate of road users will be **0.8** and in 2020 it will be **0.6** (the full road safety potentials ITS-applications have according to the OECD).

XI.3.11. Measure 56: Safety for vulnerable road users

Measure 56 is a voluntary agreement with the automotive industry to test new vehicle types from 2005 onwards on their safety for cyclists and pedestrians (soft noses) in case of a collision, and a test with enhanced pass criteria from 2010 onwards

Apart from relevant studies in the early 1990s, no new studies concerning the effectiveness of 'soft fronts' appear to exist. In the recent presentation for DG-Enterprise on 6 February 2002 (Hobbs, 2002), a 20% reduction was mentioned. This reduction appeared to be valid only for the sum of fatal and serious casualty reductions for pedestrians as well as cyclists. The value was based on well-documented TRL-estimates for serious casualty reduction from their earlier studies. On behalf of the EU the 'MIRA-study' was carried out (1997). The essence of this study, regarding fatality reduction by a soft car front, is an update of benefit calculations from all previous relevant scientific reports (from TRL, BASt, ACEA, and SWOV), in order to make these results comparable and to base the calculations on the casualty numbers of 1997. By reasoning that the benefits resulting from these relevant studies were all within a range, MIRA duplicated those two calculations that would come out at a lowest estimate and a highest estimate of benefits. This resulted with respect to pedestrian fatality reduction in a lower estimate of 3% and a higher estimate of 30% reduction.

With regard to casualty reduction for cyclists, MIRA used the earlier SWOV report as an example. However, all benefits being calculated in the SWOV report were slightly misinterpreted in the MIRA-study. This caused the quoted results to be somewhat overestimated. Since the essence of the calculation of benefits for cyclists is that SWOV assumed (and still does) that these would be 50% of those calculated for pedestrians, we will use this same procedure here (now restricted to fatality reduction only). We assume the following fatality reduction in case of a collision between car and a cyclist or pedestrian if the car has a 'soft nose' that complies with the EU criteria for 2005:

	Fatality reduction	
	Low estimate	High estimate
Pedestrians	3%	30%
Cyclists	1.5%	15%

The measure will be introduced for new car types only (no retrofit). There is a difference between *new cars* and *new types*. A new type has to be subjected to the new approval front tests. A new car is a car from an older model year that meets the older requirements (and not the new front requirements). The calculations in this chapter concern new car types (new car designs).

It is assumed that the new cars, as well as the new types have a technical life span of 12 years and that each year 1/12th of the existing car fleet is replaced by new cars. So the assumption is that after 12 years the whole car fleet will be equipped with 'soft' fronts (in reality, there will still be cars older than 12 years). This means that in 2010, 42% of all cars will have soft fronts, and in 2020 100%. Using the average of low and high estimates for the effect of soft noses, and converting to relative fatality rates for all road users by using data on the percentage of deaths on bikes and on foot from IRTAD, the relative fatality rate of measure 56 ranges from **0.97 to 0.98** in 2010 and from **0.93 to 0.97** in 2020.

XI.3.12. Extra measures

XI.3.12.1. Daytime Running Lights (DRL) for cars and motorcycles

At the moment, in most EU countries the use of low beam headlights is not compulsory during the day. During the last decade, several reviews, crash analyses, and meta analyses have been carried out to study the effects of compulsory use of daytime running lights on traffic crashes. The focus is on multi-party daytime crashes, as there is no evidence to indicate that DRL affects other types of crashes (Elvik, 1996; Rosebud, 2003). DRL-relevant crashes represent about 40% of the total amount of fatalities in EU 25 (Ecorys, 2005).

Compulsory DRL has shown to be a highly effective measure. ETSC (2003) calculated that compulsory DRL could lead to a reduction of 7% in the total number of fatalities in EU15 countries. Some countries already have laws requiring DRL: Denmark, Norway, Sweden and Finland. These countries are excluded from the analysis. Also, it is assumed that the percentage of DRL-relevant fatalities is 40% and that the use of DRL is 90%.

It is difficult to translate this figure of EU15 to EU25 countries. In EU15 countries, already 4 countries have laws requiring DRL, whereas in the 10 new EU Member States only Hungary has such a law. The effect is therefore possibly higher in the new Member States. However, assuming that the percentage of fatality reduction is the same in EU 25 as in EU 15, compulsory DRL might lead to a relative fatality rate of **0.93**.

XI.3.12.2. Safer design of roads in urban areas

Several additional measures would increase safety inside urban areas. The extent to which these measures are effective, varies a lot across countries. For example, the construction of separate bicycle lanes is less effective in countries with hardly any cyclists than in a country with many cyclists. On the other hand, countries with many cyclists probably direct more attention to the construction of bicycle facilities.

Studies that separately study the effects of these measures are difficult, because the effects of confounding variables cannot be ruled out completely. In a SWOV study (Schoon, 2000) effects of various policy measures are estimated. A combination of measures (roundabouts, separated bicycle tracks, 30-km/h zones) is supposed to lead to a casualty reduction of 17% (access roads) and 18% (distribution roads). However, these percentages refer to total amount of casualties and therefore represent the maximum achievable effect for fatalities. The number of fatalities that may be prevented by these combinations of measures is estimated at 150 per year. Keeping in mind that the average number of traffic fatalities in the Netherlands has been around 1000 per year, the estimated percentage yearly fatality reduction would be 15%; or a relative fatality rate of **0.85**. This is, again, a maximum effect, since it assumes that all the measures are implemented in all countries and that the crash types these measures are aimed at are similar across countries, which we know is not the case. Furthermore, this is directed at the Dutch situation and the assumption is made that all other measures of the traffic safety vision of the Netherlands are implemented as well (The measures of the Dutch traffic safety vision, Sustainable Safety, are described in more detail in Schoon (2000; in Dutch) and in Dijkstra, Janssen and Wegman (2005)).

XI.3.12.3. Safer design of roads in rural areas

Rural roads form a substantial problem for traffic safety because of the combination of speed differences, traffic from two directions, presence of same level intersections, and different types of road users. Crashes on rural roads are generally more severe than other crashes.

It is estimated that 50% of all fatalities occurs on rural roads, although there are large differences between countries. For example, the percentage fatalities occurring on rural roads in Italy is 49% and in Spain it is 76% (OECD 1999).

A combination of measures directed at the design of rural roads is described in Schoon (2000). These are, for example, construction of parallel roads (to prevent direct connections to dwelling areas), separation of traffic directions, roundabouts, and construction of safe (paved) shoulders. The combination of these effects is estimated to lead to a reduction of around 93 fatalities per year. This is directed at the Dutch situation and the assumption is made that all other measures of the traffic safety vision of the Netherlands are implemented as well (The measures of the Dutch traffic safety vision, Sustainably Safe, are described in more detail in Schoon (2000; in Dutch) and in Dijkstra, Janssen and Wegman (2005).). The potential effect of these measures on relative fatality rate is **0.91**.

XI.3.12.4. Measures aimed at trucks and vans

Trucks and vans are not more often than passenger cars involved in crashes when mileage is corrected for. However, because of the large mass, the crashes are generally much more severe; often leading to heavy injury or death to the other party. Measures aimed at these vehicles are therefore typically directed at preventing injuries to the other party.

Separate measures are by themselves not very effective: for example, TLN (2002) estimated that the obligation of blind spot systems on lorries would save 5 lives per year in the Netherlands; or 0.5% reduction of fatalities. However, a coherent set of measures directed at this specific group of road users might have a substantial effect. TLN (2002) provides a summary of these measures (e.g. safety culture, blind spot mirrors and cameras, closed side underrun protection) and has calculated that all of these measures together would save 32 lives per year (about 3% or a relative fatality rate of **0.97**).

XI.3.12.5. Helmets for cyclists, moped riders, and motorcyclists

An increase in the use of helmets by users of two-wheeled vehicles would reduce the number of fatalities in these road user groups substantially. For motorcycles, the use of the helmet is compulsory in all countries and wearing rates are almost 100%. For this group, little effects can be expected. The use of bicycle helmets is increasing, but the variation in use across countries is substantial. A meta-analysis (Attewel et al., 2001) concluded that the use of bicycle helmets would lead to a fatality rate reduction for the target group of 29%. Bicyclist fatalities represent about 5% of all fatalities. Therefore the use of bicycle helmets would reduce total amount of fatalities with about 1.5%.

In Schoon (2000) the effect of intensified police enforcement on helmet use by moped riders is estimated. A possible reduction of 2 fatalities per year may be accomplished by implementing this measure. Keeping in mind that the average number of traffic fatalities in the Netherlands has been around 1000 per year, intensified police enforcement on helmet use by moped riders would reduce the fatality number by 0.2%.

Ecorys (2005) calculated that compliance with legislation on crash helmet use (not specified) would possibly lead to a reduction of 1200 traffic fatalities in EU25. Keeping in mind that the yearly amount of traffic fatalities in EU25 is at the moment around 50,000, this would mean a reduction of 2.4%.

It is difficult to compare these figures because they are related to different road user groups and use different estimation methods. However, an estimated reduction in fatality rate of 1.5 % seems not unlikely, leading to a relative fatality rate of **0.985**.

XI.4. Calculations and results

XI.4.1. Relative fatality rate for all scenarios

The relative fatality rates of the P-scenario are calculated in (Ecorys 2005). The rest of the scenarios are calculated using the relative fatality rates assessed in this report. This leads to the following table.

Table 4: Relative fatality rates of all scenarios for 2010 and 2020

2001 = 100%	Year 2010				Year 2020			
	N	P	F	E	N	P	F	E
Austria	63%	56%	35%	24%	31%	27%	13%	9%
Belgium	62%	55%	36%	25%	33%	29%	14%	10%
Cyprus	68%	60%	41%	28%	39%	34%	17%	12%
Czech Republic	88%	78%	54%	37%	64%	56%	29%	20%
Denmark	73%	65%	44%	30%	44%	38%	19%	13%
Estonia	53%	46%	32%	22%	24%	20%	10%	7%
Finland	69%	61%	43%	30%	40%	35%	18%	13%
France	53%	48%	32%	22%	28%	25%	12%	9%
Germany	71%	63%	41%	28%	40%	35%	17%	12%
Greece	62%	55%	36%	25%	36%	31%	16%	11%
Hungary	73%	64%	44%	30%	41%	35%	18%	12%
Ireland	63%	56%	38%	26%	38%	33%	17%	11%
Italy	69%	61%	40%	27%	43%	38%	18%	13%
Latvia	40%	35%	24%	17%	13%	11%	6%	4%
Lithuania	65%	57%	39%	27%	36%	30%	16%	11%
Luxembourg	72%	64%	43%	29%	46%	40%	20%	14%
Malta	91%	81%	56%	38%	73%	64%	33%	23%
Poland	72%	63%	44%	30%	42%	35%	18%	12%
Portugal	55%	49%	33%	23%	24%	21%	11%	7%
Slovakia	82%	73%	50%	34%	65%	57%	29%	20%
Slovenia	61%	54%	37%	25%	27%	24%	12%	8%
Spain	81%	72%	49%	33%	59%	52%	26%	18%
Sweden	67%	59%	42%	29%	37%	32%	17%	12%
The Netherlands	73%	64%	43%	30%	43%	37%	19%	13%
United Kingdom	78%	68%	46%	31%	48%	41%	21%	14%

These results are based on a projection of the total number of fatalities. A better method (described in XI.1.2) would make use of mobility data for different traffic modes, including cyclists, motorcyclists etc.. These data are not readily available for many countries.

Even without mobility data, the projections could be improved upon, by using the number of fatalities for each combination of traffic modes (fatalities among cyclists in an accident with a lorry). These data are not available in CARE or IRTAD, and even many individual member states are yet unable to produce such data (for long time series). This became clear in a small recent study (OECD, 2006). The results of this study show that predictions of fatalities, based on the total number of fatalities may lead to an underestimation of the number of fatalities.

XI.4.2. Mobility data for all scenarios

The mobility data are average growth rates for the period 2000-2020 and are drawn from the simulation of the ASSESS scenarios carried out using the SCENES model. The SCENES model is described in Annex VI of the final report.

Table 5: Average mobility growth rates for 2000-2020

	N-scenario	P-scenario	F-scenario	E-scenario
Austria	1.5%	1.5%	1.4%	0.3%
Belgium	1.1%	0.9%	1.1%	-0.8%
Cyprus	4.1%	3.9%	4.0%	3.3%
Czech Republic	3.4%	3.6%	3.3%	2.3%
Denmark	1.2%	1.0%	1.1%	-0.2%
Estonia	3.2%	2.9%	3.0%	2.2%
Finland	1.3%	1.0%	1.1%	-0.3%
France	1.3%	1.3%	1.2%	-0.2%
Germany	0.9%	1.2%	0.9%	0.0%
Greece	1.3%	1.0%	1.2%	-0.3%
Hungary	2.6%	2.9%	2.6%	1.3%
Ireland	2.4%	1.9%	2.3%	0.0%
Italy	1.1%	0.7%	1.0%	-1.7%
Latvia	4.6%	4.5%	4.5%	3.8%
Lithuania	4.1%	3.9%	4.0%	3.1%
Luxembourg	1.3%	1.2%	1.2%	0.5%
Malta	1.0%	0.4%	0.7%	-0.8%
Poland	3.3%	3.4%	3.2%	1.9%
Portugal	0.9%	0.8%	0.9%	-0.5%
Slovakia	3.5%	3.5%	3.4%	2.9%
Slovenia	3.2%	3.2%	3.1%	2.3%
Spain	1.9%	2.0%	1.8%	0.6%
Sweden	1.7%	1.5%	1.6%	0.9%
The Netherlands	1.4%	1.2%	1.3%	0.1%
United Kingdom	1.7%	2.2%	1.6%	0.5%

With 2001 as the reference year, this leads to the following table with the relative mobility rates for all scenarios.

Table 6: Relative mobility rates of all scenarios for 2010 and 2020

2001 = 100%	Year 2010				Year 2020			
	N	P	F	E	N	P	F	E
Austria	114%	114%	113%	103%	132%	133%	130%	106%
Belgium	111%	108%	110%	93%	124%	118%	123%	86%
Cyprus	144%	141%	142%	134%	215%	207%	211%	185%
Czech Republic	135%	137%	134%	123%	189%	195%	187%	154%
Denmark	111%	109%	111%	98%	125%	121%	124%	97%
Estonia	133%	129%	131%	122%	183%	172%	177%	152%
Finland	112%	110%	111%	97%	128%	122%	124%	94%
France	112%	112%	112%	98%	128%	127%	126%	95%
Germany	109%	111%	108%	100%	120%	125%	118%	100%
Greece	112%	109%	112%	97%	127%	120%	126%	94%
Hungary	126%	129%	126%	112%	163%	171%	162%	127%
Ireland	124%	118%	123%	100%	157%	143%	154%	99%
Italy	110%	106%	109%	86%	122%	114%	121%	72%
Latvia	150%	149%	148%	140%	237%	232%	230%	205%
Lithuania	144%	141%	142%	131%	215%	208%	210%	177%
Luxembourg	112%	112%	112%	105%	128%	126%	126%	110%
Malta	109%	103%	106%	93%	121%	107%	113%	85%
Poland	134%	135%	133%	119%	186%	188%	183%	144%
Portugal	109%	108%	108%	96%	119%	117%	118%	92%
Slovakia	136%	136%	135%	129%	191%	191%	188%	171%
Slovenia	132%	133%	131%	122%	181%	183%	177%	153%
Spain	119%	120%	117%	106%	143%	147%	140%	113%
Sweden	117%	114%	116%	109%	139%	133%	136%	120%
The Netherlands	113%	112%	113%	101%	130%	127%	129%	102%
United Kingdom	116%	122%	116%	105%	137%	152%	136%	110%

XI.4.3. Predicted fatalities for all scenarios

We take the product of the relative fatality rates and the relative mobility rates to calculate the relative fatality figures for all scenarios in 2010 and 2020.

Table 7: Predicted relative fatality rates for all scenarios for 2010 and 2020

	Year 2010				Year 2020			
	N	P	F	E	N	P	F	E
Austria	72%	64%	40%	25%	42%	36%	17%	9%
Belgium	68%	59%	40%	23%	41%	34%	18%	9%
Cyprus	98%	84%	58%	38%	85%	70%	36%	22%
Czech Republic	119%	108%	73%	46%	121%	110%	54%	31%
Denmark	81%	71%	48%	30%	55%	46%	24%	13%
Estonia	71%	60%	42%	27%	43%	34%	18%	11%
Finland	78%	67%	48%	29%	52%	42%	23%	12%
France	60%	53%	35%	21%	36%	32%	16%	8%
Germany	77%	70%	45%	28%	48%	43%	20%	12%
Greece	69%	60%	41%	24%	45%	37%	20%	10%
Hungary	92%	82%	55%	34%	67%	59%	29%	16%
Ireland	78%	66%	47%	26%	59%	46%	26%	11%
Italy	76%	65%	43%	23%	53%	43%	22%	9%
Latvia	61%	53%	36%	24%	31%	26%	13%	8%
Lithuania	94%	81%	56%	36%	77%	62%	33%	19%
Luxembourg	81%	71%	48%	31%	59%	51%	25%	15%
Malta	99%	84%	59%	36%	89%	69%	38%	19%
Poland	97%	85%	58%	36%	77%	66%	33%	18%
Portugal	60%	52%	36%	22%	29%	25%	13%	7%
Slovakia	111%	99%	67%	44%	124%	108%	55%	34%
Slovenia	81%	72%	48%	31%	49%	43%	21%	13%
Spain	96%	86%	57%	35%	85%	76%	37%	20%
Sweden	78%	68%	48%	31%	52%	43%	23%	14%
The Netherlands	82%	72%	49%	30%	55%	47%	24%	13%
United Kingdom	90%	83%	53%	33%	65%	62%	28%	16%

Finally, we combine Table 7 with the predicted fatalities for 2001 (Ecorys 2005) to calculate the absolute fatalities for all scenarios in 2010 and 2020.

Table 8: Predicted fatalities for all scenarios

	Reference data 2001	Year 2010				Year 2020			
		N	P	F	E	N	P	F	E
Austria	960	690	610	382	238	399	349	162	90
Belgium	1455	993	859	579	336	602	501	258	124
Cyprus	103	101	87	60	39	88	72	38	23
Czech Republic	1358	1617	1461	989	621	1647	1489	739	420
Denmark	446	363	316	216	132	245	207	107	58
Estonia	193	137	116	81	52	83	66	35	21
Finland	410	319	275	195	117	211	174	93	48
France	8146	4894	4337	2888	1738	2947	2570	1281	665
Germany	6997	5390	4864	3119	1989	3347	3037	1416	830
Greece	1875	1294	1115	761	455	849	699	367	188
Hungary	1250	1148	1028	689	422	839	742	363	196
Ireland	402	313	265	188	105	237	187	103	46
Italy	6689	5066	4344	2904	1562	3535	2880	1489	610
Latvia	528	320	278	191	124	164	136	69	43
Lithuania	702	659	567	393	250	539	438	229	133
Luxembourg	63	51	45	30	19	37	32	16	10
Malta	15	15	13	9	5	13	10	6	3
Poland	5562	5395	4747	3231	1978	4307	3664	1847	995
Portugal	1680	1005	879	601	368	487	412	212	114
Slovakia	611	678	603	412	270	759	662	337	210
Slovenia	279	226	201	135	86	137	120	59	35
Spain	5522	5314	4768	3148	1953	4703	4207	2033	1126
Sweden	572	445	386	275	178	297	247	133	81
The Netherlands	1021	841	734	499	307	566	477	245	133
United Kingdom	3590	3201	2812	1900	1313	2295	1962	991	641
Absolute totals	**50277**	**40372**	**35762**	**23796**	**14479**	**29286**	**25516**	**12600**	**6738**
Relative totals	**100%**	**80%**	**71%**	**47%**	**29%**	**58%**	**51%**	**25%**	**13%**

XI.5. Summary

XI.5.1. Preliminary remarks on the road safety assessment

The table below shows observed and expected number of traffic fatalities in EU15 and NMS10. The observed numbers are according to IRTAD and CARE databases. The expected numbers are according to the partial scenario, as assessed in Annex XI. It can be seen that the number of fatalities is decreasing. However, continued effort is required to fulfil the White Paper target of halving the number of persons killed by 2010.

Table 9: Number of persons killed

	observed				partial scenario		
	2000	2001	2002	2003	2005	2010	2020
EU15	41121	39 852	38 604	na	33 989	26 660	18 118
NMS10	11481	10535	11131	10782	9 934	9 101	7 399

Fatality rates of road traffic have decreased significantly following the introduction and enforcement of more stringent speed limits and vehicle and infrastructure safety standards. But in the new Member States the growth in traffic is increasingly offsetting these improvements; the number of fatalities in the period 2000-2003 was stabilising. It is expected that these countries will follow the rest of Europe in a decrease towards 2010.

The assessments of the future number of fatalities were carried out in April and May of 2005, using the then available data on the number of fatalities. The assessment was part of the midterm review of the Road Safety Action Program (Ecorys, 2005). Data of 2004 was at that moment not yet available. In 2004, the number of fatalities in Europe decreased more than usual. For some large countries the decrease was very substantial (Spain :-12%), France (-8%), some smaller countries had even better results (Netherlands –19%, Denmark –15%). This overall decrease is of course promising. Unfortunately the 2004 results are not available for all countries. Also, the main assessment of the projections of fatalities to 2010 and 2020 is not very sensitive to temporary fluctuations in a single year. We have therefore concluded that the estimated number of fatalities should not be adjusted for the sudden decrease in 2004.

When 2005 proves that the decrease in 2004 indicates a real trend break, this will mean that it will be a lot less difficult to achieve the goal. As for now, we are not convinced that this is the case, and we prefer to be not too optimistic in our assessment of predicted safety.

XI.5.2. Scope of the road safety assessment

Improving traffic safety is a shared responsibility of the commission and the Member States. The reach of the White Paper (as an independently assessable set of measures) is therefore limited, and so is the assessibility of the White Paper measures of the actual reduction of fatalities. This is due to the fact that the effect of some measures depends upon what is being undertaken in the Member States, and the effect of others to future steps not being known now. Still, the aim of this project is to quantitatively assess the effects of the White Paper, and specifically of the safety measures therein. In assessing the effects of the white paper safety measures, we encountered quite some difficulties. Not because the White Paper measures aren't good, but because the measures were mostly not expressed sufficiently specific to enable assessment of the expected effects. Traffic safety may well benefit from the White Paper measures, but to quantitatively assess them, many measures are not specified sufficiently.

Not all White Paper measures were stated in a way that made it clear and easy to decide what effects are to be expected from the measure. For other measures, the effects are clearly positive, although small in a quantitative sense. As the project aims at an assessment on a European level, very small effects are not considered in our quantitative analysis, and also we sometimes assumed specific activity in the Member States, as a result of the White Paper.

The measures stated in the White paper roughly fall into two action levels: harmonization of penalties and promotion of new technologies to improve road safety. These are indeed important issues. Controls and penalties vary across states, and for drivers to comply with traffic laws, it would be best to have a European traffic system that is consistent, predictable and uniform. Also, technological improvements have a great potential to improve safety.

These "action levels" that are stated in the White paper, (the harmonization level and the technological improvement level) could be extended with more levels of action, or more categories of measures. The focus is now on measures with a legislative or technological character, but one could also think of measures organised around infrastructure or behaviour.

Then for the specific measures, the following conclusions can be made. Some of the measures are indeed important and should be carried out, but they are in themselves not significantly reducing the number of traffic fatalities. We illustrate this with two examples.

Measure 47 proposes to set a target of halving the number of traffic fatalities in 2010 as compared to 2001. Target setting is extremely important, because it gives a motivation to the national authorities to invest effort to reach the target. However, for target setting to be effective itself, other measures are to be taken by the Member States. Assessment of the effect depends on these local measures. To calculate the effect of Measure 47 one should know the different measures that have been taken and the vision that has been developed by the Member States. Also, if a Member State decides for a less ambitious target, the EU target becomes virtually ineffective for that country. A quantitative assessment of the effect of the EU-target itself is therefore not possible.
Measure 52 proposes independent technical investigations. Again, this is a promising measure, but it is impossible to make an accurate assessment about the effects of having a supra national independent road safety research council on the relative fatality rate of road users. Such a council would no doubt generate new and valuable knowledge, and we advise in favour of such a measure. The effects on the number of fatalities would however only be through new measures, being thought of due to this new knowledge.

Some of the measures are possibly not very effective, when we only look at the number of fatalities, because either the traffic safety problem they are directed at is not substantial (seat belts in coaches) or prior research shows that safety effects are marginal (driver improvement courses). However, it should not be understood that these measures are to be avoided. It is very well possible that measures with modest effects are still cost effective. If cost-effective measures are to be selected, the absolute number of fatalities saved is not the only criterion. In the sense that the effect of measures is to be quantitatively assessed, the measures are sometimes not appropriately described (which is a consequence of the nature of EU measures).

Other measures are potentially effective, but could be extended, for example the measure on black spots. Measures directed at black spots would have the potential to increase road safety. However, in the measure the focus is on signposting. This may have a small effect, which can be improved upon with other (e.g. infrastructural) measures to handle black spots. Signposting itself is not very effective, but can be worthwhile when the measure is easily carried out. Once it is known where these black spots are (which is perhaps quite an investment for some countries), taking additional measures to tackle the problems connected to these black spots, may be an important and effective next step.

Finally, the White Paper lists measures on several important subjects, such as enforcement and e-safety. The effects of e.g. speed limit enforcement and Intelligent Speed Adaptation are beyond doubt. However, the measures as stated do not lead directly to implementation of enforcement or e-safety. So although the subjects of these measures are very important to traffic safety, the measures need further specification to enable estimation of the expected effect. In the assessment of this report, however, we have optimistically assumed that both measures are indeed followed by the intended implementation steps.

The general conclusion is that the measures do indeed offer good possibilities to improve road safety. In order to be more effective, it would be good to determine measures on those selected levels that are known to be problematic for road safety, and to design measures that tackle more of the actual problem at hand. Finally, for a quantitative assessment of safety measures, a distinction should be made between measures that facilitate road safety research and policy, (like target setting and installing traffic safety boards) and measures that are actually directed at reducing road traffic fatalities. The first type is not well assessable.

XI.5.3. The four scenario's

In the White Paper, the goal is stated to halve the number of people killed in traffic between 2001 and 2010. For the four scenarios used in the estimation of the safety effects, the conclusions are as follows.

XI.5.3.1. N-scenario: none of the White Paper measures have been implemented.

For this scenario, the predictions of the number of fatalities in 2010 and 2020 are based upon autonomous changes, corrected (in a negative way) for those White Paper measures that have been implemented and effective. Thus, effects of the measures with high or very high likelihood to be implemented are excluded. According to this scenario, the objective of a reduction in traffic fatalities of 50% will not be reached. None of the EU Member States would reach a 50% reduction in 2010 and for some Member States there would even be an increase in fatalities (Slovakia and Czech republic). For the 25 EU Member States the overall predicted relative fatalities for this scenario is 87%.

XI.5.3.2. Partial and most likely implementation (P-scenario)

For this scenario, the predictions of the number of fatalities in 2010 and 2020 are based upon autonomous changes (including the effects of the measures with high or very high likelihood, see Annex XI) in the relative fatality rate of road users and on changes in mobility rates. The assessment is based on a projection of a time series of the total number of fatalities. This approach is expected to lead to an underestimation of the number of fatalities. The results may therefore be a little too optimistic. (Annex XI.4.1).

According to this scenario, none of the Member States will reach the 50% reduction in 2010. Some states are approaching the objective (Latvia, France, Portugal), whereas Czech Republic still shows an increase in fatalities. For the 25 EU Member States the overall predicted relative fatalities for this scenario is 73%.

XI.5.3.3. Full implementation scenario (F-scenario)

For this scenario, the predictions of the number of fatalities in 2010 and 2020 are based upon autonomous changes in the relative fatality rate of road users, on changes in the relative fatality rate of road users caused by all measures contained in the White Paper, and on changes in mobility rates. According to this scenario, part of the EU Member States reach a 50% reduction of traffic fatalities. The majority of the Member States still show a prediction of relative fatalities which is higher than 50%, although not to a great extent. The overall estimate for all 25 Member States is 49%, so for the EU as a whole, according to the full implementation scenario, the objective will be reached. However, in this scenario a rather rigorous implementation of (among other things) e-safety (measure 55) is assumed, which is responsible for a large part of the reduction (without measure 55 the reduction of the full scenario would be 75%).

XI.5.3.4. Extended scenario (E-scenario)

In the E-scenario, the extended scenario, all the measures stated in the White Paper are implemented. Also, additional measures are included in the scenario (e.g. sustainable safe infrastructure in urban and rural areas all over Europe, daytime running lights). According to this scenario, all EU Member States reach the objective of a 50% reduction in 2010. The overall predicted relative fatalities comes down to 30% for all 25 EU Member States.

Although the full implementation and the extended scenario show positive estimates, care should be taken to be too optimistic. Many assumptions were made to come to these estimates. As stated before, the full implementation scenario is not the most likely scenario, and as the extended scenario is based on the full implementation scenario, this scenario is even less likely. Even if the full implementation scenario will not be reality, proposed additional measures are obviously necessary.

A more realistic estimate would be found for a scenario without measure 55 (e-safety). In our assessment we assumed a far-reaching implementation of e-safety. However, we think this far reaching implementation is unlikely to be fully carried out. A reduction to 40% may be the maximum achievable. This would still ask for vast investments in safe infrastructure. A very rigorous programme might lead to a 50% reduction.

Of course, these estimates are not based on the possibly enduring effect that was seen in 2004 in some countries. Reality may turn out to be (and hopefully will be) more positive than the estimated reduction of fatalities in this report. However, as stated in III.2.5, we propose to be careful with considering the 2004-results to be absolute and definite. History has proven that a sudden decrease in the number of traffic fatalities may well be followed by a substantial rise in the next year.

XI.5.4. Recommendations

We showed that two out of four scenarios will lead to a fatality reduction that meets the objectives of the EU for 2010. However, these scenarios are not the most likely scenarios. Therefore, to reach an effect that is both realistic and substantial, it is necessary to review the measures and if possible to adjust them.

With regard to the action levels, it is recommended to extend these with more levels that are known to be relevant for traffic safety. Harmonization is not equally effective for all fields mentioned, which is to be taken care of when further steps are taken in harmonization of BAC-level, speed limits etc. (see Annex XI,3.3). Measures that aim at European harmonization will be difficult for individual Member States to implement. Although it is difficult to decide e.g. what speed limits should be applied to which road types, all over Europe, we suggest that steps be taken to come to an advisory set of speed limits that correspond to road types (even if the implementation may take years). These road types might be based on principles concerning the function of the road, the vehicles that use the road, design of intersections etc. This links harmonization and technical improvements to areas like infrastructure and road user behaviour. A detailed problem analysis, as was done by Ecorys (2005) would help to clarify those areas where the maximum gain can be reached in terms of fatalities and helps to determine in which areas most effort should be invested.

The measures stated in the White Paper are in itself good measures but in order to reach maximum effect, they could be more specific. For each of the measures, it should be clarified which are the target groups they are directed at; is this an area in which safety effects may be reached, what do we know from prior research about the effects of this measures and how are we going to operationalise the measure. This would make the implementation of the measure more likely and at the same time it would increase the effectiveness of the measure, distinction should be made between measures directed at a reduction of fatalities, and measures directed at facilitation of research and policy. Measures should also be reviewed in terms of cost-effectiveness. For some of the measures mentioned in the extended scenario, cost-effectiveness studies have already been carried out. It may be worth the effort to perform a robust cost effectiveness assessment for some of the most straightforward measures and best practises, when applied in different countries. It may perhaps help Member States to decide for implementation of measures that are especially cost-effective for that Member State.

Finally, to be able to make estimations of effects of measures on road safety, many assumptions have been made. These assumptions are not necessarily reality. For example, with regard to harmonising alcohol controls, it is assumed that setting the European BAC-limit at 0.5 g/l will only have a safety effect in countries with a BAC limit above 0.5 g/l. Also, with regard to *soft nose*, the assumption is made that after 12 years the whole car fleet will be equipped with 'soft' fronts (in reality, there will still be cars older than 12 years). It would be good to clarify these assumptions and, if these assumptions turn out to be highly unlikely, to replace the measures by others that are more specific and based on more extensive research.

A last remark may be made about accident data. With CARE and IRTAD data, the more straightforward statistics are available. For a sophisticated study like this, statistics are actually not sufficient. For this type of research it is actually necessary to have access to the entire database of accident data of each country. Nowadays it is technically possible to offer web enabled access to databases. Only very few countries use this technique. Perhaps it leads too far outside the field of the White Paper assessment, but we would like to give this idea into consideration: enhance the use of web enabled access to accident databases of individual Member States.

In sum, we recommend

1. Clarify and specify the measures stated in the White paper (guidelines or even legislation on speed limits, BAC etc.)
2. Conduct cost-effectiveness analyses or reviews in order to decide what measures to implement
3. Distinguish between policy and research facilitating measures and road safety measures
4. Shift the attention from those measures that are either less effective, less specific, or for which the assumptions are questionable, to new measures as described in paragraph 3.12.of Annex XI (Daytime Running Lights, Sustainable Safe infrastructure in urban and rural area's etc.).
5. Enhance the use of web enabled access to accident databases of individual Member States

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