Long-term forecasts of road traffic fatalities in the European Union

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Summary

This report describes methods to forecast road crash fatalities. The methods were used in two European Union studies, *Impact Assessment* and *ASSESS*. These studies were both carried out in 2005. This report describes the general method, compares the applications in the two studies and presents the results.

The general method is based on predictions of the overall risk, i.e. the ratio between the total number of fatalities and the total distance travelled (the mobility). Both studies calculate the future total number of fatalities by forecasting risk and mobility separately. By multiplication of future risk and future mobility we obtain the expected total number of fatalities.

In both studies, SWOV used structured time series analysis (state space analysis) to assess future risk. In the *Impact Assessment* the future mobility was estimated with a state space approach as well, while in *ASSESS* the future mobility was estimated with the use of economic growth models by other partners in the consortium. Therefore the results of both studies are different.

The forecast in the *Impact Assessment* was made in order to assess the feasibility of the target of the Road Safety Action Programme, halving the number of road deaths by 2010. The forecast presumes that no additional efforts will be made to reduce the number of fatalities; this is called the 'business as usual' scenario. The gap between the target and the predicted number of fatalities in 2010 should be bridged by the Road Safety Action Programme.

In *ASSESS*, four scenarios are considered. One of them, the 'most likely' scenario, is comparable to the expected development in the *Impact Assessment*. The other three scenarios differ in the expected mobility growth, and in the supposed safety measures taken. The effect of safety measures was taken into account by estimating a risk reduction for every safety measure to be considered. This risk reduction led to a new value of the predicted risk. The assessment of the effect of changes in mobility is straightforward (we multiplied the risk and the new values for the mobility).

Contents

1. Introduction

In 2005, SWOV carried out two traffic safety assessments for the European Union. In these assessments, SWOV estimated the expected number of traffic fatalities for 25 EU countries, in 2010 and 2020. The first study was in the framework of the Midterm Review of the European Road Safety Action Programme, the other in the framework of the Midterm Review of the White Paper on European transport. The first was called the *Impact Assessment*, the second was called *ASSESS*

Both studies differed in context, approach and use of reference data. The *Impact Assessment* was more specifically aimed at an evaluation of EU policy in road traffic safety and was carried out by Ecorys Transport in cooperation with SWOV. *ASSESS* focussed on EU policy for the future development of multimodal transport in Europe. *ASSESS* treats economic development and the effects on rail, road, air, waterway and shortsea transport. This assessment was carried out by a consortium lead by Transport & Mobility, Leuven, with TNO, Netherlands; WSP, UK; TRT, Italy; DLR, Germany; University of Gdansk, Poland; ITS Leeds, UK; CAU Kiel, Germany; Istanbul Technical University, Turkey; and SWOV, Netherlands.

The contributions of SWOV to both midterm reviews are published separately at the EU website (Ecorys Transport & SWOV, 2005; Vlakveld et al., 2005). They both describe in detail the data that were available, the techniques that were used and the results obtained. In this report we describe and compare the methods and we present the main results. Some improvements for future forecasts are recommended.

2. Methods for long-term forecasts of traffic fatalities

2.1. Method used in the *Impact Assessment*

In the *Impact Assessment*, for each country data on the annual number of fatalities and the annual amount of mobility were gathered, for as long a time period as possible. Practically all data were obtained from CARE and IRTAD for the period 1970-2003. Then for every year the risk was calculated, according to the following robust relation between the yearly number of fatalities N_F, the mobility M (in motor vehicle km driven or, for some countries, number of vehicles) and the risk r:

$$N_F = r \cdot M \tag{1}$$

With r(t) and M(t) as time dependent variables, a state space regression was carried out, in which risk as well as mobility was supposed to be locally loglinear with time. Then the expressions for risk r(t) read:

$$\begin{aligned} \ln(r_{t+1}) &= \alpha_t + \beta_t \cdot t + \varepsilon_t && (\varepsilon \text{ normally distributed), with} \\ \alpha_t &= \alpha_{t-1} + \xi_t && (\xi \text{ normally distributed), and} \\ \beta_t &= \beta_{t-1} + \zeta_t && (\zeta \text{ normally distributed).} \end{aligned} \tag{2}$$

and similar expressions for the mobility M(t)

Essentially, *Equation 2* is a linear model, of which the parameters may vary slightly over time, so as to permit extra variation of the expected value for risk and mobility due to unknown influencing factors. By using state space analysis, the estimates of he predictions are not corrupted by the incorrectly incorporated influence of these unexplained factors.

The state space analysis enables calculation of the expected number of fatalities in 2010 and 2020, by an estimate of r_t and M(t) for t = 2010 and t = 2020, and calculation of $N_F(t)$ from *Equation 1*. The results are not sensitive to unexplained or coincidental fluctuations of the data (either mobility or accident data). Data that are missing in the time series are estimated as well. Also the predictions are provided with a margin of reliability.

The forecast in the *Impact Assessment* was made in order to assess the feasibility of the target of the Road Safety Action Programme (RSAP), halving the number of road deaths by 2010. The forecast presumes that no additional efforts will be made to reduce the number of fatalities, this is called a ‘business as usual’ scenario. The gap between the target and the predicted number of fatalities should be bridged by the RSAP.

Since the forecast is based on data up to 2002 (for mobility) and 2003 (for fatalities), it takes into account the impact of all measures taken until those years, at any level in the EU. Because the RSAP has been issued in 2003, the forecast does not yet fully take into account the interventions taken in this last year as a consequence of this particular programme. However, it includes the effect of earlier Action Programmes which are in several ways in line with the RSAP. We assumed that the ‘business as usual’ scenario at least partly takes into account the 2003-RSAP actions.

2.2. Method used in *ASSESS*

Because of the different nature of the *Impact Assessment* and *ASSESS*, the approaches for both analyses differed. In *ASSESS*, the 100 measures that the European Commission proposed in the field of transport had to be evaluated. Most of the measures are not yet carried out, and it is not known to what extent these measures will be carried out in future. Therefore four scenarios for transport economic development were defined and compared. Each measure was attributed to one or more of these scenarios. Each of these scenarios was assessed separately. As a consequence, the *ASSESS* method differed from the *Impact Assessment* method in two essential ways:

1. In *ASSESS*, future mobility was estimated with SCENES, an economic transport model, operated by ITS, Leeds. This model used independent data sets and dimensions, so we indexed the mobility data of SCENES, and applied these to the Dutch mobility data, with 2000 as the reference year. This lead to predicted values of M(t) that were different from those found in the *Impact Assessment* approach. As *ASSESS* uses different scenarios, the mobility data were then varied, in SCENES, according to these scenarios.
2. Future risk was also estimated for the different scenarios. For one of these, the 'most likely scenario', the risk values estimated in the *Impact Assessment* were used. The other three scenarios involved specific safety measures, that were to be applied, or assumed to be NOT taken, in the different scenarios. Essentially, for every scenario it was decided which measures were likely to be applicable (in that specific scenario), and corresponding effects were applied, or left out, in the estimated risk. The effects of each measure were estimated based on current knowledge.

Ad 1.
SCENES is an economical model, based on transport economics knowledge. It contains mathematical relations between international activities and transport by different modes. It uses the current infrastructure, information about productivity in different sectors, etc. The different sets of measures had strong consequences on the modal shift and volume of (inter)national transport, so the mobility is significantly different in the four scenarios.

Ad 2.
In the analysis, we had to decide what measures were to be considered in the 'most likely scenario', as this was used as a reference for the other three scenarios. For the most likely scenario we used the estimated risk development from the *Impact Assessment*. Measures that where implemented between 2001 and 2004 were considered to be included in the assessed risk development in the *Impact Assessment*. Another scenario was the 'null scenario', where the measures that were implemented between 2001 and 2004 were to be 'turned off'. For the null scenario, the estimated risk reduction for these measures was used to calculate an increased risk (as compared to the most likely scenario). Then there were the 'full scenario' (all White Paper measures implemented) and the 'recommended scenario' (what additional measures should be implemented). For each measure we estimated its possible effect, sometimes with large uncertainties.

3. Results

3.1. Results of the *Impact Assessment*

The main goal of the research was to give an estimation of the number of fatalities per country in 2010. For this purpose, 25 separate analyses have been conducted. *Table 3.1* lists the observation from 2001, the prediction for 2010 and compares it to the target set by the White Paper. More elaborate overviews (listed per country) can be found in the full report of the *Impact Assessment* (Ecorys Transport & SWOV, 2005). *Tables 3.2* to *3.5* show the results for exposure, risk and the qualitative evaluation.

The results provide clear indications of the size of the gap that needs to be bridged, as the model predicts a gap of nearly 13,500 fatalities in 2010. Given the relatively short period to bridge this gap, this is not an easy task. This holds for the EU15 as well as for the 10 new member states, although the gap is expected to be larger in the latter group of countries. Without intensified actions in the field of road safety, the new member states will only reach a 10% fatality reduction, compared with 27% reduction for the old member states.

The forecast of risk and exposure is based on fatality data till 2003 and exposure data till 2002 for almost all countries. The fatality data since 2003 in EU25 show a continuation of the downward trend, which means that the actual gap is smaller than shown in *Table 3.1*. At the same time the forecast makes it clear that the yearly reduction is insufficient (see *Figure 3.1*).

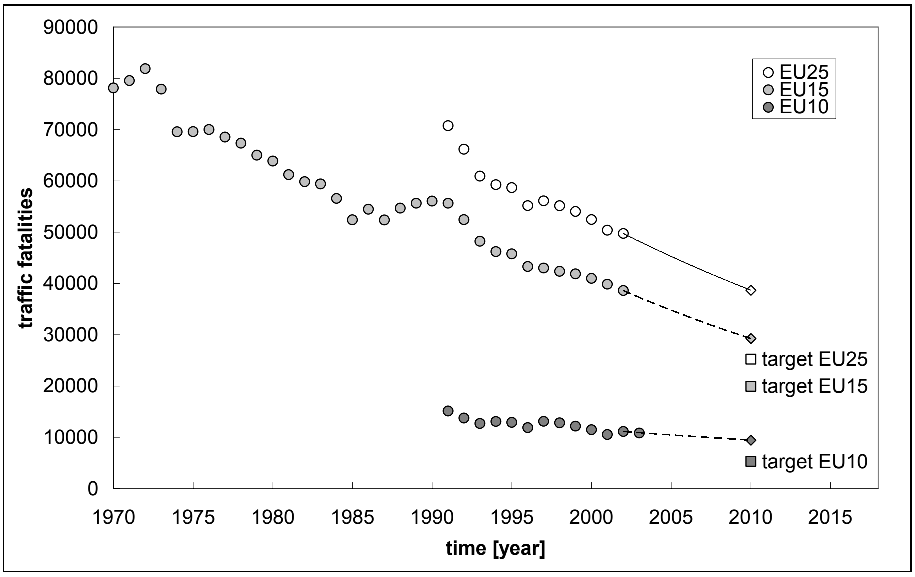

Figure 3.1. *Overall prognosis and targets. Remark: Fatality data for 2003 are missing for 2 of the EU15 countries. Therefore the graph of EU15 series and of the EU25 series stops in 2002, but the analysis is carried out using all data available.*

	Observation 2001	Prediction 2010	Predicted reduction	Target 2010	Targeted reduction	Gap
EU15	39,861	29,247	27%	19,931	50%	9,317
EU10	10,535	9,444	10%	5,268	50%	4,176
EU25	50,396	38,691	23%	25,198	50%	13,493

Table 3.1. *Observations, predictions and gaps in fatality numbers.*

Country	Abbreviation	Indicator	Observation 2001	Prediction 2010	Predicted growth	
					abs.	*%*
'Old' EU countries	EU15	10^6 vehicle km	2,168,702	2,459,492	290,790	13
		vehicle fleet (x1000)	81,638	110,858	29,220	36
'New' EU countries	EU10	vehicle fleet (x1000)	27,711	39,241	11,530	42
All EU countries	EU25	10^6 vehicle km	2,168,702	2,459,492	290,790	13
		vehicle fleet (x1000)	109,349	150,099	40,750	37

Table 3.2. *Exposure observations and predictions.*

Country	Abbreviation	Indicator	Observation 2001	Prediction 2010	Predicted reduction	
					abs.	*%*
'Old' EU countries	EU15	fatalities / 10^9 vehicle km	11	6	5	43
		fatalities / 1000 vehicles	0.2	0.13	0.07	37
'New' EU countries	EU10	fatalities / 1000 vehicles	0.38	0.24	0.14	37
All EU countries	EU25	fatalities / 10^9 vehicle km	11	6	5	43
		fatalities / 1000 vehicles	0.25	0.16	0.09	36

Table 3.3. *Risk observations and predictions.*

Each country was categorized in the categories low, average and high (see *Table 3.4*). It was chosen to do this by calculating the percentiles from 0-33%, 33-67% and 67-100% for each indicator and assigning the countries accordingly.

Low fatalities reduction and:	*Average exposure growth & Low/Average risk reduction:*	CZ, HU, UK
	High exposure growth & Low risk reduction:	ES, MT, SK
	High exposure growth & High/Average risk reduction:	EL, LT, PL
Average fatalities reduction and:	*Low exposure growth & Low/Average risk reduction:*	DK, NL, CY
	Average exposure growth & Average/High risk reduction:	IT, AT
	High exposure growth & High risk reduction:	IE, LV
High fatalities reduction and:	*Low exposure growth & Average risk reduction:*	DE, FI, SE
	Low exposure growth & High risk reduction:	BE, FR
	Average exposure growth & High/Average risk reduction:	LU, EE, PT, SI

Table 3.4. *Categorization of countries.*

When we assess the outcomes per country in more detail, it can be seen that the 10 new countries have a relatively low predicted fatalities reduction percentage, and a relatively high predicted exposure growth. For the 'old' countries the general trend is the reverse: the fatality reduction is relatively high, while the exposure growth is relatively low (see *Table 3.5*).

The variation in risk reduction is more evenly divided among all countries in both groups. So it seems that the development of mobility has an important influence on the safety prognosis of the 10 new member states. However, it is felt that the growth of mobility in the 10 new member states could turn out to be smaller than predicted by the model. The forecast draws heavily on the strong increase of the vehicle stock since 1991 and this growth will probably slow down before 2010. So in the 10 new member states the gap could turn out to be somewhat smaller than 40%.

Country	Abbreviation	Exposure indicator	Fatalities *(reduction)*	Exposure *(growth)*	Risk *(reduction)*
'Old' EU countries	EU15	vehicle km or vehicle fleet	High		
		10^6 vehicle km		Low	Average
		vehicle fleet (x1000)		Average	Low
'New' EU countries	EU10	vehicle fleet (x1000)	Low	High	Low
All EU countries	EU25	vehicle km or vehicle fleet	Average		
		10^6 vehicle km		Low	Average
		vehicle fleet (x1000)		High	Low

Table 3.5*. Qualitative evaluation of road safety developments.*

3.2. **Results of *ASSESS***

The *ASSESS* aimed at conclusions about the effectiveness of measures in the White Paper. This was done with the help of four scenarios, each including or excluding sets of measures.

For the partial and most likely scenario (P-scenario) the number of fatalities was forecasted along the lines described in *§ 2.2*. For the other three scenarios, the resulting number of fatalities was then adjusted for the effect of measures that were included in the scenario. The resulting number of fatalities for each scenario, both for 2010 and 2020, are shown in *Table 3.6.*

The goal of the report was to show the possible effectiveness of the White Paper measures, and their contribution to achieve the safety objectives. In the next sections the conclusions about the White Paper measures, as formulated in the full report (Vlakveld et al., 2005), are summarized.

Country	Reference data 2001	Year 2010				Year 2020			
		N	P	F	R	N	P	F	R
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%

Table 3.6. *Number of traffic fatalities in 2001, and forecasts of the number of fatalities in 2010 and 2020, according to four scenarios: 'null' (N), 'most likely' (P), 'full' (F) and 'recommended' (R).*

3.2.1. *Conclusions with regard to White Paper measures*

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 important issues indeed. 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 organized around infrastructure or behaviour.

Then for the specific measures, the following conclusions can be made. Some of the measures are important indeed, and should be carried out, but they are in itself not directed at reducing the number of traffic fatalities. This is, for example, the case in Measure 46: setting a target of halving the number of traffic fatalities in 2010 as compared to 2003. Target setting is important, because it gives a motivation to the national authorities to invest effort to reach the target. However to determine the effects of target setting, one should know the different measures that have been taken and the vision that has been developed. Another example is Measure 52: independent technical investigations. It is impossible to make an accurate assessment about the effects of having a supranational independent road safety research council on the relative fatality rate of road users.

Some of the measures are possibly not very effective, because either the traffic safety problem they are directed at is not substantial (seat belts in busses) or prior research shows that safety effects are marginal (driver improvement courses). 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 sign posting, which is not the most effective way to handle black spots.

A general conclusion could therefore be that the measures do indeed offer possibilities to improve road safety. However, 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 in a way that they tackle the whole problem, and not part of the problem. Finally, 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.

3.2.2. *Conclusions with regard to road safety objectives*

In the White Paper, the goal is stated to halve the number of people killed in traffic between 2000 and 2010. For the four scenarios used in the estimation of the safety effects, the conclusions are as follows.

N-scenario: none of the White Paper measures implemented
For this scenario, the predictions of the number of fatalities in 2010 and 2020 are only based upon autonomous changes. Thus, effects of the measures with high or very high likelihood in the relative fatality rate of road users and on changes in mobility rates 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 will reach a 50% reduction in 2010 and for some member states there will 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%.

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 in the relative fatality rate of road users and on changes in mobility rates. Also 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 the Czech Republic still shows an increase in fatalities. For the 25 EU member states the overall predicted relative fatalities for this scenario is 73%.

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.

Recommended scenario (R-scenario)
In the R-scenario, the recommended scenario, all the measures stated in the White Paper are implemented. Also, additional measures are included in the scenario. 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 recommended 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 recommended 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.

4. Conclusions and evaluation

4.1. Conclusions

The following table presents the main results of *Impact Assessment* for EU15 and the 10 new member states separately and for the EU25. Essentially, these results are not very different for those of the *ASSESS* analysis.

	Observation 2001	Prediction 2010	Predicted reduction	Target 2010	Targeted reduction	Gap
EU15	39,861	29,247	27%	19,931	50%	9,317
EU10	10,535	9,444	10%	5,268	50%	4,176
EU25	50,396	38,691	23%	25,198	50%	13,493

Table 4.1. *Overview of observations, predictions and gaps for road fatalities, as compared to 2001.*

The results provide clear indications of the size of the gap that needs to be bridged, as the model predicts a gap of nearly 13,500 fatalities in 2010. Given the relatively short period to bridge this gap, this is not an easy task. This holds for the EU15 as well as for the 10 new member states, although the gap is expected to be larger in the latter group of countries. Without intensified actions in the field of road safety, the new member states will only reach a 10% fatality reduction, compared with 27% reduction for the old member states.

The forecast of risk and exposure is based on fatality data till 2003 and exposure data till 2002 for almost all countries. The fatality data since 2003 in EU25 show a continuation of the downward trend, which means that the actual gap is smaller than shown in *Table 4.1*. At the same time the forecast makes it clear that the speed of reduction is insufficient. The forecasted numbers of fatalities have been determined by multiplying exposure and risk, for each of the 25 countries. Therefore the detailed results of the modelling exercise can to some extent explain why countries have a good or a bad safety prognosis.

The 10 new member states generally show a relatively low predicted fatalities reduction (only 2 of them have a high reduction percentage, i.e. more than 26%) and a relatively high predicted exposure growth (only 1 has a low growth rate).

The EU15 group has a relatively high predicted fatalities reduction (only 3 have a low reduction percentage, i.e. less than 20%) and a relatively low predicted exposure growth (only 3 have a high growth rate). In these countries, mobility is generally rising less fast, while the risk of a crash is reducing faster.

The variation in risk reduction is more evenly divided among all countries in both groups. So, it seems that the development of mobility has an important influence on the safety prognosis of the 10 new member states. However, it is felt that the growth of mobility in the 10 new member states could turn out to be smaller than predicted by the model. The forecast draws heavily on the strong increase of the vehicle stock since 1991 and this growth will probably slow down before 2010. So, the gap in 10 new member states could turn out to be somewhat smaller than 40%.

As for the effectiveness of measures, the following recommendations are stated:

Two out of four scenarios will lead to a fatality reduction that does meet the objectives of the EU for 2010. However, these scenarios are not the most likely scenarios. Therefore, to reach a 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. Not only harmonization and technical improvements are important: areas like infrastructure and road user behaviour deserve considerably more attention. A detailed problem analysis, as was done in the *Impact Assessment* 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 it an area in which safety effects may be reached? What do we know from prior research about the effects of this measures? How are we going to put the measure into practice? 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 recommended scenario, cost-effectiveness studies have already been carried out. These studies should be considered when measures are selected.

Finally, to be able to make estimations of effects of measures on road safety, many assumptions have been made. These assumptions are not necessarily realistic. For example, with regard to harmonizing alcohol controls, the White Paper measure is to harmonize the BAC limit. It does not state which limit. We have assumed a specific BAC level (0.5 g/l) and also 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 they turn out to be highly unlikely, to replace the measures by others that are more specific and based on more extensive research.

4.2. Evaluation

The analyses presented here had to be robust, in the sense that they had to be applied to time series of all countries of interest. For many of those countries, there is insufficient data for a detailed and accurate analysis. We chose a method for which only the total annual numbers of fatalities and total mobility were needed.

The sense and impact of these analyses lie in the comparison of countries or scenarios, and in the discussion about the ins and outs of the analysis. The accuracies of the absolute values found are limited. This is caused by the data, the methodology and of course, by the fact that the future is unknown.

In the case of the *Impact Assessment* the aim of the analysis was to estimate the number of fatalities in 2010 in EU25. *ASSESS* went a step further, and aimed at comparing different scenarios, where different sets of measures would be carried out. As these measures also acted on mobility, it was necessary to allow for changes in mobility also.

Generally, the *Impact Assessment* method is more robust; its result can be interpreted easily. The accuracy is influenced by the uncertainty of the future development of e.g. mobility. There is no way to know if mobility will develop in accordance with the supposed loglinear extrapolation. The *ASSESS* results allow for comparison between scenarios. One of these scenarios (P-scenario) is based on the results of the *Impact Assessment*. The other results are relative changes with respect to this P-scenario. The absolute results are just as uncertain as the result of the *Impact Assessment*. The advantage of *ASSESS* lies in the possibility to compare, but this possibility can only be achieved at the expense of extra uncertainties, because of inaccuracies of the economic models used, or the uncertainties in the calculated effects of safety measures.

For both methods, the most important limitations are a consequence of the limited quality of the data. A few remarks about these limitations and possible improvements.

4.2.1. *Limited knowledge of future mobility*

The first and most important limitation is, of course, that assessment of *future economic values* is very difficult. Future mobility, even if its effect on safety is fully understood and modelled, is uncertain. In the *Impact Assessment*, mobility was loglinearly extrapolated with a state space technique by SWOV. In *ASSESS*, the consortium derived values for the passenger car mobility in 2010 and 2020 using an economic model (SCENES). If the economic models are sufficiently valid the forecasts based on *ASSESS* mobility data may be more reliable than those of the *Impact Assessment*. There is no way to know if this is true.

An evaluation of the accuracy of SCENES is beyond the scope of this report.

4.2.2. *Limits of model and techniques*

The model we used is a loglinear model, optimized with a state space analysis. Whereas the state space analysis takes care of overdispersed data (more fluctuations than can be explained by chance), it does not take care of a probable incorrectness of the supposed loglinearity. A more correct approach might consider the data as a sum of several subsets of the data (e.g. urban and rural traffic separated).

Another limitation is caused by the assumption that the total number of fatalities is a product of total risk and passenger car mobility. This choice was made because of available data, so this subject is treated in *§ 4.2.3*.

4.2.3. *Limits of the data*

The methods for traffic safety forecasts used in the *Impact Assessment* and in *ASSESS* are based on fatality data and mobility data. For countries that do not have a sufficiently long time series of data of travelled distance, fleet data were used (assuming a constant mileage). If all countries were able to provide data on distance travelled, this would improve the comparability of the results.

The methods described here all suppose that the number of traffic fatalities is the product of mobility and road traffic safety risk. Mobility is then approximated by passenger car mobility of passenger car fleet. A change in modal shift (e.g. when there is a shift from motorcycle to car, at the same time maintaining the total mobility at the same level), which leads to a change in the number of traffic fatalities is not explicitly modelled. Of course, it would be preferable to distinguish between traffic modes, for mobility as well as safety data. For many countries the data of mobility by mode are not available, neither observed, nor predicted values. An approach that uses mobility data for different traffic modes and disaggregated accident data is therefore not possible now. Such an approach is expected to enhance the understanding of traffic safety development.

A further improvement would therefore be possible, if mobility and fatality data were available for relevant traffic modes. Disaggregation with respect to traffic mode would enable analysis of the effects of modal shifts explicitly. SWOV therefore recommends that countries measure mobility (traffic volume) for all relevant traffic modes (relevant means: the traffic mode is often involved in fatal crashes), either by direct observation or by other means (e.g. by using fleet size and other information, such that combining data gives a good estimate of mobility. SWOV also recommends that countries register fatalities for all relevant conflict types (a conflict is a combination of traffic modes involved in a fatal crash).

References

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