Costs-Benefit Analysis of Road Safety Improvements

Final Report

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ICF Consulting, Ltd.
3rd Floor, Hamilton House
Mabledon Place
London WC1H 9BB

with

Imperial College Centre for Transport Studies
London, UK

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Note concerning numbering style used in tables and for numbers in the text.

Given that commas and full stops are used in different ways in different European countries for the decimal point and for separating groups of three numbers in large numbers, it is important to define and use a consistent style throughout the report. The style adopted for this report is:

- A full stop (.) is used for the decimal point.
- A small gap is used to separate groups of three numbers in numbers with four or more digits, for example 15 000 for fifteen thousand.

This style is that recommended by the Bureau International des Poids et Measures for use with the International System (SI) of units

Executive Summary

ES1 Introduction

Every year more than 40.000 people die and more than one million are injured in road crashes in the Member States of the European Union. As well as the human tragedy of so many deaths and injuries, road crashes have a substantial economic cost, in the order of 160 billion euros annually. It is the objective of the European Commission to reduce this toll by 50% by 2010. Among the many possible actions, the Commission believes that better enforcement of existing road safety laws can make a substantial contribution to meeting this objective. More specifically, two initiatives are envisaged:

1. Improving enforcement with respect to three important contributors to fatalities in road crashes – speeding, drunk driving and non-use of seat belts

2. Improving enforcement of existing European Commission road safety laws relating to commercial road transport

To this end, the Commission intends to submit to the European Parliament and the Council of Ministers a package of two proposals for directives, one dealing with the enforcement of laws relating to speeding, drunk driving and non-use of seat belts with respect to all road users, and the other consisting of a 'refonte' of existing EU legal instruments dealing with enforcement of EU safety rules for commercial road transport.

Before moving ahead with these initiatives, however, the European Commission wishes to analyse and document the benefits and costs of implementing the proposed directives, for the information of decision makers in the Parliament and Council. The analyses presented in this report provide an estimate of the costs and benefits for each of the two proposed initiatives. The results from a parallel effort by the legal firm, Clifford Chance, to document road safety laws and enforcement practices in the member states, has been incorporated into this analysis.

ES2 Results from analysis of speeding, drunk driving and non-use of seat belts

This final report provides results for the proposed countermeasures against speeding, drunk driving, and non-use of seat belts, and for two scenarios:

- Bringing the performance of all Member States up to the performance of the best performing State (UK for speeding and Sweden for drunk driving and seat belt use)

- Applying the countermeasures proposed in the Commission's Working Paper on enforcement in the field of road safety.

The general approach to analysing the costs and benefits of implementing the proposed enforcement measures and scenarios was as follows:

- From prior EC studies and the international literature, obtain estimates of the unit costs of crashes, fatalities and injuries. The figures used in these analyses are given in the table below.

Crash/ Injury Severity	Lost Output	Human Costs	Medical Costs	Property Damage	Insurance Admin.	Police Cost	Delay Cost	Total per Accident
Fatal Crash	598 408	1 150 000	8 056	11 172	314	1 999	15 000	1 789 754
Injury Crash	6 632	35 000	3 524	3 445	130	91	5 000	53 736
Individual Fatality	520 355	1 000 000	7 005	NA*	NA*	NA*	NA*	1 527 360
Individual Injury	4 877	26 000	2 591	NA*	NA*	NA*	NA*	33 468

*NA = Not Applicable

- From prior EC studies, the international literature, and the concurrent review of road safety laws and enforcement practices in Member States by Clifford Chance, develop relationships between the number of crashes, fatalities and injuries attributable to speeding, drunk driving and non-use of seat belts, and enforcement practices used in each Member State

- Estimate the annual reduction in crashes, fatalities and injuries, and associated cost savings for each scenario that would result from implementation of the proposed countermeasures

- Estimate the annual costs of implementing the proposed countermeasures for each scenario and for speeding, drunk driving and non-use of seat belts, and for each scenario.

- Calculate benefit to cost ratios

The analyses indicate a very substantial positive benefit is all cases, and for both scenarios, as illustrated in the table below:

Safety Issue	Best State Scenario			Implementation of Working Paper Proposals		
	Annual Cost Saving (Million Euros)	Saving (percent of GNP)	Benefit:Cost Ratio	Annual Cost Saving (Million Euros)	Saving (percent of GNP)	Benefit:Cost Ratio
Speeding	4 267	0.05	5.3	12 684	0.15	5.0
Drunk Driving	7 963	0.09	6.9	9 065	0.11	3.8
Seat Belt Non-Use	7 710	0.09	10.2	15 407	0.18	10.0

The annual saving is the difference between annual costs and annual operating expenses, once the improvement measures are fully implemented. The benefit to cost ratios are for a fifteen year stream of benefits and costs, including one-time initial costs to set up the programmes and the time lags between incurring implementation costs and realising benefits in the form of reduced crashes, injuries and fatalities.

The benefits of the proposed countermeasures can also be illustrated by the numbers of injuries and fatalities prevented by implementation of the countermeasures, as shown in the table below:

Safety Issue	Best State Scenario		Working Paper Proposals	
	Fatalities	Injuries	Fatalities	Injuries
Speeding	2 161	53 793	5 840	184 395
Drunk Driving	3 024	116 652	3 888	148 379
Seat Belt Non-Use	2 663	160 607	4 343	346 484

In the case of speeding, research shows that speeding is widespread on European roads, and that traditional enforcement methods are only able to discourage speeding at a few locations at any one time. Research also shows that speeding has a significant effect on the number of injuries and fatalities in crashes. A 1% reduction in speed will typically result in a 3-5% reduction in injuries and fatalities. Automated speed enforcement (using a system of speed sensors and cameras to identify and sanction all speeding vehicles) has been shown to be very effective, reducing average speeds by several km/h and virtually eliminating speeding where installed. The analysis assumed that for full implementation, automated speed enforcement systems would be installed on approximately 1.27 million lane-km, which is about 15% of the European total. Because the installations would target high traffic and high crash risk locations, the installation would cover 50-60% of accident locations. The results show favourable benefit to cost ratios in all Member States and overall.

Drunk driving is also widespread in the Member States of the EU. However, estimates of the extent of drunk driving and of the involvement of impaired drivers in crashes are highly variable, and do not appear to be reliable. In particular, there is no correlation between the reported incidence of drunk driving and drunk driving law enforcement practices, characterised by the numbers and types of checks and severity of sanctions. For this reason, it is quite difficult to estimate the reduction in

crashes, injuries and fatalities that would result from application of specific drunk driving countermeasures. The available evidence, however, suggests that a maximum 15% reduction in total fatalities and a 10% reduction in total injuries is achievable in Member States that have at present the least effective drunk driving countermeasures. Other Member States, which use more effective countermeasures, would experience smaller reductions. Using this approach, the analysis gave favourable benefit to cost ratios, as shown in the Table.

The analysis of the non-use of seat belts shows that use varies from a low of around 30% to a maximum of nearly 90% in different Member States. Non-use by rear seat passengers in cars is particularly widespread. Seat belts are very effective in reducing the severity of injuries and the number of fatalities in crashes: About 6000 fatalities and 375 000 injuries could be prevented by universal use (100% of vehicle occupants). The analysis concluded that the maximum achievable seat belt use rate would be 95% with intensive and sustained enforcement and publicity campaigns, resulting in a reduction of 4300 fatalities and 275 000 injuries. The related benefit to cost ratios are highly favourable, mainly due to the relatively low cost of countermeasures compared with those for speeding and drunk driving.

If all three programmes of countermeasures are implemented in parallel, the total net benefit is likely to be less than the sum of the three individual programmes. This is because drivers in individual crashes may exhibit two or more of the behaviours that the programmes are aimed at preventing. For example, if an accident involving a speeding drunk driver who is not wearing a seat belt is prevented or reduced in severity, then the benefits are only counted once not three times. The simplest assumption for calculating the combined effect is to assume that the unsafe behaviours are randomly distributed among the whole population of drivers. In this case, the combined effect is multiplicative rather than additive. For example, if each countermeasure reduces the occurrence of accidents to 90% of its previous level, then the combined effect is 0.9 x 0.9 x 0.9 = 0.27, or a 27% reduction. The same approach would be correct if the unsafe behaviours are similarly randomly distributed, but among a specific segment of the driving population. The approach is not correct if different populations exhibit the different unsafe behaviours, which would mean the effects are simply additive, or if the countermeasures designed for one behaviour have an beneficial effect on another behaviour, which would also tend to increase the benefit. Thus the multiplicative approach is reasonably conservative. Using this approach, the net benefit of all three programmes of countermeasures is approximately 19.0 billion euros (0.22% of GNP)for the Best State Scenario and 34.4 billion euros (0.40% of GNP)for the Full Implementation scenario.

This analysis has not addressed the feasibility of implementing the proposed countermeasures. There are two feasibility issues. One concerns finding the financial resources for implementation, which would mean increasing the budgets of law enforcement authorities (police, courts, etc) and national, regional and local authorities responsible for roads and road safety. This could be difficult at a time when government financial resources are stretched everywhere and there are many competing demands. The benefits of avoiding crashes, although large, are diffused throughout the economy, and in the case of human and lost output benefits, may be spread over a number of years. Only a portion of the benefits are realised as direct savings in the year in which the crash is avoided.

The second feasibility issue concerns the political acceptance of the proposed countermeasures by the public in all the Member States. It is possible that some of the proposed countermeasures might be seen as overly intrusive, especially intensive random checks for drunk driving. At the very least, the publicity campaigns associated with the countermeasures should emphasise the public benefits to be obtained from reducing crashes, to set against any inconvenience experienced by the driving public.

ES3 Results from analysis of improved enforcement of commercial road transport regulations

Although driving and rest periods for commercial road vehicle drivers have been regulated by the EC for over 15 years, there is a substantial lack of compliance in the road transport industry. The EC has recognised that the existing regulations and enforcement practices are not adequate and is moving to implement a number of improvement measures. These are:

- Introduce the digital tachograph to provide more complete monitoring of driving and rest periods, and reduce the chance of tampering with tachograph data

- Revise the existing regulations to remove ambiguities and legal loopholes that allow undesirable driving schedules and reduce the effectiveness of the regulations

- Add checking of working time to checking of driving time

- Improve international cooperation in enforcement of the regulations

- Most importantly, increase the frequency, consistency and efficiency of roadside and premises checks for compliance with the regulations

These actions are expected to reduce the number of crashes due to fatigued drivers and vehicle mechanical defects, improve social conditions of work for drivers, and ensure fair competition among firms in the industry.

Analysis of crashes involving commercial vehicles – lorries and buses – showed that there are about 4000 fatalities and over 200 000 injuries annually in such crashes, the majority of which are suffered by road users other than occupants of commercial vehicles. The associated cost of fatalities, injuries and damage total about 16.5 million euros annually, about 10% of the costs of all crashes.

The analysis of costs and benefits indicated that the proposed improved enforcement measures would reduce crash costs by about 25% or 4.0 billion euros, equivalent to 0.047% of GNP. The detailed analysis of a 15-year stream of costs and benefits, including one-time initial costs to prepare for the new checking procedures, gave a benefit to cost ratio of 3.54.

The corresponding reduction in total injuries and fatalities in lorry and bus-involved crashes from applying the proposed measures are as follows:

Reduction in fatalities:	951
Reduction in injuries:	59 529

A review of international literature on commercial road transport safety indicated that premises checks of transport firms are more effective than roadside checks, and that encouraging firms to implement good safety management practices is a highly effective approach to reducing lorry and-bus involved crashes.

1 Background and Introduction

Every year more than 40.000 people die and over one million are injured in road crashes in the Member States of the European Union. As well as the human tragedy of so many deaths and injuries, road crashes have a substantial economic cost, of the order of 160 billion euros annually. It is the objective of the European Commission, as documented in the DG TREN transport White Paper (European Commission (2001)), to reduce this toll by 50% between 2000 and 2010. Among the many possible actions, the Commission believes that better enforcement of existing road safety laws can make a substantial contribution to meeting this objective. More specifically, the Commission is planning two major initiatives

1. Improving enforcement with respect to three important contributors to fatalities in road crashes - speeding, drunk driving and non-use of seat belts

2. Improving enforcement of existing European Commission road safety laws relating to commercial road transport, primarily by standardizing and intensifying checks on vehicles, drivers and transport firms.

To this end, the Commission intends to submit to the European Parliament and the Council of Ministers a package of two proposals for directives, one dealing with the enforcement of laws relating to speeding, drunk driving, and non-use of seat belts with respect to all road users, and the other consisting of a 'refonte' of existing EU legal instruments dealing with enforcement of EU safety rules for commercial road transport. A Working Paper of the Commission describing the first initiative is reproduced in Attachment A

Before moving ahead with these initiatives, however, the European Commission wishes to analyse and document the benefits and costs of implementing the proposed directives, for the information of decision makers in the Parliament and Council. The analyses presented in this report provide an estimate of the costs and benefits for each of the proposed initiatives. Results from a parallel effort by the legal firm, Clifford Chance, to document road safety laws and enforcement practices in the member states, have been incorporated into this analysis.

Section 2 of the report provides an analysis of the existing road traffic and safety situation in each Member State, extrapolating to the year 2002 from the most recent available data. The situation in 2002 is taken as the baseline for estimates of future traffic levels and crashes, with and without implementation of the proposed safety initiatives.

Section 3 provides a detailed analysis of the costs and benefits of implementing two levels of increased enforcement of speeding, drunk driving and seat-belt-use laws. The two analysis scenarios are:

- Bringing the performance of all Member States up to the performance of the best performing State (UK for speeding and Sweden for drunk driving and seat belt use).

- Applying the countermeasures proposed in the Commission's Working Paper on enforcement in the field of road safety.

Section 4 provides a detailed analysis of costs and benefits associated with the program of more effective and standardised checks of commercial road transport compliance with applicable laws and regulations throughout the EC. The costs of introducing the proposed enforcement measures are compared with estimated benefits from a reduction in crashes and improved social conditions for commercial lorry and bus drivers.

2 EU Traffic Levels and Road Safety Performance

The first step in the analysis of both road safety initiatives is to assemble road usage and crash data from which to calculate the present cost of crashes in the European Union. In particular, a distribution of road usage (measured by vehicle-kilometres) and crashes by vehicle or road user type is required. These data form the base from which reductions in crash occurrence and severity, and thus benefits can be estimated.

The analyses documented in this report are based on crash and casualty data for 1997, extrapolated to 2002. 1997 is the most recent year for which reasonably complete data are available in the CARE database and from other sources. Table 2.1 gives the number of reported crashes, injuries and fatalities for each EU Member State in 1997, and totals for the five largest States and for all 15 States.

Member State	Crashes	Injuries	Fatalities
Austria	39 695	49 547	1 105
Belgium	50 078	69 543	1 364
Denmark	8 004	9 617	489
Finland	6 980	8 957	438
France	125 202	169 123	8 444
Germany	380 835	501 094	8 549
Greece	24 295	33 464	2 199
Ireland	8 496	13 298	473
Italy	190 031	270 480	6 713
Luxembourg	1 016	1 498	60
Netherlands	41 036	49 116	1 163
Portugal	49 417	65 934	2 521
Spain	86 062	125 238	5 604
Sweden	15 752	21 280	541
United Kingdom	247 479	336 758	3 743
Totals	1 274 378	1 724 947	43 406
Total, 5 large States	1 029 609	1 402 693	33 053

Table 2.1: Reported accident and casualty data for EU Member States for 1997

It is clear from Table 2.1 that the number of crashes injuries and fatalities is dominated by the five large Member States of the EU: France, Germany, Italy, Spain and the United Kingdom. About 77% of fatalities and over 80% of crashes and injuries occur in these States.

The fatality data in Table 2.1 are believed to be consistent, reliable and complete: all data except that for Germany were derived from the CARE database (CARE 2002), and reporting practices for fatalities are reasonably consistent across member countries. However, minor differences in reporting practice may exist between countries, primarily associated with different policies for counting fatalities where an injured person dies some time after the accident. Data for Germany was not available in the CARE database, and instead was obtained from a United Nations report on road crashes (United Nations 2001). The fatality counts include vehicle occupants, motorcyclists, pedestrians and bicycle riders.

The crash count is for all reported crashes causing an injury to a vehicle occupant, cyclist or pedestrian. The reporting threshold for injuries and crashes causing at least one injury is when the injury requires attention in a hospital emergency room or by a doctor. The data on the number of crashes and injuries are less reliable than that for fatalities, primarily because of different reporting practices in different Member States. These variations are known to lead to a large and variable undercounting of crashes and injuries. The draft report on the SUNflower project (Wegman et al.

2002) quotes estimates of the under-counting of serious and slight injuries for the Netherlands, Sweden and UK, shown in table 2.2.

Member State	Reported Injuries	Estimated Total Injuries	Undercounting of Injuries (%)	
			Serious*	Slight
Netherlands	46 084	72 011	30	65
Sweden	22 623	38 565	50	75
United Kingdom	316 874	422 057	20	35
Average of three states	NA	NA	33	58
Total Injuries	385 881	532 633	38 (all injuries in the three States)	

*Serious injuries are between 12 and 20% of the total

Table 2.2: Undercounting of injuries in three Member States

Other research into undercounting produces similar results. Rosman and Knuiman (1994) compared four prior studies comparing hospital records with police records, and also carried out a similar comparison in Western Australia. Their results are summarized in Table 2.3

Location of Study	Undercounting of Injuries (%)	
	Serious Injuries	Slight Injuries
North-eastern Ohio (US)	35 (all injuries)	
United Kingdom	17	33
Skaraborg County Sweden	80 (all injuries)	
Netherlands	20 (all injuries)	
Western Australia	30	60

Table 2.3: Results from prior studies of undercounting of crash injuries

The high and variable level of undercounting means that economic benefits from reducing crashes will be underestimated if not corrected for probable undercounting. The average undercounting values shown in the bottom line in Table 2.2 seem to be reasonably consistent with the results of other research quoted in Table 2.3, and will be used for the analyses described in Sections 3 and 4 of this report. None of the investigators have attempted to estimate undercounting of reported crashes causing at least one injury, but it is likely that undercounting of reported injury crashes is roughly the same as for injuries.

The final observation on undercounting concerns inconsistencies in the injury and fatality data for France and Germany shown in Table 2.1. France reports only 20 reported injuries for each fatality compared with Germany which reports 59 reported injuries for each fatality. The average for all other Member States is about 40 injuries for each fatality. This suggests that there is very substantial undercounting in France, but virtually none in the reported numbers for Germany. It must be assumed that the inconsistency is a result of differing reporting practices: it is highly unlikely that variations in accident characteristics in the two States would account for the difference. Therefore, the working assumptions on undercounting will be:

France:	Undercounting at 150% (so that injury/fatality ratio is similar to other member states)
Germany:	No undercounting
All other Member States:	Table 2.2 percentages, using the averages where State-specific data are unavailable

The resulting estimates of total injuries and injury crashes are given in Table 2.4.

Member State	Reported		Undercounting	Estimated Total	
	Crashes	Injuries	(%)	Crashes	Injuries
Austria	39 695	49 547	38	54 779	68 375
Belgium	50 078	69 543	38	69 108	95 969
Denmark	8 004	9 617	38	11 046	13 271
Finland	6 980	8 957	38	9 632	12 361
France	125 202	169 123	150	313005	422 808
Germany	380 835	501 094	0	380 835	501 094
Greece	24 295	33 464	38	33 527	46 180
Ireland	8 496	13 298	38	11 724	18 351
Italy	190 031	270 480	38	262 243	373 262
Luxembourg	1 016	1 498	38	1 402	2 067
Netherlands	41 036	49 116	56	64 016	76 621
Portugal	49 417	65 934	38	68 195	90 989
Spain	86 062	125 238	38	118 766	172 828
Sweden	15 752	21 280	70	26 778	36 176
United Kingdom	247 479	336 758	33	329 147	447 888

Table 2.4: Estimated crashes and injuries after correcting for undercounting

The estimates of undercounting in Netherlands, Sweden and the UK given in Table 2.4 reflect the actual mix of serious and slight injuries in those States, and are not a simple average of the undercounts for serious and slight injuries. The actual percentage of serious injuries is 20.8 in the Netherlands, 16% in Sweden and 11.3% in the UK. Further discussion of undercounting and its effect on estimated crash costs is provided in Section 3.3, including in Tables 3.3 and 3.4 the number of serious and slight injuries before and after correcting for undercounting.

The next stage in the analysis was to develop a breakdown of fatalities by vehicle type and for pedestrians versus vehicle occupants, shown in Table 2.5. The source of all data except for Germany is CARE, and figures for certain vehicle types (shown in italics) are consultant estimates.

Member State	Pedest-rians	Vehicle Occupants and Bicycle and Motorcycle Riders							Total
		2-wheel Vehicles	Car or Taxi	Lorry >3.5t	Lorry <3.5t	Bus	Other/ Unknown	All	
Austria	156	235	666	17	18	3	10	949	1 105
Belgium	142	315	844	19	26	10	8	1 222	1 364
Denmark	87	111	258	2	27	1	3	402	489
Finland	69	85	247	5	21	2	9	369	438
France	982	1 766	5 358	116	129	36	57	7 462	8 444
Germany	1 147	1 855	5 069	*140*	*161*	*30*	*0*	7 255	8 402
Greece	409	538	896	17	145	10	90	1 696	2 105
Ireland	130	92	220	10	14	2	7	345	475
Italy	893	1 650	3 724	*110*	*150*	25	161	5 820	6 713
Luxembourg	8	4	46	0	0	1	1	52	60
Netherlands	119	422	547	11	57	3	4	1 044	1 163
Portugal	549	755	1 000	42	124	4	48	1 973	2 522
Spain	967	1 015	2 998	186	331	58	49	4 637	5 604
Sweden	72	91	348	8	15	0	7	469	541
United Kingdom	1 010	712	1 859	47	69	29	17	2 733	3 743
Totals	6 740	9 646	24 080	730	1 287	214	471	36 428	43 168
Total, 5 Large States	4 999	6 998	19 008	599	840	178	284	27 907	32 906

Table 2.5: Breakdown of fatalities by type of person and vehicle type

These data are required to help identify fatalities in crashes involving heavy commercial vehicles (lorries and buses), and to help evaluation of the proposed safety improvement measures. One

striking observation is the high number of fatalities among riders of motorcycles and bicycles, typically between 20 and 25% of fatalities, and 36% in the Netherlands. Fatalities of pedestrians and bicycle and motorcycle riders combined amount to 38% of all fatalities. Another observation is that fatalities among occupants of heavy commercial vehicles are relatively few, at 944 or 2.1% of total fatalities. The other/unknown category includes fatalities on farm equipment operating on public roads and also crashes where vehicle type was not reported.

For meaningful comparisons of the road safety performance between Member States, raw crash, injury and fatality data must be normalized by a measure of exposure to road accident risk. The most direct measure of exposure is vehicle- kilometres travelled in each State, broken down by vehicle type to correspond to the categories used in Table 2.5. Table 2.6 provides estimated vehicle-kilometres travelled by vehicle type and Table 2.7 the resulting fatality rates.

Member State	Motor Cycles	Cars and Taxis	Lorries and Buses	Total
Austria	1.5	51.0	12.0	65
Belgium	1.4	70.0	11.0	82
Denmark	1.2	34.0	8.0	43
Finland	0.9	37.0	6.1	44
France	14.0	371.0	102.0	487
Germany	28.8	525.0	65.0	619
Greece	9.0	40.0	27.0	76
Ireland	0.2	29.0	4.0	33
Italy	71.5	418.0	76.0	566
Luxembourg	0.1	4.0	0.6	5
Netherlands	1.7	93.0	19.9	115
Portugal	1.7	47.0	32.9	82
Spain	8.0	247.0	79.6	335
Sweden	0.8	57.0	8.4	66
United Kingdom	4.0	422.0	32.9	459
Totals	145	2,445	485	3,075
Total, 5 large States	126	1,983	356	2,465

Table 2.6: Vehicle-km for 1997 by vehicle type (billions)

There are no specific comments to be made about this table, except to observe that about 80% of total vehicle-kilometres are operated in the five large Member States and the remaining 20% in the 10 smaller States.

The fatality rates are given in Table 2.7. The Table shows very clearly the high fatality rate for motor cycle riders and the significance of pedestrian and bicyclist fatalities in the overall fatality picture. The table also shows the wide variation between member states, which can be divided into four groups:

Low fatality rates:	Finland, Netherlands, Sweden and the United Kingdom
Moderate fatality rates:	Denmark, Germany, Luxemburg and Italy
High fatality rates:	Austria, Belgium, France, Ireland, and Spain
Very high fatality rates:	Greece and Portugal

Member State	Motor Cycle Riders	Car and Taxi Occupants	Lorry and Bus Occupants	Overall Rates		
				All Powered vehicle Riders/Occupants	Pedestrians and Bicycles	All Road Users
Austria	112.7	13.1	3.2	14.7	4.8	19.6
Belgium	137.9	12.1	5.0	14.8	3.4	18.3
Denmark	38.3	7.6	3.8	9.3	4.0	13.3
Finland	26.7	6.7	4.6	8.4	3.1	11.5
France	101.3	14.4	2.8	15.3	4.0	19.4
Germany	40.8	9.7	5.1	11.7	3.7	15.4
Greece	56.2	22.4	6.4	22.3	10.8	33.1
Ireland	340.0	7.6	6.5	10.4	7.8	18.2
Italy	17.1	8.9	3.8	10.3	3.2	13.5
Luxembourg	30.0	11.5	1.7	11.1	3.4	14.5
Netherlands	105.9	5.9	3.6	9.1	2.1	11.2
Portugal	400.0	21.3	5.2	24.2	13.5	37.6
Spain	112.4	12.1	7.2	13.9	5.8	19.6
Sweden	61.3	6.1	2.7	7.1	2.2	9.3
United Kingdom	131.3	4.4	4.4	6.0	4.4	10.4

Table 2.7: Fatality rates by vehicle type (fatalities/billion vehicle-km)

All the data presented so far in this discussion is for the year 1997, chosen as the most recent year for which reasonably complete crash data were available. The proposed changes, however, are planned to take place in 2003 and beyond, starting from the current road safety situation at the end of 2002. Therefore, it is necessary to estimate the changes in road traffic levels, crashes, injures and fatalities between 1997 and 2002. Traffic (vehicle-km) will have increased, and crash, injury, and fatality rates will have declined with ongoing implementation of road safety improvements in each Member State. Estimates of 2002 crashes, injuries and fatalities are given in Table 2.9, derived from the trend estimates given in Table 2.8. The trend estimates are derived from trends in person-km by private car obtained from ECMT/OECD (2002) (vehicle-km data are too incomplete to be useful), and for crashes, injuries and fatalities from a UN report (United Nations, 2001). In both cases, trends were calculated from data for the period 1985 to 1997. Judgmental adjustments were made in the forecast data in the light of per-capita travel for each State and external economic and political conditions that might have influenced the source data or the projections. Especially, traffic growth rates may have slowed after 1999/2000 with the economic slowdown.

Member State(s)	Annual Traffic Growth (%)	Annual Change in Casualty Rates (per v-km) (%)		Net Annual Change in Casualties (%)		Estimated Change: Five Years 1997-2002 (%)	
		Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries
Greece	6.0	-5.0	-6.0	+1.0	0	+5.1	
Spain/ Portugal	4.5	-5.0	-5.0	-0.5	-0.5	-2.5	-2.5
Germany	3.0	-4.0	-3.0	-1.0	-1.0	-5.1	-5.1
All others	2.0	-4.0	-3.0	-2.0	-1.0	-10.4	-5.1

Table 2.8: Estimated traffic and accident casualty trends 1997 – 2002

The changes listed in the last two columns of Table 2.8 are applied to the 1997 fatality data given in Table 2.1 and crash and injury data given in Table 2.4 to yield an estimate of 2002 crashes, injuries and fatalities. The trend for crashes is assumed to be the same as for injuries.

Member State	Crashes	Injuries	Fatalities
Austria	51 985	64 888	990
Belgium	65 583	91 075	1222
Denmark	10 482	12 595	438
Finland	9 141	11 730	392
France	297 042	401 244	7 566
Germany	361 412	475 538	8 113
Greece	33 527	46 180	2 311
Ireland	11 127	17 415	424
Italy	248 868	354 226	6 015
Luxembourg	1 331	1 962	54
Netherlands	60 751	72 713	1 042
Portugal	66 491	88 714	2 458
Spain	115 796	168 508	5 464
Sweden	25 413	34 331	485
United Kingdom	312 361	425 046	3 354
Total	1 671 310	2 266 166	40 327

***Table 2.9*: Estimated crashes, injuries and fatalities for 2002**

Finally, an estimate is needed of road traffic growth for a period of 15 years after 2002, for use in present-value calculations of the proposed safety initiatives. Also the analysis must take into account crash, injury and fatality reductions due to road safety developments other than those considered in this study. Specifically, these are:

- Continuing improvements in the safety of the vehicle fleet, as older vehicles are scrapped and new vehicles with improved safety features are put into service.

- Continuing safety-related improvements in the road infrastructure.

Both these kinds of improvement will continue into the future, producing a continuing safety benefit in addition to that from enforcement initiatives. There is no obvious way to separate the relative contribution to crash reduction of enforcement as compared with vehicle and road safety improvements, but all are clearly substantial, and enforcement is probably the most significant. Using this logic, half the historic annual percentage changes in crash rates given in Table 2.8 will be attributed to vehicle and road improvements and half to changes in enforcement. For the purpose of analysis, the baseline number of crashs, injuries and fatalities will be estimated assuming that vehicle and road safety improvements continue, but that improvements due to enforcing more responsible driver behaviour is held constant at 2002 values.

In addition, traffic growth will continue throughout the EU, increasing the exposure to crash risk and tending to offset the reduction in crashes due to safety improvements. The resulting estimates of traffic growth are derived primarily from an International Union of Railways report (UIC 2002), which quoted data from the TRENDS database (Transport and Environment Database from the EC DGVIII). This source estimated total traffic growth in the European Community to be at 1.6%/year. The resulting estimates for traffic growth and percentage reductions in crash rates are shown in Table 2.10.

Member State(s)	Annual traffic growth	Change in crash and casualty rates due to improved vehicles and roads		
		Crashes	Injuries	Fatalities
Greece	+3.5%	-3.0%	-3.0%	-2.5%
Portugal	+2.5%	-2.5%	-2.5%	-2.5%
Spain	+2.0%	-2.5%	-2.5%	-2.5%
Germany	+2.0%	-1.5%	-1.5%	-2.0%
All others	+1.6%	-1.5%	-1.5%	-2.0%

Table 2.10: Estimated traffic growth and crash rate changes from 2003

The higher rates for Greece, Spain and Portugal all reflect more rapid change in those Member States as they change to become more like the remaining Member States in both their economies and in road safety practices. The net effect of traffic growth and the reduction in crashes, injuries and fatalities due to improved roads and vehicles is close to zero: The increase in traffic offsets the expected safety improvements, resulting in no net change in the number of crashes, injuries and fatalities, excluding the effect of changes in enforcement practices.

3 Analysis of Costs and Benefits of Improving Enforcement of Speeding, Drunk-Driving and Seat Belt Use Laws

3.1 Objectives of the Analysis

The objectives of this analysis are to perform cost-benefit analyses of proposed stricter enforcement measures for three domains: speeding, drunk driving, and non-use of seat belts. The proposed enforcement measures are primarily aimed at reducing the number of infractions of present road safety laws for the three domains in each Member State, through a mixture of more effective checks for infractions, the application of more effective sanctions for the infractions, and public awareness campaigns.

The economic benefits result from a reduction in the costs associated with crashes, injuries and fatalities prevented by implementation of the proposed measures, and include the following:

- Value of lives saved
- Value of injuries avoided, including medical attention, loss of income, psychological damage, pain and suffering by crash victims and their families
- Property damage costs avoided, primarily for damage to road vehicles
- Environmental damage and clean-up costs avoided, due to spills of damaging materials
- Road congestion costs avoided, resulting from crashes and the accompanying emergency response

The costs for more intensive traffic law enforcement include:

- Administrative costs associated with introducing and implementing new national legislation
- Costs for additional trained personnel for law enforcement
- Capital, maintenance and operation costs for additional technical equipments for checking and other enforcement activities
- Costs for publicity campaigns

Implementation of stricter enforcement programmes may result in a higher total level of fines collected from drivers, which could be used to offset increased enforcement costs. Income from fines has not been included in the economic analysis, for two reasons. Firstly, fines are a transfer from drivers to government authorities, and do not represent a real economic saving to a Member State comparable to the benefit from preventing a crash. Secondly, the goal of the overall programme is to prevent crashebs from better compliance with road safety laws, not to catch more drivers violating the laws. With improved compliance, there may be fewer law-breakers and thus fines, not more.

Two distinct improvement scenarios will be analysed in comparison with the present situation in each Member State:

1. The application by all Member States of the policies and procedures for each domain (speeding, drunk-driving, and seat-belt use) used by the best performing Member State in each domain.

2. The application by all Member States, of the provisions of the Commission's Working Paper on road safety enforcement. This Paper proposes the broad use of automated speed enforcement equipment, combined with intensive checking for drunk driving and non-use of seat belts and effective public awareness campaigns.

3.2 Analysis Approach

The starting points for this initial analysis are the data on crashes, injuries, fatalities and road use presented in Section 2 of this report. Then the steps in the analysis are as follows:

1. From prior EC studies and the international literature on road safety, obtain estimates of road crash and injury costs as a function of the level of injury caused (slight injury, serious injury, fatality). Cost differences between Member States are taken into account.

2. From prior EC studies and the international technical literature on road safety research, obtain information linking the incidence of speeding, drunk-driving, and non-use of seat belts with number and severity of crashes and crash casualties.

3. Using information in the literature, together with data from the Clifford Chance survey of Member States, develop relationships between the incidence of speeding, drunk driving and non-use of seat belts and road safety laws, sanctions, enforcement practices and public awareness campaigns in each Member State.

4. Using the results of Steps 2 and 3, develop estimates of the reduction in crashes, injuries and fatalities that would follow from implementation of the improved enforcement practices in each Member State, as detailed in Section 3.1.

5. Using information from prior EC studies and the international road safety literature, obtain estimates of costs for automated speed enforcement systems and for road safety checks for drunk driving and seat belt use.

6. Estimate annual costs and benefits for each of the three road safety initiatives by member State from crash costs estimated in Step 1, the reduction in crashes estimated in step 4, and program costs estimated in Step 5, assuming the initiatives are fully implemented.

7. Complete a long term cost-benefit comparison by calculating the ratio of the present value of costs and benefits over a 15-year period for each initiative, assuming a practical period of years for implementing the initiatives, and for the initiatives to reach full effectiveness, and including any one-time initial costs.

In performing the analysis, the approach recognizes that reducing the occurrence of speeding may reduce the number of crashes, but the more important effect is to reduce the severity of crashes, thus reducing the number of fatalities and injuries, and property damage. Reducing the occurrence of drunk driving will reduce the number of crashes, but will not change the severity of individual crashes. Seat belt use specifically reduces injury severity for occupants of cars and commercial road vehicles, but does not change other crash characteristics.

3.3 Unit Crash Costs

This section develops estimates for unit crash costs to be used in cost-benefit calculations. In general, cost information is rather limited – only a few studies address crash or enforcement costs, and these often only provide data for one Member State or type of enforcement action. However, enough data has been located to support this analysis. Since the sources give data in a variety of currencies and at different dates, all cost data has been converted to 2002 euros at current exchange rates and assuming 3%/year inflation. In most cases, the years of the source data are between 1990 and 2000.

A paper from the UK Transport Research Laboratory (TRL) in 1995 gave considerable detail for per-accident costs for fatal, serious injury and slight injury crashes. The original cost in 1994 UK pounds have been converted to 2002 euros by multiplying by 1.54 for the euro to pound exchange rate and by 1.27 for 8 years inflation at 3%.

Crash Severity	Lost Output	Human Costs	Medical Costs	Property Damage	Insurance Admin.	Police Cost	Total per Accident
Fatal	598 408	1 169 454	8 056	11 172	314	1 999	1 789 403
Serious Injury	26 774	158 232	16 052	5 311	196	274	206 839
Slight Injury	3 077	13 152	1 313	3 116	118	59	20 835
Damage Only	NA*	NA*	NA*	1 999	59	4	2 058

NA = Not Applicable

Table 3.1: Estimated per-crash costs, 2002 euros, UK prices

These costs are fairly complete. Comments on the individual cost categories are as follows.

- Lost output comprises the loss to the economy resulting from the lost working time of the crash victim. This includes lost earnings by the victim(s) as well as other losses to the economy at large.

- The human cost is the value placed on a fatality or injury, separate from identifiable economic losses. The term human cost is assumed to be equivalent to the value of a life referenced in the TOR, and is usually estimated by analysing how much people are willing to pay to reduce the risk of becoming an crash victim.

- Property damage includes the cost of damage to all involved road vehicles, the cost of a replacement vehicle, where required, and damage to other property.

- Police costs are based on actual surveys of police activity related to crashes, including administrative duties as well as attendance at the crash scene.

- Insurance costs are not counted as a crash cost. The costs of a crash are assumed to be independent of whether any of the costs can be reimbursed to the injured parties by insurance. An administrative cost for insurance is included, as an insurance claim will trigger costs for assessing the damage and processing the claim.

It should be noted that these costs are per crash, not per fatality or injury. The data in Section 2 suggest that there are typically 1.36 injuries per injury-causing crash. There is no comparable figure available for fatalities, but the number of fatalities per crash is unlikely to be as high as 1.36 and cannot be less than 1.00. A value of 1.15 fatalities per fatal crash is assumed. Using these ratios, the costs given in Table 3.1 can be presented in terms of per fatality or per injury costs, as shown in Table 3.2.

Crash Severity	Lost Output	Human Costs	Medical Costs	Share of cost per fatality or injury			
				Property Damage	Insurance Admin.	Police Cost	Total, all costs
Fatal	520 355	1 016 917	7 005	9 714	273	1 738	1 555 002
Serious Injury	19 687	116 347	11 803	3 905	144	201	152 087
Slight Injury	2 263	9 670	965	2 291	87	43	15 320

Table 3.2: Estimated costs per fatality or injury, 2002 euros

The largest individual cost is the human cost. This cost has received a lot of attention from researchers. A review of multiple studies yielded a range of estimates between 0.5 and 3 million euros. The terms of reference for this study specify that a value of 1 million euros should be used for the human value of a fatality, which is at the lower end of the range, but very close to the value calculated from the UK TRL study given in table 3.2. A value of $3 million is currently used in the United States for combined human, lost output and medical costs in cost-effectiveness analyses of

health and safety issues, including road crashes. Human costs for severe and slight injuries are also significant. Another reference suggests that a severe injury value is about 13% of a fatality and a slight injury is 1%, also based on a survey of a number of prior studies. This is consistent with the costs given in Table 3.2.

So far, costs have been estimated for fatalities, serious injury and slight injury crashes. Most of the available crash data do not distinguish between serious and slight injuries, so a composite injury crash cost is required, combining serious and slight injury crashes in the correct proportion. One estimate of the mix of injury crashes can be obtained from the SUNflower analysis.

Member State	Severe Injuries	Slight Injuries	Total Injuries	Percent Severe
Netherlands	11 507	34 577	46 084	25.0%
Sweden	4 103	18 520	22 623	18.1%
United Kingdom	38 155	278 719	316 874	12.0%
All Three States	53 765	331 816	385 581	13.9%

Table 3.3: Injury counts from the SUNflower analysis

The result of this calculation is strongly influenced by UK data, which is believed to include more slight injuries than are caused by crashes in other Member States. Also, correcting for the estimated undercount (per Table 2.2) will change the mix of severe and slight injury crashes, as shown in Table 3.4 below

Member State	Severe Injuries	Slight Injuries	Total Injuries	Percent Severe
Netherlands	14 959	57 052	72 011	20.8%
Sweden	6 155	32 410	38 565	16.0%
United Kingdom	45 786	376 271	422 057	11.3%
All Three States	66 900	465 733	532 633	12.6%

Table 3.4: Injury counts from the SUNflower analysis, corrected for undercounting

Overall, an estimate of about 15% severe appears reasonable for the average of the Member States, given that the UK is known to be lower than other states. Thus the average costs associated with an injury crsh, combining severe and slight injuries, are as given in Table 3.5.

Lost Output	Human Costs	Medical Costs	Property Damage	Insurance Admin.	Police Cost	Total per Accident
6 632	34 914	3 524	3 445	130	91	48 736

Table 3.5: Average costs for all injury crashes

The final crash cost to be estimated is the costs of road congestion resulting from crashes and the cost of environmental damage from spills of harmful products. In one example, congestion costs were estimated to be $2000/minute of delay, with a typical injury crash causing 57 minutes delay. This means a total cost of $114 000 per crash. Both the delay time and the cost per minute are for a multi-lane motorway in a major conurbation at a peak travel time. Average delay cost for all crashes including at off-peak travel times and on all road types will be only a fraction of this cost, probably less than 10%. Other sources (*Washington Post*, 2003; Skabardonis et al., 2003) indicate that between 10 and 40% of all traffic delay and congestion is crash-related. The *Washington Post* reported that the State of Maryland (with less than 5 million inhabitants) estimated savings of $527 million just from better management of unexpected delays, which translates into roughly $6000 per injury crash, assuming that 25% of delays are due to crashes. Although these data are sketchy, all available information indicates that delay costs can be substantial, on the order of several thousand Euros per crash. A value of 15 000 euros is estimated for fatal crashes and 5 000 euros for injury crashes

In summary, costs used to calculate benefits from the reduction in crashes, fatalities and injuries are as described below and listed in Table 3.6

- Fatal crash costs from Table 3.2, assuming 1.15 fatalities per fatal accident and using the one-million euro cost for the human cost of a fatality, as specified by DG TREN
- Injury crash costs from Table 3.5, assuming 1.36 injuries per injury crash
- Benefits from a reduction in property-damage-only crashes are not included in this analysis
- A congestion cost of 15,000 euros for fatal crashes and 5,000 euros for injury crashes
- All costs except the human costs are adjusted for by Member State for local cost variations, as discussed below

Crash/ Injury Severity	Lost Output	Human Costs	Medical Costs	Property Damage	Insurance Admin.	Police Cost	Delay Cost	Total per Crash
Fatal Accident	598 408	1 150 000	8 056	11 172	314	1 999	15 000	1 789 754
Injury Accident	6 632	35 000	3 524	3 445	130	91	5 000	53 736
Individual Fatality	520 355	1 000 000	7 005	NA*	NA*	NA*	NA*	1 527 360
Individual Injury	4 877	26 000	2 591	NA*	NA*	NA*	NA*	33 468

*NA = Not Applicable

Table 3.6: Summary of crash costs

Most of these costs derive from a UK source, and should not be applied directly to the other Member States. It is necessary to adjust costs to reflect variations in the cost of goods and services in each State. These variations apply to both the cost of crashes and the cost of proposed enforcement measures. Two cost elements were examined to evaluate this effect and to provide cost adjustment factors for each Member State. One was to obtain data on relative wage rates and the other to obtain information on the cost of cars in the different Member States. Most of the property damage in crashes is damage to cars, and also a significant component of policing cost is for road vehicles. Using these data a composite relative cost index was developed for each State, giving labour costs a higher weight than car costs. The index is partly judgmental – it takes into account that inhabitants of less wealthy states will likely drive smaller and cheaper cars and use less sophisticated and costly equipment in health care and for law enforcement. Table 3.7 gives the two individual cost indices and the resulting composite index.

Member State	Cost Adjustment Factor (UK = 1.00)		
	Labour	Cars (before tax)	Composite
Austria	1.10	0.94	1.05
Belgium	1.27	0.93	1.15
Denmark	1.30	0.97	1.19
Finland	1.23	0.86	1.11
France	0.95	0.89	0.93
Germany	1.32	0.79	1.14
Greece	0.50	0.86	0.62
Ireland	0.87	0.88	0.87
Italy	0.84	0.93	0.87
Luxembourg	1.07	0.90	1.02
Netherlands	1.08	0.85	1.00
Portugal	0.32	0.91	0.50
Spain	0.69	0.71	0.75
Sweden	1.10	0.81	1.05
United Kingdom	1.00	1.00	1.00

Table 3.7: Cost adjustment factors

These indices are used in all cost and benefit calculations except for the human cost of injuries and fatalities.

The three types of safety improvement measures affect crash costs in different ways:

- A reduction in speeding tends to reduce both the number of crashes and the severity of each crash. Since the effect of reducing speeding is partly to reduce the severity of a crash rather than preventing the crash, only half of property damage, policing and insurance administration costs will count toward the benefit.

- A reduction in drunk driving reduces the number of crashes, so all categories of cost will be included in the benefit calculation

- Increased seat belt use will reduce the number of fatalities and injuries, but does not affect property damage. Therefore, only lost output, human and medical costs are included in the benefit calculation.

Enforcement costs are generally specific to each road safety issue, and are calculated for each of speeding, drunk driving and non-use of seat belts in the following sections.

3.4 Analysis of Speeding Countermeasures

Speeding is one of the most widespread of road safety problems. All Member States for which an estimate has been located typically report between 30 and 60% of vehicles exceeding the posted speed limit, depending on road type. Traditional enforcement methods – police patrols, manual radar or laser speed measurement and similar methods - are limited in their ability to control speeding. It is usually not possible with these methods to provide continuous and widespread enforcement, except for occasional "blitzes". With limited resources, enforcement focuses on maximizing the deterrence effect of a visible police officer and regular checks at known crash black-spots. Police will also take action to apprehend and sanction the small percentage of extreme speeders. As a result, drivers become habituated to a moderate level of speeding (between 5 and 25 km/h) at most times and locations. This level of speeding is typically tolerated by enforcement authorities.

However, there is a well-known and quantified effect of speed on crashes, injuries and fatalities. Speed affects both the likelihood and severity of crashes. Numerous studies indicate that a 1% reduction in speed will reduce crashes by about 3%, and injuries and fatalities by a higher percentage. Thus, there is a strong road safety rationale for reducing average speeds, even by a few km/h within the customary tolerance zone.

A simple model developed by Swedish road safety experts can be used to quantify effect of speed on the number of crashes, injuries and fatalities:

$$m_{IA} = \left(\frac{v_A}{v_B}\right)^X n_{IB} + \left(\frac{v_A}{v_B}\right)^Y (m_{IB} - n_{IB})$$

where,

I = the category of injuries
A = indicates after the policy change
B = indicates before the policy change
v = speed
n = number of crashes
m = number of people injured

$$X = \begin{Bmatrix} 2, & if & all & injuries \\ 3, & if & serious & injuries \\ 4, & if & fatalities & \end{Bmatrix}$$

$$Y = \begin{Bmatrix} 4, & if & all & injuries \\ 6, & if & serious & injuries \\ 8, & if & fatalities & \end{Bmatrix}$$

The advent of automated methods to measure speed and to identify a speeding vehicle opens the way to more intensive enforcement of speed limits, without the costs and limited effectiveness of traditional enforcement methods or the need to stop the offending vehicle and impede traffic flow.

A number of studies have documented the success of automated speed enforcement.

- A 100km test section of road in the Netherlands, equipped with automated speed enforcement equipment, showed an average speed reduction of 8% (10km/h) with few drivers exceeding the limit. (Wegman et al., 2002)

- Measurements of effectiveness over 174 speed camera locations in the UK showed an average speed reduction of 6.7 km/h and a 27.9% reduction in crashes, at or near the camera locations. (Hooke et al. 1996)

A more recent study of a large number of UK locations showed that use of speed cameras resulted in an average speed reduction of 6 km/h at all locations and average speeds at urban sites (with speed limits of 30 and 40 mph (48-65 km/h)) fell by 12-13%. The study also measured a 35% reduction in fatalities and serious injuries and a 14% reduction in injury crashes (Department for Transport (UK) 2003).

In conclusion, it can be assumed that automated speed enforcement reduces speeds by about 7% at typical locations, yielding a benefit in reduced crashes, injuries and fatalities that can be quantified using the Swedish model described above.

For the cost-benefit analysis it is necessary to develop an estimate of the extent of the speeding problem in each Member State and the extent to which automated speed enforcement is currently used in each state. Efforts to obtain data on the extent of speeding are documented in Attachment B, with a table providing data for most States. Unfortunately most of the data are for the situation in the early to mid 1990s, before the installation of automated enforcement systems. Also, different States collect different speeding statistics and State-to-State comparisons are not reliable. However, the data do show widespread speeding in all states where measurements have been made.

The alternative approach is to determine the current extent of automated speed enforcement in each Member State, and assume that the expected benefits are being achieved. This was done by combining information from the Clifford Chance survey and the Escape working paper on automated enforcement (Escape 2000), to give the results shown in table 3.8.

Member State	Clifford Chance Survey (2003)		ESCAPE WP 6 (2000): Number of boxes/cameras + mobile units	Consultant Estimate of Speed Camera Sites in Use (2002)
	Speed Camera Use	Sanctions		
Austria	Some use	Low	363/79 + 77	800
Belgium	Some use	Moderate		200
Denmark	Some use	Moderate	0 +8	200
Finland	Yes, 280 road-km	Moderate	84/8 + 8	200
France	Very limited	Moderate		100
Germany	Some use	Low	NA	500
Greece	No use	Moderate		0
Ireland	Some, started 2000	Moderate		100
Italy	A few	Moderate		100
Luxembourg	No use	Moderate		0
Netherlands	Substantial use	Low	NA	1 500
Portugal	No use	Moderate		0
Spain	No use	Moderate		0
Sweden	Substantial use	High	7/2 + 20	500
United Kingdom	High use	High	3 000/400 + 500	6 000

Table 3.8: Speed camera usage and speeding sanctions

Some comments on the data shown in this table are:

- The United Kingdom is clearly the leader in speed camera use, although the numerical totals may include cameras monitoring compliance with red lights as well as speed limits.

- Although sanctions have been classified as high moderate and low, sanctions are fairly uniform among Member Stares and the total range is not great.

From these rather limited data we have attempted to estimate the number of speed cameras and boxes currently in use in each Member State. The result is given in the fifth column of Table 3.8.

The next step is to compare the estimated actual camera sites with the number needed to either bring all States up to the standard of the best-performing State (in this case the UK) or to meet the requirements of the EC Working Paper, reproduced in Attachment A.

Knowledge of the length of the road network in each Member State, and how this length is distributed among different road types is the key input to the calculation of the number of camera sites needed. Table 3.9 provides estimates of network length by Member State and in total. The data were obtained from IRTAD, with missing values roughly estimated by reference to geographically similar States and vehicle-km data. Estimated values are shown in italics.

Member State	Road-Kilometres				
	Motorway	Trunk	Urban	Rural	Total
Austria	1 634	*6 000*	19 001	*79 904*	106 538
Belgium	1 702	11 389	28 814	105 216	147 121
Denmark	953	2 855	19 026	*53 279*	76 113
Finland	512	12762	6 726	*80 000*	*100 000*
France	9 310	24 000	212 921	*738 693*	984 924
Germany	11 515	31 883	175 749	*406 986*	626 133
Greece	*0*	*3 000*	5 033	*32 131*	40 164
Ireland	103	5 190	3 286	87 150	95 729
Italy	6 444	*20 000*	98 556	*37 5000*	*500 000*
Luxembourg	114	*500*	527	*1 711*	2 852
Netherlands	2 207	7 296	58 298	48 699	116 500
Portugal	883	*7 500*	7 617	*64 000*	*80 000*
Spain	*3 500*	*20 000*	76 500	*300 000*	*400 000*
Sweden	1 437	*15 000*	23 564	170 000	210 001
United Kingdom	3 405	35 557	171 928	183293	394 183
Totals	43 719	202 932	907 545	2 726 062	3 880 258

Table 3.9: Estimated length of the EU road network

Given the large number of estimates that had to be made and the uncertainty over the consistency of road type definitions in Member States, these figures must be regarded as highly approximate, and should not be used for any purpose other than the calculations in this report.

The EC Working Paper specifies that automated speed enforcement shall be used on all motorways and trunk roads, and on busy urban roads, emphasizing locations where a high incidence of speeding is suspected. The calculation steps to arrive at an estimate of the number of speed cameras needed were as follows:

- Since the number of speed enforcement sites is a function of traffic lane-km rather than road-km, lane-km in each State was estimated by assuming that motorways have an average of six lanes, trunk roads 3.5 lanes, urban roads 2.5 lanes and rural roads 2 lanes. This gave a total of 8.5 million lane-km for all EU Member States.

- Following the requirements of the Working Paper, it was assumed that all motorways and trunk roads would need to be equipped with speed cameras, plus 20% of urban roads. EU-wide, this comprised about 15%of the total lane-km. But these lane-km carry heavy traffic, estimated to be between 40 and 50% of total vehicle-km. Because of the higher crash risk per million vehicle-km on busy roads (due to high traffic density), and the siting of cameras at known high-risk locations, we estimate that 55% of injury and fatal crashes will be covered by the cameras.

- The number of cameras and camera sites was estimated at one site every 12 lane-km. Several factors contributed to this estimate:

  - A camera-site will inhibit speeding for 4 to 6 km “downstream” from the camera
  - One camera may cover more than one lane, depending on camera type and local road details
  - One study (Department for Transport (UK) 2003) noted that reduced speeding was not confined just to roads equipped with automated speed enforcement cameras. Once several

lengths of road were equipped in an area, speeding was reduced on both equipped and unequipped roads.

- Camera installations would be concentrated on known high-speeding areas, increasing the overall effectiveness of the enforcement program.

This analysis gives an estimate of the total number of cameras and camera sites needed to meet the requirements of the EC working paper. The number of additional camera sites in each State is obtained simply by subtracting existing sites from the total. For the Best State scenario, number of additional enforcement sites in each State to reach the same fraction of full implementation as the best State (the UK) was calculated. Existing sites in the UK are at about 30% of the total sites for full implementation, estimated to cover roads having about 20% of crashes, as compared with 55% for full enforcement.

The results of these calculations are shown in Table 3.10, giving the estimated number of additional camera enforcement sites for each Member State for each scenario

Member State	Number of Enforcement Sites				
	Total for Full Enforcement Per Working Paper	Present Sites	For Best State Equivalency	Required Additional Sites	
				Best State Scenario	Full Implementation Scenario
Austria	3 359	800	1 048	248	2 559
Belgium	5 373	200	1 676	1 476	5 173
Denmark	2 102	200	656	456	1 902
Finland	4 259	200	1 328	1 128	4 059
France	20 527	100	6 402	6 302	20 427
Germany	22 380	500	6 980	6 480	21 880
Greece	1 085	0	338	338	1 085
Ireland	1 702	100	531	431	1 602
Italy	13 162	100	4 105	4 005	13 062
Luxembourg	225	0	70	70	225
Netherlands	5 661	1500	1 766	266	4 161
Portugal	2 946	0	919	919	2 946
Spain	10 771	0	3 359	3 359	10 771
Sweden	6 075	500	1 895	1 395	5 575
United Kingdom	19 237	6 000	6 000	0	13 237
Totals	118 862	10 200	37 073	26 873	108 662

Table 3.10: Requirements for additional speed enforcement sites for each scenario

The reduction in the number of injury and fatality crashes may be estimated using the Swedish formula described above. If the average speed reduction achieved over roads equipped with camera sites is 7 km/h, then the reduction on equipped roads will be 16.5% for injury crashes and 27.7% for fatal crashes. Then using the estimate that enforcement sites cover roads having 20% of crashes for the Best State scenario and 55% for the Full Implementation scenario, it is possible to calculate the reduction in crashes and the corresponding benefit, as shown in Tables 3.11 and 3.12. Unit costs of crashes are as given in Table 3.6.

Member State	Reduction in Crashes		Reduction in Casualties		Value of Crash Reduction (Million Euros)		
	Injury	Fatal	Injuries	Fatals	Injury	Fatal	Total
Austria	399	13	542	15	22	24	47
Belgium	1 875	60	2 550	69	116	123	239
Denmark	232	17	315	19	15	36	51
Finland	247	18	335	21	15	37	51
France	9 436	413	12 832	474	472	687	1 158
Germany	10 856	417	14 764	480	665	851	1 516
Greece	1 040	128	1 415	147	35	142	176
Ireland	288	19	392	22	13	30	43
Italy	7 844	325	10 668	374	367	506	873
Luxembourg	42	3	58	3	2	5	8
Netherlands	297	9	404	10	16	16	31
Portugal	2 124	136	2 888	156	57	122	179
Spain	3 664	303	4 984	348	148	406	554
Sweden	607	20	826	23	34	37	71
United Kingdom	0	0	0	0	0	0	0
Totals	38 951	1 879	52 973	2161	1 977	3 021	4 997

Table 3.11: Benefit from reduced speeding – Best State scenario

Member State	Reduction in Crashes		Reduction in Casualties		Value of Crash Reduction (Million Euros)		
	Injury	Fatal	Injuries	Fatals	Injury	Fatal	Total
Austria	3 534	100	4 807	115	199	188	387
Belgium	5 637	156	7 667	179	348	321	669
Denmark	829	53	1 128	60	53	112	165
Finland	761	50	1 035	57	45	98	144
France	26 231	997	35 674	1 147	1 311	1 660	2 971
Germany	31 439	1 051	42 758	1 208	1 926	2 144	4 070
Greece	2 860	306	3 890	352	95	340	435
Ireland	919	53	1 250	61	43	82	125
Italy	21 942	791	29 841	909	1 026	1 231	2 257
Luxembourg	117	7	158	8	6	13	19
Netherlands	3 992	101	5 429	117	215	182	396
Portugal	5 840	326	7 942	374	157	291	448
Spain	10 077	724	13 705	832	406	972	1 378
Sweden	2 081	59	2 831	68	117	111	228
United Kingdom	19 323	306	26 280	352	1 038	547	1 586
Totals	135 584	5 079	184 395	5 840	6 987	8 292	15 279

Table 3.12: Benefit from reduced speeding – Full implementation scenario

A 1996 study by the Police Research Group in the UK (Hooke et al. 1996) gave the capital and annual operating costs of a speed camera installation to be 22 757 euros and 15,494 euros respectively (converted from original 1996 English pound costs to 2002 Euros). If the cameras have a five-year life, then annualised capital cost of one installation is about 5 500 Euros, making total annualised costs of 20 994 euros per installation. The cost of implementing the two scenarios was calculated using this per installation cost plus a cost for publicity campaigns on 0.75 Euros/driver for the Best State scenario and 1.5 euros per driver for the Full Implementation scenario. The resulting costs and benefit to cost ratios are given in Table 3.13.

Member State	Cost of Countermeasures (Million Euros)		Benefit/Cost Ratios		Net Benefit as a percent of GNP	
	Best State	Full Impl'n	Best State	Full Impl'n	Best State	Full Impl'n
Austria	9	63	5.4	6.2	0.019	0.158
Belgium	40	134	5.9	5.0	0.081	0.218
Denmark	13	52	3.8	3.2	0.021	0.064
Finland	29	101	1.7	1.4	0.017	0.033
France	152	457	7.6	6.5	0.072	0.179
Germany	199	611	7.6	6.7	0.065	0.170
Greece	9	24	18.8	18.1	0.137	0.336
Ireland	9	32	4.8	4.0	0.033	0.092
Italy	110	311	8.0	7.2	0.065	0.167
Luxembourg	2	5	4.4	3.6	0.029	0.069
Netherlands	12	101	2.5	3.9	0.005	0.075
Portugal	15	42	11.9	10.8	0.144	0.357
Spain	71	206	7.8	6.7	0.080	0.193
Sweden	35	132	2.0	1.7	0.015	0.039
United Kingdom	24	327	NA	4.9	-0.002	0.082
All Member States	730	2 595	6.8	5.9	0.050	0.149

Table 3.13: Benefits, costs and benefit-cost ratios for speeding countermeasures

Net benefits can also be expressed as a percent of GNP for each Member State and for the EU as a whole, as shown in the right hand columns of Table 3.13. For most Member States, and for all States combined, moving from the Best State Scenario to the Full Implementation Scenario tends to reduce the benefit:cost ratio, but increase the net benefit. This apparently contradictory result is because the incremental benefit of moving to the Full Implementation scenario is still greater than the incremental cost, thus adding to net benefit, but the incremental benefit:cost ratio is lower than for the Best State Scenario. A simple fictitious example illustrates the effect:

Best state:	Benefit 10 units, cost 2 units, ratio 5:1, net benefit: 8 units
Full Implementation:	Benefit 20 units, cost 5 units, ratio 4:1, net benefit 15 units

All the results presented in Table 3.13 are for years in which the speeding countermeasures are fully implemented and have reached full effectiveness. This does not take account of any up-front costs to initiate the programme, for example legislative changes, planning, getting budgets approved, contracting with firms to supply and install the equipment and so on. Also, this programme, with substantial capital costs, could take several years to implement, and the benefits will lag the investment by a year or two because it will take time for drivers to modify their speeding in response to the enforcement actions. A fifteen-year present value calculation has been carried out to evaluate the impact of these considerations, based on the following assumptions:

- Up-front costs at 20% of one years enforcement cost plus 20% of the initial capital investment, incurred in year 1, based on typical legal/planning/permitting costs for public projects
- Implementation in five equal instalments over years 2 to 6
- Benefits grow to full value in five equal instalments in years 3 to 7
- Capital investment is repeated every five years, to replace worn-out equipment and to upgrade the technology of cameras, speed sensors and associated information and communications equipment.

Table 3.14 compares the present value of fifteen years of costs and benefits for each member state and for the EU as a whole for each scenario. The results show that benefit to cost ratios are reduced by between 10 and 20% compared with the "simple" benefit to cost ratios shown in Table 3.13. The results also show that, in general, benefit to cost ratios are lower in Member States that already have relatively good road safety records. There is obviously less room for improvement in such States, and the improvement comes at a relatively higher cost than in Member States that do not have a good record.

Member State	Best State Scenario			Full Implementation Scenario		
	Present Values (million Euros)		Benefit to Cost Ratio	Present Values (million Euros)		Benefit to Cost Ratio
	Costs	Benefits		Costs	Benefits	
Austria	81	347	4.3	559	2 856	5.1
Belgium	378	1 764	4.7	1 215	4 937	4.1
Denmark	126	376	3.0	465	1 218	2.6
Finland	277	376	1.4	916	1 063	1.2
France	1 428	8 546	6.0	4 013	21 926	5.5
Germany	1 917	11 583	6.0	5 322	31 096	5.8
Greece	102	1 336	13.2	180	3 302	18.4
Ireland	89	317	3.6	286	923	3.2
Italy	1 032	6 443	6.2	2 583	16 657	6.4
Luxembourg	17	59	3.5	47	140	3.0
Netherlands	117	229	2.0	883	2 923	3.3
Portugal	151	1 305	8.7	341	3 266	9.6
Spain	684	3 870	5.7	1 760	9 626	5.5
Sweden	330	524	1.6	1 194	1 683	1.4
United Kingdom	232	0	0.0	2 837	11 705	4.1
All Member States	6 959	37 075	5.3	22 601	113 320	5.0

Table 3.14: Fifteen-year comparison of costs and benefits (2003-18)

3.5 Analysis of Drunk Driving Countermeasures

The second of the three road safety improvement measures proposed by the European Commission is the implementation of uniform and highly effective measures to reduce the incidence of drunk driving. This analysis is to estimate the benefit from two levels of improvement, one using the practices of the best performing Member State, and one to the level of enforcement specified in the Commission's Working Paper on road safety enforcement. To perform the necessary calculation, information is needed on the following:

- Drunk-driving laws and enforcement practices in member states thought to influence the prevalence of drunk driving in Member States, specifically:
  - Maximum level blood alcohol (BAC) permitted when driving
  - Whether or not random testing used to enforce drunk-driving laws
  - Number of tests performed annually per licensed driver
  - Severity of sanctions for violating drunk-driving laws
- Data on the actual involvement of drunk drivers in crashes, for example the percentage of crashes in which one or more drivers has a blood alcohol level exceeding the legal limit.

The Clifford Chance survey gives reasonably complete data for the four enforcement parameters. Current maximum BAC levels for all Member States are listed, together with recent changes and information on the use of higher maximum BAC levels to trigger more severe sanctions. It should be noted that several States reduced BAC limits between 1997 and the present. Data on testing procedures and intensity are given for most States, although it is not always clear exactly what random testing procedures are permitted or used. Finally, full details are given for almost all States regarding sanctions for drunk driving. The structure of sanctions in most states is quite complex with various mixes of fines, suspension of driving licenses, and in serious cases prison terms, with variations for alcohol level and the number of previous offences. Also the discretion of the court or police to select the sanction varies from state to state. Some States, for example the UK, have severe mandatory sanctions, whereas in other States the police and courts have quite wide discretion.

The approach taken in this analysis is to compare the four enforcement parameters (BAC limit, use of random tests, testing intensity, and sanction severity), and to assign a score between 1 and 4 to each depending on each Member States' conditions. Then the scores were weighted and summed to give an overall score for each State. In addition a score was calculated for a hypothetical "perfect" State that met the requirements of the EC Working Paper and also used the practice of the most effective State in each area. Then the difference between the scores of each State with the "best" State and the "perfect" state indicated the potential for improvement.

Table 3.15 gives comparative data on the laws and practices of each Member State with respect to each drunk driving enforcement parameter. The data in this table was obtained from the 2003 Clifford Chance report, the Escape reports, the Sunflower report, and ETSC 1999. In many cases the information was incomplete or contradictory. On the question of random testing, some member states indicated that they used random testing and then qualified the statement by saying testing targeted high-risk times and locations. On the question of the number of tests performed, data was unavailable for two Member States (Denmark and Italy), and that for the other States was obtained from multiple and possibly inconsistent sources, depending on how testing data were compiled. Finally, there does not appear to be consistent relationship between the use of random testing and the number of tests performed.

Member State	Blood Alcohol Limit (mg/ml 2002)	Blood Alcohol Limit (mg/ml 1997)	Random Testing (Yes/Partial/No) (1)	Testing Intensity (% drivers/yr)	Sanction Severity (2)
Austria	0.5	0.8	Y	4	M
Belgium	0.5	0.8	Y	5	L
Denmark	0.5	0.8	P	No Info	H
Finland	0.5	0.5	Y	30	H
France	0.5	0.5	Y	25	M
Germany	0.5	0.8	N	7	M
Greece	0.5	0.5	Y	13	L
Ireland	0.8	0.8	N	2	H
Italy	0.5	0.8	P	No Info	L
Luxembourg	0.5	0.5	Y	2	M
Netherlands	0.5	0.5	Y	7	M
Portugal	0.5	0.8	Y	17	L
Spain	0.5	0.8	Y	7	L
Sweden	0.2	0.2	Y	22	VH
United Kingdom	0.8	0.8	N	3	VH

Notes: (1) Y=Yes; P=Partial; N=No.
(2) VH = very high; H = high; M = moderate; L = low.

Table 3.15: Drunk Driving Enforcement Measures by Member State

This information is converted into a numerical score using the conventions listed below. All scores are between one and four, with "4" indicating the most stringent conditions and "1" indicating the most relaxed.

- BAC limits: 0.2 = 4; 0.5 =3; 0.8 = 2. 2002 levels are used for consistency with 2002 accident data estimated using the procedure described in Section 2. The reduction from 0.8 to 0.5 was implemented very recently in several Member States, and may not be fully reflected in current safety statistics.

- Random testing: Yes = 4; No = 1; A score of 2 may be used when a Member State uses a mix if random and "on suspicion" testing, for example only testing drivers at times and places where a high occurrence of drinking drivers is likely

- Testing Intensity: Over 20% = 4; 10-20% = 3; 5-10% = 2; 0-5% = 1; no information default = 2

- Severity of sanctions; VH = 4; H = 3; M = 2; L = 1

The research literature (Escape 2002; Wegman et al. 2002) generally agrees that emphasizing random rather than "on-suspicion" testing is the most effective countermeasure against drunk driving, followed by the severity and certainty of sanctions, testing intensity, with actual blood alcohol level last. This conclusion is primarily based on lengthy experience in Nordic countries, especially Finland. Accordingly weighting factors of 2.5 for random testing, 2.0 for sanctions, 1.5 for test intensity and 1.0 for BAC level are applied, to give the result shown in Table 3.16. However, it should be noted that there are differences in degree among the Nordic countries. Relative to Finland, Sweden has fewer checks but more severe sanctions. Also, a relatively good result has been achieved in the UK where random testing is not permitted and enforcement relies strongly on severe sanctions. Perhaps one key to success is that the approach should be highly visible, making drivers aware that police are active and there is a high chance of getting caught if you drive drunk. The details of the approach – random or "on suspicion" checking strategies, BAC limits, severity of sanctions etc. - may be less critical.

Member State	Drunk Driving Enforcement Scores				
	BAC (2002)	Random Testing?	Testing Intensity (1)	Sanctions	Weighted Totals
Austria	3	4	1	2	18.5
Belgium	3	4	1	1	16.5
Denmark	3	2	2	3	17
Finland	3	4	4	3	25
France	3	4	4	2	23
Germany	3	1	2	2	12.5
Greece	3	2	3	1	14.5
Ireland	2	1	1	3	12
Italy	3	2	2	1	13
Luxembourg	3	4	1	2	18.5
Netherlands	3	4	2	2	20
Portugal	3	4	3	1	19.5
Spain	3	4	2	1	18
Sweden	4	4	4	3	26
United Kingdom	2	1	1	4	14
Hypothetical "Perfect" State	4	4	4	4	28

Note: (1) A default level of 5% was used for testing intensity where no other information was available.

Table 3.16: Estimated drunk-driving enforcement scores for each Member State

The data on actual involvement or responsibility of drunk drivers in crashes is unsatisfactory. Although data have been found for all the Member States, there seems to be little correlation with enforcement practices and sanctions. Table 3.17 shows two sets of estimates (from NHTSA 2001and NHTSA 2000) alongside the enforcement ratings from Table 3.16.

Member State	Percentage Drunk Drivers in Fatal Crashes		Rating from Clifford Chance Survey
	NHTSA (2001)	NHTSA (2000)	
Austria	9%	9%	20
Belgium	9%	31%	18
Denmark	22%	22%	17
Finland	25%	25%	25
France	19%	33%	23
Germany	17%	17%	12.5
Greece	42%	42%	11.5
Ireland	29%	29%	12
Italy	2%	2%	13
Luxembourg	7%	7%	18.5
Netherlands	9%	9%	20
Portugal	3%	3%	19.5
Spain	4%	28%	18
Sweden	7%	18%	26
United Kingdom	14%	17%	14

Table 3.17: Estimated percentage of drunk drivers involved in fatal crashes

No correlation could be found between reported involvement of drunk drivers in fatal crashes and the ratings, or with the individual components of the ratings. Other sources of data failed to throw any light on the problem (Wegman et al. 2002; Irish Times 2001; ICADTS 2000; Time Europe 2002 and others). The Sunflower report (Wegman et al. 2002) discusses this measurement problem in some detail, acknowledging that the data are incomplete or inconsistent. For this reason, very few past studies attempt to provide a numerical estimate of the reduction in crashes, injuries or fatalities that would result from a particular set of countermeasures. The best estimate from the authors of the SUNflower report was that drunk-driving crashes could be reduced by about 10% in the Netherlands and the UK.

The next step is to calculate the potential reduction in crashes, injuries and fatalities. This is accomplished by calculating the difference in score between each country and Sweden for the first scenario (applying the practices of the best-performing Member State), and between each country score and the perfect score for the second scenario. Then the estimated reduction in crashes is

calculated for the premise that the largest improvements possible are a 15% reduction in fatalities and a 10% reduction in injuries for the worst-performing State. This rather arbitrary approach was adopted because of the lack of credible data on the actual involvement of drunk-drivers in crashes and thus the likely effect of a particular set of countermeasures. The resulting percentage reductions in injuries and fatalities are shown in Table 3.18.

Member State	Matching Best Member State (% reduction)		Meet Working Paper Requirements (% reduction)	
	Fatalities	Injuries	Fatalities	Injuries
Austria	6.0	4.0	8.1	5.4
Belgium	7.7	5.1	9.9	6.6
Denmark	7.3	4.9	9.4	6.3
Finland	0.0	0.0	2.6	1.7
France	2.1	1.4	4.3	2.9
Germany	11.1	7.4	13.3	8.9
Greece	9.4	6.3	11.6	7.7
Ireland	11.6	7.7	13.7	9.1
Italy	10.7	7.1	12.9	8.6
Luxembourg	6.0	4.0	8.1	5.4
Netherlands	4.7	3.1	6.9	4.6
Portugal	5.1	3.4	7.3	4.9
Spain	6.4	4.3	8.6	5.7
Sweden	0.0	0.0	1.7	1.1
United Kingdom	9.9	6.6	12.0	8.0

Table 3.18: Estimated reduction in drunk driving injuries and fatalities (percent)

The values in the table are comparable to the measured results of specific efforts to reduce drunk driving quoted in Escape 2001 and the 10% estimated by the authors of the SUNflower report. These are reasonable expectations for the results of a sustained EU-wide campaign over several years. The next step toward completion of this analysis is to calculate crash cost savings from the percentage reductions in crashes given in Table 3.18. First the number of fatal crashes is estimated from the number of fatalities in each Member State by dividing by 1.15, the estimated number of fatalities per fatal crash. Then the number of injury crashes is estimated by subtracting fatal crashes from total crashes. The reduction in fatal and injury crashes is calculated for each scenario by multiplying crash counts by the percentages given in Table 3.18 to give the reduction in fatal and injury crashes, and then multiplying by per-crash costs given in Tables 3.6 for fatal and injury crashes, to give estimated cost savings. The results of the calculations are given in Tables 3.19 and 3.20 for the two scenarios.

Member State	Reduction in Crashes		Reduction in Casualties		Value of Crash Reduction (Million Euros)		
	Fatal	Injury	Fatals	Injuries	Fatal	Injury	Total
Austria	52	2 045	59	2 781	97	115	212
Belgium	82	3 318	94	4 513	169	205	374
Denmark	28	491	32	667	59	31	90
Finland	0	0	0	0	0	0	0
France	141	4 149	162	5 643	235	207	442
Germany	786	26 324	904	35 800	1 604	1 613	3 216
Greece	189	1 981	218	2 694	210	66	276
Ireland	43	830	49	1 129	66	39	105
Italy	560	17 403	644	23 668	873	814	1 686
Luxembourg	3	51	3	70	5	3	8
Netherlands	43	1 881	49	2 558	76	101	178
Portugal	110	2 206	126	3 001	98	59	158
Spain	305	4 759	351	6 472	410	192	602
Sweden	0	0	0	0	0	0	0
United Kingdom	287	20 335	331	27 655	514	1 093	1607
Totals	2 629	85 773	3 024	116 652	4 417	4 538	8 955

Table 3.19: Benefit from reduced drunk-driving crashes – Best State scenario

Member State	Reduction in Crashes		Reduction in Casualties		Value of Crash Reduction (Million Euros)		
	Fatal	Injury	Fatals	Injuries	Fatal	Injury	Total
Austria	70	2 775	81	3 774	132	157	288
Belgium	105	4 240	120	5 766	216	262	478
Denmark	36	635	41	864	77	41	117
Finland	9	151	10	205	17	9	26
France	282	8 299	324	11 287	469	415	884
Germany	937	31 386	1078	42 685	1 912	1 923	3 835
Greece	233	2 431	267	3 307	258	81	339
Ireland	51	984	58	1 338	79	46	125
Italy	672	20 883	773	28 401	1 047	976	2 023
Luxembourg	4	70	4	95	7	4	11
Netherlands	62	2 736	71	3 721	111	147	258
Portugal	156	3 126	179	4 251	139	84	223
Spain	407	6 345	468	8 630	547	256	802
Sweden	7	286	8	388	14	16	30
United Kingdom	350	24 756	402	33 668	626	1 330	1 957
Totals	3 380	109 102	3 888	148 379	5 651	5 746	11397

Table 3.20: Benefit from reduced drunk-driving crashes – Full Implementation scenario

The last step in the analysis is to estimate the cost of implementation, primarily the cost of conducting many more random tests than is currently the practice in most Member States. The number of additional tests is estimated from the difference between the present number of tests, as given in the sixth column of Table 3.15, and the required number of tests calculated for the two scenarios, multiplied by the estimated cost of a single test. The required numbers of tests were estimated to be 22% of registered drivers per year for the Best State Scenario and 40% of drivers for the Full Implementation scenario. An estimated cost of 25 euros per test is used, based on Irish information from Bacon, 2002. Several other literature sources mention cost-benefit analyses for police enforcement, but do not give any hard data from which a cost per test can be estimated. In addition, a cost for publicizing drunk driving countermeasures, considered a requirement in an effective programme of countermeasures by many experts, is added at the rate of 1 Euro/driver/year for the "Best State" scenario and 2 Euros/driver/year for the "Full Implementation" scenario. These publicity costs are based on information from Ireland (Bacon, 2002) and some information on public-service advertising costs in the United States. Table 3.20 gives the resulting for the two countermeasure scenarios, together with benefit/cost ratios.

Member State	Cost of Countermeasures (million euros)		Benefit/Cost Ratios		Net Benefit as a percent of GNP	
	Best State	Full Impl'n	Best State	Full Impl'n	Best State	Full Impl'n
Austria	23.5	46.6	9.5	6.5	0.092	0.117
Belgium	33.2	67.2	13.0	8.2	0.136	0.163
Denmark	14.1	28.9	7.6	4.8	0.042	0.047
Finland	NA	8.4	NA	3.5	NA	0.013
France	38.5	187.9	10.7	4.4	0.029	0.051
Germany	274.4	592.9	13.4	7.4	0.143	0.155
Greece	21.7	58.1	7.9	3.6	0.215	0.248
Ireland	9.8	18.5	9.3	5.9	0.095	0.107
Italy	254.7	521.5	5.8	3.4	0.126	0.135
Luxembourg	2.0	3.8	4.1	2.9	0.029	0.033
Netherlands	43.8	93.5	4.1	2.8	0.034	0.042
Portugal	16.2	55.4	4.9	2.0	0.131	0.172
Spain	113.9	245.8	4.0	2.4	0.085	0.102
Sweden	NA	37.3	NA	0.8	NA	-0.004
United Kingdom	187.5	366.4	8.6	5.3	0.093	0.104
All Member States	1 024	2 332	8.1	4.7	0.093	0.107

Table 3.21: Benefits, costs and benefit-cost ratios for drunk driving countermeasures

The results show benefit to cost ratios averaging 8.6 for the "Best State" scenario and 4.9 for the "Full Implementation" scenario, well above the breakeven point of 1.0. Thus even if benefits are significantly over-estimated and costs significantly underestimated, both of the drunk-driving countermeasures would likely still show large benefits.

All the results presented in Table 3.21 are for years in which drunk driving countermeasures are fully implemented and have reached full effectiveness. This does not take account of any up-front costs to initiate the programme, for example legislative changes, planning, getting budget changes approved, contracting with firms to supply required equipment, set up new databases to track enforcement efforts, and so on. Also, this programme may take several years to implement, and the benefits will lag the investment by a year or two because it will take time for drivers to modify their behaviour in response to the enforcement actions. A fifteen-year present value calculation has been carried out to evaluate the impact of these considerations, based on the following assumptions:

- Up-front costs at 20% of one years enforcement cost in year 1, based on typical legal/planning/permitting costs for public projects
- Implementation in four equal instalments over years 2 to 5, to take account of the need to recruit and train police and other staff involved in the effort, and to refine the programme to reach full effectiveness in the light of experience
- Benefits grow in four equal instalments in years 3 to 6, lagging implementation by one year

Table 3.22 compares the present value of fifteen years of costs and benefits for each member state and for the EU as a whole for each scenario. As with speeding countermeasures, the effect of introducing the up-front costs and a time lag between implementation and achieving benefits is to reduce benefit to cost ratios by about 20%. For two Member States, Finland and Sweden, the benefit to cost ratios are less than 1.0 in both scenarios, meaning that costs are greater than benefits. Both these states already have a low rate of fatal and injury crashes, and implementing additional measures to control drunk driving does not appear to produce sufficient benefits to outweigh costs.

Member State	Best State Scenario			Full Implementation Scenario		
	Present Value (million Euros)		Benefit to Cost Ratio	Present Value (million Euros)		Benefit to Cost Ratio
	Costs	Benefits		Costs	Benefits	
Austria	400	1648	4.1	463	2239	4.8
Belgium	330	2907	8.8	668	3716	5.6
Denmark	140	700	5.0	287	910	3.2
Finland	238	0	0.0	497	202	0.4
France	383	3436	9.0	1867	6872	3.7
Germany	2814	25856	9.2	5892	30833	5.2
Greece	251	2205	8.8	577	2708	4.7
Ireland	105	816	7.8	184	972	5.3
Italy	2531	13106	5.2	5182	15726	3.0
Luxembourg	20	62	3.1	38	86	2.3
Netherlands	435	1384	3.2	929	2006	2.2
Portugal	173	1214	7.0	551	1713	3.1
Spain	1168	4436	3.8	2443	5910	2.4
Sweden	0	0	NA	371	233	0.6
United Kingdom	1863	17502	9.4	3641	15213	4.2
All Member States	10852	75273	6.9	23588	89337	3.8

Table 3.22: Fifteen-year comparison of costs and benefits

3.6 Analysis of Countermeasures for Non-Use of Seat Belts

Although there have been steady gains over the years, non-use of seat belts remains a significant road safety issue. As will be shown in this analysis, increasing seat belt use can result in substantial reductions in fatalities and injuries.

Recent estimates of seat belt use in Member States are given in Table 3.23, obtained from ETSC (1999). Seat belt usage is given in this publication by type of road and location of vehicle occupant – driver, front seat passenger, and rear seat passenger. By making an estimate of the fractions of total person-kilometres represented by the location of the vehicle occupants, it is possible to estimate the average use of seat belts, as also shown in Table 3.23. Most notably, the non-use of belts by rear seat passengers significantly lowers the overall average. This appears to be because early efforts to promote seat belt use focused on front seat occupants, leading to a perception that unbelted travel in rear seats was relatively safe. More recent research indicates that using belts in rear seats is also critical to safety, and use is growing in response to on-going publicity and enforcement efforts.

Member State	Seat Belt Use By Location (percent)			Average, All Locations (percent)
	Driver	Front Seat Passenger	Rear Seat Passenger	
Austria	86	88	30	77
Belgium	69	71	33	63
Denmark	68	70	34	63
Finland	89	91	57	84
France	89	91	70	86
Germany	88	90	68	85
Greece	39	41	10	35
Ireland	78	80	54	74
Italy	36	38	10	32
Luxembourg	69	71	33	63
Netherlands	78	80	37	72
Portugal	87	89	55	82
Spain	87	89	10	74
Sweden	90	92	80	89
United Kingdom	90	92	66	86

Table 3.23: Estimated seat belt usage in Member States

Research shows that non-use of seat belts among vehicle occupants that are killed or seriously injured is substantially higher than the fraction of all unbelted vehicle occupants. Firstly, non-users are more likely to get into crashes in the first place. Hunter et al. (1993) estimate that non-belted drivers have 35% more crashes than belted drivers, independent of the severity of injuries suffered by the vehicle's occupants. Secondly, research also shows that there is a substantial reduction in serious injuries and fatalities when seat belts are used, in the range of 40% to 60%. A reduction of 50%, in the centre of the range suggested by the research has been assumed for this calculation. Applying the factors for non-use and higher injury and fatality risk, it is possible to calculate directly the percent of non-users among crash casualties from the percent of non-users among all vehicle occupants. Table 3.24 summarizes the results of this calculation, together with the estimates of injuries and fatalities preventable by 100% seat belt use.

Member State	Vehicle Occupant Casualties (excl. motor cycles)		% Non-Use Among Crash Casualties		Preventable Casualties with 100% belt use	
	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries
Austria	640	49 504	45	45	143	11 064
Belgium	813	70 630	61	61	247	21 509
Denmark	261	9 178	62	62	80	2 828
Finland	254	8 967	34	34	43	1 520
France	5 104	313 756	30	30	766	47 064
Germany	5 214	361 700	32	32	838	58 114
Greece	1 271	32 261	84	84	532	13 492
Ireland	226	11 962	48	48	54	2 880
Italy	3 736	264 321	85	85	1 590	112 499
Luxembourg	43	1 699	61	61	13	517
Netherlands	557	50 051	52	52	144	12 969
Portugal	1 187	57 982	37	37	220	10 770
Spain	3 531	128 578	48	48	851	30 970
Sweden	339	27 401	25	25	43	3 486
United Kingdom	1 811	294 030	31	31	276	44 888
Totals	24 987	1 682 018			5 842	374 571

Table 3.24: Impact of seat belt non-use on crash casualties

The percentages of non-use are similar in magnitude to the values reported by Clifford Chance in the responses to their question 4.4 (Clifford Chance, 2003). The data cannot be compared exactly with that in Table 3.24 because it contains a number of unknowns, and was collected in different ways at different points in time. The results presented in Table 3.24 also show that nearly 6 000 fatalities and 380 000 injuries could be prevented with universal use of seat belts. This is lower than some estimates in the literature, which have suggested that up to 10 000 fatalities might be preventable, but a moderate estimate for seat belt benefits has been assumed for this calculation.

Injuries and fatalities among pedestrians and riders of two wheeled vehicles are not affected by seat belt use, and have been excluded from the base numbers of fatalities and injuries. However, some researchers believe that there is a tendency for wearers of seat belts to be more likely to injure pedestrians and cyclists. This effect is hard to quantify with any confidence, and has not been included in this analysis. Different countermeasures apply to riders of two wheeled vehicles, such as greater use of crash helmets or improved crash helmet designs.

The next step is to estimate the actual effect of improved countermeasures, specifically more vigorous enforcement and regular publicity campaigns. Present practice throughout the EU is that seat belt use is required by law (with a few exceptions for specific vehicle types and road transport services), but enforcement is typically a secondary activity during checks performed for other reasons. Sanctions are relatively mild, typically a fine in the range 30 – 50 euros. The situation in each Member State is summarized in Table 3.25, derived from Clifford Chance (2003).

Member State	Seat Belt Use Compulsory?	Sanction for non-use (without other offence)	Typical Sanctions
Austria	Y	No	Up to 72Euros
Belgium	Y	No	50-250 Euros
Denmark	Y	No	500 Kroner
Finland	Y	No	35 Euros
France	Y	No	Fine + Penalty Point
Germany	Y	No	30 Euros
Greece	Y	Fines	155 Euros
Ireland	Y	Starting in 2003	Penalty points
Italy	Y	No	33-130 euros
Luxembourg	Y	No	49 euros
Netherlands	Y	No	40 Euros
Portugal	Y	No	120-600 Euros
Spain	Y	Sometimes	60 Euros
Sweden	Y	No	600 Kroner
United Kingdom	Y	50 pound fine	50 pounds

Table 3.25: Clifford Chance data relating to seat belt use.

Without exception, Member States only conduct checks for compliance with seat belt laws when also checking for other road safety offences or after a crash. In spite of all having laws that make seat belt use compulsory, few will apply penalties if the only offence is not wearing the belt. However, Clifford Chance reports that all States do levy fines, presumably in combination with sanctions for other offences committed at the same time.

The primary tool to increase seat belt use has been publicity campaigns. Although seat belt use varies substantially between Member States, all States seem to follow a similar approach to reducing non-use. The differences in use between Member States is likely related to differences in the past history of efforts to encourage seat belt use, primarily the duration and intensity of publicity campaigns, rather than to the use of fundamentally different approaches.

To illustrate the range of possibilities, the benefits from two levels of seat belt use were estimated. The first scenario was to reduce seat belt non-use among occupant casualties to the level estimated for Sweden, the best-performing Member State. The second scenario was to reduce non-use among casualties to 12%, to indicate the best achievable performance. This performance is equivalent to achieving 95% seat belt use, higher than any State has yet achieved in practice. The resulting reductions in injuries, fatalities and costs are shown in Tables 3.26 and 3.27, using preventable unit costs of 1 527 330 euros for a fatality and 33 468 euros for an injury. These costs include lost production, human costs and medical costs, but not other crash costs. Seat belt use reduces the severity of injuries, but does not prevent the crash.

Member State	Casualties Prevented		Cost Savings (Million Euros)		
	Fatalities	Injuries	Fatalities	Injuries	Totals
Austria	62	4 767	99	168	266
Belgium	144	12 524	253	482	735
Denmark	47	1 661	86	66	152
Finland	11	379	18	14	32
France	116	7 153	165	223	388
Germany	174	12 103	304	462	766
Greece	370	9 389	350	195	545
Ireland	26	1 359	34	40	74
Italy	1 115	78 875	1 482	2 297	3 778
Luxembourg	8	301	12	10	22
Netherlands	74	6 602	112	221	333
Portugal	69	3 394	53	57	110
Spain	401	14 614	460	367	827
Sweden	0	0	0	0	0
United Kingdom	46	7 486	70	251	321
Totals	2 663	160 607	3 498	4 851	8 349

Table 3.26: Fatality and injury cost savings – Best State scenario

The most notable observation from this analysis is that Italy accounts for nearly half of all savings, due primarily to very low seat belt use and the fact that it is one of the larger countries.

Member State	Casualties Prevented		Cost Savings (Million Euros)		
	Fatalities	Injuries	Fatalities	Injuries	Totals
Austria	105	8 094	168	284	452
Belgium	199	18 176	349	700	1 049
Denmark	65	2 394	118	95	213
Finland	28	1 383	47	51	99
France	459	44 834	652	1 395	2 048
Germany	525	53 893	914	2 056	2 970
Greece	455	12 957	431	269	700
Ireland	41	2421	54	70	125
Italy	1 366	109 455	1 815	3 187	5 002
Luxembourg	11	437	16	15	31
Netherlands	111	10 854	169	363	533
Portugal	149	9521	114	159	273
Spain	639	26 031	732	653	1 385
Sweden	23	3576	37	126	162
United Kingdom	168	42 458	256	1 421	1 677
Totals	4 343	346 484	5 873	10 846	16 719

Table 3.27: Fatality and injury cost savings – estimated best possible performance

Costs associated with improving seat belt use are assumed to be for additional enforcement actions and for on-going publicity campaigns. The best source located is an Irish report on the cost of traffic law enforcement (Peter Bacon, 2002), which quotes total costs for publicity campaigns and enforcement actions in the order of 4 million euros/year for education and publicity and 22 million euros/year for enforcement. These figures are for a safety initiative that addresses all three issues, speeding, drunk driving and non-use of seatbelts. The seat belt component of the effort is likely to emphasize publicity, and can roughly be estimated at between 0.75 and 1.5 million for publicity and 2 and 4 million for enforcement. These amounts are for a Member State that has about 1.5 million drivers. The actual estimates used for the two scenarios expressed in costs per driver:

- Best State performance: 0.75 euros per driver per year for publicity plus 2 Euros/year for enforcement

- Best Possible performance: 1.5 euros per driver per year for publicity plus 4 Euros/year for enforcement

The resulting annual costs and cost-benefit ratios are given in Table 3.28. Ratios exceeding 1.0 show that benefits exceed costs. As can be seen, the benefit to cost ratios for the EU as a whole and for most individual Member States are very large. Obviously Member States with low present seat belt usage are those that show the largest benefit to cost ratio. Even if the estimates of benefits and costs developed in this analysis are in error in an unfavourable direction, it is clear that a positive benefit to cost ratio can be achieved in all member states.

Member State	Best State		Best Possible		Net Benefit (percent of GNP)	
	Cost	Benefit/ Cost	Cost	Benefit /Cost	Best State	Best Possible
Austria	12.1	22.0	24.3	18.6	0.124	0.209
Belgium	19.6	37.5	39.2	26.8	0.291	0.411
Denmark	8.8	17.3	17.6	12.1	0.081	0.111
Finland	12.8	2.5	25.6	3.8	0.015	0.055
France	98.5	3.9	197.0	10.4	0.021	0.132
Germany	181.5	4.2	363.1	8.2	0.029	0.128
Greece	11.3	48.3	22.6	31.0	0.437	0.554
Ireland	3.8	19.4	7.6	16.4	0.069	0.115

Italy	116.1	32.6	232.1	21.6	0.314	0.409
Luxembourg	0.9	23.4	1.9	16.6	0.104	0.144
Netherlands	24.9	13.4	49.7	10.7	0.078	0.122
Portugal	9.8	11.2	19.6	14.0	0.088	0.223
Spain	49.5	16.7	98.9	14.0	0.128	0.212
Sweden	0.0	NA	33.8	4.8	0.000	0.052
United Kingdom	89.5	3.6	178.9	9.4	0.015	0.098
All Member States	639	13.1	1 312	12.7	0.091	0.181

Table 3.28: Costs (million euros) and benefit to cost ratios for enforcement of seat belt use

All the results presented in Table 3.28 are for years in which countermeasures against the non-use of seat belts are fully implemented and have reached full effectiveness. This does not take account of any up-front costs to initiate the programme, for example legislative changes, planning, getting budget changes approved, contracting with firms to supply equipment, and so on. Also, the programme will take a number of years to implement, and the benefits will lag the investment by a year or two because it will take time for drivers to modify their behaviour in response to the enforcement actions. A fifteen-year present-value calculation has been carried out to evaluate the impact of these considerations based the following assumptions:

- Up-front costs at 20% of one years enforcement cost in year 1, based on typical legal/planning/permitting costs for public projects
- Implementation in two equal instalments over years 2 and 3
- Benefits grow in two equal instalments in years 3 and 4, lagging implementation by one year

Implementation of measures to counter non-use of seat belts can be implemented more quickly than the other safety improvements discussed in this study. All Member States have laws mandating the use of seat belts, and experience has shown that once safety authorities start to emphasize use in enforcement actions and accompanying publicity efforts, there is a prompt public response. Also, seat belt laws are relatively cheap and uncontroversial to enforce, requiring no equipment and a modest effort on checks. Thus, efforts to enforce seat belt use typically yield higher benefit to cost ratios than the other safety initiatives examined in this study. Table 3.30 compares the present value of fifteen years of benefits and costs for each member state and for the EU as a whole for each scenario.

Member State	Best State Scenario			Full Implementation Scenario		
	Present Value (million Euros)		Benefit to Cost Ratio	Present Value (million Euros)		Benefit to Cost Ratio
	Costs	Benefits		Costs	Benefits	
Austria	236	2287	9.7	263	3887	14.8
Belgium	212	6320	29.8	424	9020	21.2
Denmark	95	1307	13.7	191	1831	9.6
Finland	139	275	2.0	277	851	3.1
France	1067	3336	3.1	2133	17610	8.3
Germany	2025	6798	3.4	3932	26358	6.7
Greece	141	4808	34.1	245	6175	25.2
Ireland	44	636	14.4	82	1075	13.1
Italy	1257	32485	25.8	2513	43010	17.1
Luxembourg	10	189	19.4	21	267	13.0
Netherlands	270	2863	10.6	538	4583	8.5
Portugal	113	935	8.2	212	1862	8.8
Spain	552	6764	12.2	1071	11328	10.6
Sweden	0	0	NA	366	1393	3.8
United Kingdom	969	3496	3.6	2035	14420	7.1
All Member States	7130	72501	10.2	14304	143670	10.0

Table 3.29: Fifteen-year comparison of costs and benefits

4 Safety and Social Improvement Measures for Commercial Road Transport

4.1 Introduction, Scope and Approach

This section of the report presents the analysis of the impacts of proposed measures to improve enforcement of safety and social regulations on commercial road transport. The specific regulations that are associated with this initiative are listed below:

- Council Regulation 3820/85, specifying requirements for maximum driving hours and rest periods
- Council Regulation 3821/85, as amended by Council Regulation 2135/98 on recording equipment in road transport and Commission Regulation 1360/2002 on requirements for construction, testing, installation and inspection of digital tachographs
- Council Directive 88/599/EEC, as amended by Regulation 2135/98, providing requirements for roadside and premises checks of driving and rest hours
- Council Directive 95/50/EC, specifying roadside checks for vehicles carrying dangerous goods
- Council Directive 2000/30/EC, specifying the content and minimum number of roadside checks on the mechanical condition of commercial road vehicles

Experience to date with roadside and premises checks of commercial road vehicles and operations indicates that there is a substantial lack of compliance with these Directives and Regulations, and that more intensive and effective measures to improve compliance are required. Accordingly, the Commission intends to introduce a number of measures to improve compliance, with the following objectives:

- Reduce the number of crashes attributable to fatigued drivers
- Reduce the number of crashes due to mechanical defects in commercial vehicles
- Improve social conditions for commercial vehicle drivers, especially by enforcing the periodic longer rest periods detailed in Regulation 3820/85 (i.e. requirements for weekly and monthly rest periods.
- Remove any commercial advantage gained by road transport firms by disobeying the regulations, especially by having drivers work excessively long work hours.

The means by which these benefits are to be gained is primarily through more intensive and effective enforcement of existing laws, such as more frequent and thorough checks at the roadside and transport firms' offices and better co-operation between Member States in enforcement activities. The specific enforcement proposals are listed in section 4.2. At the same time Regulations and Directives concerned with checking procedures (88/599/EEC, 95/50/EC and 2000/30/EC) are being restructured in a "refonte" into one new integrated directive. The refonte, however, does not change the basic requirements of the underlying directives and regulations regarding driving and rest periods, commercial road vehicle technical condition, etc.

However, previous studies (ETSC 2001, Serafimovski 1998 and European Commission 1998) have drawn attention to possible inconsistencies and loopholes in both the regulations pertaining to commercial vehicle driver hours of work and rest periods and associated enforcement practices:

- Multiple interpretations of the driving and rest time regulations in 3820/85 are possible, and different Member States are using different interpretations. This is especially critical in the migration to digital tachographs required by Council Regulation 2135/98, amending Regulation 3821/85, and Commission Regulation 1360/2002, where both on-board units in

lorries and software used by inspectors will be programmed to identify violations of the regulations. To be effective, the same interpretation must be used by all parties

- Legal loopholes exist in the details of Regulation 3820/85 (and have been upheld by the European Court of Justice) that allow undesirable work schedules, thus reducing the effectiveness of the regulation.

- Regulation 3820/85 is concerned only with driving and rest times, and does not specify any requirements for driver on-duty time spent on other activities, such as loading and unloading. ETSC 2001 points out that about 30% of driver work hours are typically spent on activities other than driving, contributing to fatigue but not covered by the primary regulation. A new Directive 2002/15/EC has been issued to regulate total work hours, limiting the average work week to 48 hours. This directive is to be in effect in Member States from 23 March 2005. However, the average work week for long-haul commercial drivers is now close to 60 hours (ETSC 2001), so it is likely there will be resistance from the commercial road transport industry to implementation of this directive.

- The effectiveness of enforcement is hampered by legal barriers in many Member States to applying penalties for violations that occurred in other States. In particular, drivers on international trips can ignore the limits on cumulative drive time over two weeks and for weekly rest with little fear of sanctions. It is often only possible to enforce the daily driving and rest period limits after entering a Member State. (European Commission 1998)

- The use of subcontractors by transport undertakings can undermine the obligation of an employer of drivers to set work schedules that do not conflict with the drive time and rest period regulations. Small subcontractors often lack the management resources to properly manage driver schedules, and in a highly competitive industry, may be yield to the temptation to agree to delivery times that cannot be met without violating the driving time regulations.

It is clear from this list that significant barriers exist to the effective regulation and enforcement of reasonable driving and work time limits for commercial vehicle drivers. The proposed 'refonte' of the directives and regulations concerned with enforcement regulations will address some of the problems, as will the new work-time regulation, 2002/15/EC, but some further action may be required, for example to establish one agreed interpretation of 3820/85. This analysis is carried out on the assumption that the problems will be addressed over the next few years, and the intent of the regulations can be effectively enforced using the proposed measures.

The steps in the analysis are:

Step 1: Summarize existing Regulations and Directives applicable to commercial road transport, the proposed changes in safety and social regulations, and proposed changes in associated enforcement practices. This summary forms the base from which to estimate impacts of the proposed changes on safety performance, driver working conditions and on competition in the road transport industry.

Step 2: Estimate the number and cost of crashes involving commercial vehicles in 2002. Cost includes the cost of injuries and fatalities among crash victims, property damage, traffic disruption, and environmental damage. This estimate forms the base from which to estimate the reduction in crashes and costs resulting from proposed changes in enforcement practices. The term crashes is used in preference to accidents because the word accident suggests that such events are not controllable. This may be true at the level of individual events, but the in the aggregate, total crashes are a result of transport safety policies and practices, not chance.

Step 3: Estimate the reduction in crashes and associated cost savings from improved enforcement of applicable regulations and directives. The reduction in crashes is primarily due to better enforcement of limits on driving and working time and rest periods, with a contribution from a more stable and experienced workforce of drivers due to better working conditions in the industry.

Step 4: Estimate the one-time and ongoing costs associated with the proposed regulatory and enforcement changes

Step 5: Compare costs and benefits and present the resulting cost-benefit ratios by Member State and the EU as a whole, including the results of a fifteen-year present-value calculation of costs and benefits.

Step 6: Review the effects of changed working conditions for commercial vehicle drivers resulting from more effective enforcement of the social regulations.

Step 7: Review and comment on the potential competitiveness impacts of the proposed changes in regulations and enforcement.

The following report sections describe the analyses and results obtained.

4.2 Existing Regulation and Enforcement Practices and Proposed Improvement Measures

A number of EC Directives and Regulations (collectively termed regulations in this discussion) set out both safety and social regulations that apply to commercial road transport throughout the EU, and the required procedures for enforcement of the regulations. Key requirements of the regulations of relevance to this analysis are summarized in the following paragraphs.

Applicability

With a few exceptions, the regulations apply to commercial road transport vehicles that either exceed 3.5 metric tonnes gross weight or can carry more than nine people and travel more than 50 km in normal service. This last qualification is primarily designed to exclude from the regulations buses used to provide local public transport service in cities and towns. (EC Council Regulation 3820/85)

Primary Regulations concerning the construction and use of commercial road vehicles.

- Minimum age of drivers is either 18 or 21, depending on type of vehicle route and certification
- Driving and rest periods. The daily driving period may not exceed 9 hours. This may be extended twice in one week to 10 hours. Six daily driving periods must be followed by a weekly rest period of between 24 and 45 consecutive hours depending on the location where the rest is taken. Total driving periods in a 14-day period may not exceed 90 hours. (Council Regulation 3820/85)
- Total work hours: a new regulation specifying that the average weekly work time over four months must not exceed 48 hours with individual weeks not exceeding 60 hours. Night work time must not exceed ten hours. (Council Directive 2002/15/EC)
- Requirements specific to the carriage of dangerous goods (Council Directive 94/55/EC, as amended by directive 2000/61/EC). This regulation provides detailed requirements for the packaging and labelling and transport of dangerous goods
- Maximum vehicle size and weight regulations for international traffic (Directive 96/53/EC).

Primary regulations concerning enforcement of regulations

- Detailed requirements for ensuring compliance with driving and rest periods through driver scheduling and maintaining proper records by transport undertakings, and the use of recording equipment in the vehicle cab. Notably, the implementation of digital tachographs is to take place over 24 months from August 2002, as specified in Council Regulation 2135/98, amending Council Regulations 3820/85 and 3821/85.
- Detailed requirements for official enforcement for the regulations, including roadside checks, checks at the premises of transport undertakings, and co-operative efforts among different Member States. Most notably, checks must cover 1% of the days worked by drivers (Directive 88/599/EC)

- Specific checks of vehicles carrying dangerous goods (Council Directive 95/50/EC)

- Requirements for annual roadworthiness checks for commercial vehicles, including lights, suspension wheels and tyres, steering systems, etc., supplemented by visual and document checks during roadside inspections (Directives 96/96/EC and 2000/30/EC).

Experience has shown that there is a significant level of non-compliance with these regulations, especially with regard to driving and rest time requirements, and that the present target of checking 1% of driver working days (Directive 88/599/EC) is inadequate. To address this situation a 24 point program of more thorough and frequent checks among other improvements is proposed. A full list of the 24 points, together with the change from current practice and implications for costs and benefits is detailed in the Table in Attachment C and summarized below.

Points 1 and 2: number of checks

Make a substantial increase in the number of roadside and premises checks, compared with the present requirement of 1% of days checked, as given in the Table 4.1.

Scenario	Percent of Driver-Days Checked			
	Initially	After 3 Years	After 6 Years	After 10 Years
Scenario A	3	5	7	10
Scenario B	3	8	14	20
Scenario C	3	10	20	30

Table 4.1: Proposed checking programmes for commercial road transport

In addition, two scenarios are proposed for the distribution of checks between roadside and at premises:

Scenario	Minimum Roadside	Minimum On Premises
Scenario A	20%	35%
Scenario B	30%	50%

Table 4.2: Distribution of checks between roadside and premises

The distribution of checks may alter effectiveness in reducing violations, to the extent that roadside checks are more or less effective than on-premises checks.

Points 3 to 12: Quality and content of checks

- Develop standard procedures and equipment for roadside and premises checks, including use of computers and software for checking data from the digital tachograph, and

- Increase the number of available checkpoints (e.g. at all motorway service stations), and introduce a random rotation among checkpoints to prevent avoidance

- Perform checks on working time as well as driving time, per 2002/15/EC

- *Introduce a harmonized approach to both roadside and premises checks based on a review of four weeks of data, especially to check compliance with daily and weekly rest periods*

- Include a review of contract arrangements and transport permits to ensure that all parties in the transport chain (prime contractors, subcontractors, etc.) are fully meeting responsibilities under the relevant laws, regulations and directives

Points 13 to 16: Organisation and international cooperation

- More concerted operations involving multiple Member States (increase from twice to six times annually)
- Establish greater cooperation between authorities within each Member State (e.g. police, judicial authorities, customs, regional authorities, etc.)
- Establish a central coordination body and improved arrangements for collaboration and data sharing between Member States

Points 17 to 21: Sanctions

As far as possible, harmonise sanctions between Member States to ensure that sanctions are effective, proportionate and dissuasive, including use of spot fines, immobilizing the vehicle, and fines to offset any commercial advantage gained by violating regulations.

Points 22 –24: Training

Each Member State to develop procedures for training inspectors and keeping them properly informed. In addition, an international committee will be established to establish and advise member States on standards and best practices in enforcement.

Overall these actions will address many of the problem areas described above and substantially increase the likelihood that violators of the regulations will be detected and sanctioned. This will lead to substantially improved compliance with the regulations, resulting in reductions in crashes, improved social conditions for drivers and fairer competition between road transport firms.

4.3 Number and Cost of Commercial Road Transport Crashes

This section presents an estimate of the number and cost of crashes involving trucks and buses subject to the regulations described in Section 4.2. The starting point for developing these estimates is the number of fatalities among the occupants of buses and lorries over 3.5t, as given in Table 4.3, derived from data presented in Table 2.5.

Member State	Vehicle Occupant Fatalities		
	Lorry >3.5t	Bus	Lorry + Bus
Austria	17	3	20
Belgium	19	10	29
Denmark	2	1	3
Finland	5	2	7
France	116	36	152
Germany	*140*	*30*	170
Greece	17	10	27
Ireland	10	2	12
Italy	*110*	25	135
Luxembourg	0	1	1
Netherlands	11	3	14
Portugal	42	4	46
Spain	186	58	244
Sweden	8	0	8
United Kingdom	47	29	76
Totals	730	214	944

Table 4.3: Lorry and bus occupant fatalities in crashes (1997)

Following the procedure described in Section 2, estimated fatalities for 1997 are adjusted for estimated changes in traffic levels and crashes over the period 1997 to 2002, as shown in Table 4.4.

Member State(s)	Annual Traffic Growth (%)	Annual Change in Casualty Rates (per v-km) (%)		Net Annual Change in Casualties (%)		Estimated Change: Five Years 1997-2002 (%)	
		Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries
Greece	6.0	-5.0	-6.0	+1.0	0	+5.1	
Spain/ Portugal	4.5	-5.0	-5.0	-0.5	-0.5	-2.5	-2.5
Germany	3.0	-4.0	-3.0	-1.0	-1.0	-5.1	-5.1
All others	2.0	-4.0	-3.0	-2.0	-1.0	-10.4	-5.1

Table 4.4: Estimated traffic and crash casualty trends 1997 – 2002

Applying the trends shown in Table 4.4 to the fatalities shown in Table 4.3 results in the adjusted fatalities shown in Table 4.5

Member State	Vehicle Occupant Fatalities		
	Lorry >3.5t	Bus	Lorry + Bus
Austria	15	3	18
Belgium	17	9	26
Denmark	2	1	3
Finland	4	2	6
France	104	32	136
Germany	133	28	161
Greece	18	11	28
Ireland	9	2	11
Italy	99	22	121
Luxembourg	0	1	1
Netherlands	10	3	13
Portugal	41	4	45
Spain	181	57	238
Sweden	7	0	7
United Kingdom	42	26	68
Totals	682	200	882

Table 4.5: Estimated lorry and bus occupant fatalities in Crashes for 2002

Occupant fatalities are only one of the consequences of crashes involving lorries and buses. There are, in addition, fatalities of pedestrians, riders of cycles and motorcycles, and occupants of other types of vehicle involved in collisions with commercial vehicles, as well as injuries among the occupants of truck buses and other vehicles involved in lorry and bus crashes. Because the other vehicle in lorry and bus-involved crashes is likely to be smaller and lighter, there will be substantially more fatalities and injuries among the occupants of the other vehicle. Fatality matrices for three Member States, Sweden, Netherlands and the UK are presented in the SUNflower report (Wegmann et al. 2002), showing the number of fatalities by collision and vehicle types for the year 2000. These data are presented in Table 4.6, leading to an estimate of the total number of fatalities in lorry and bus involved crashes relative to fatalities among lorry and bus occupants.

Member State	Lorry-Involved Crashes			Bus-Involved Crashes		
	Occupants	Others	Total	Occupants	Others	Total
Netherlands	60	211	271	0	23	23
Sweden	24	120	144	0	13	13
UK	121	538	659	15	101	116
Total	205	869	1074	15	137	152

Table 4.6: Occupants and other fatalities in lorry and bus Involved crashes (source: SUNflower report, Wegmann et al. 2002)

The data in this table indicates that there are a total of 5.6 fatalities for every lorry or bus occupant fatality. Lorry and bus occupant fatalities in single vehicle crashes total 69 lorry occupants and 6 bus occupants), leaving 145 commercial vehicle occupant fatalities in multi-vehicle crashes. This means

there are 7.9 total fatalities for every commercial vehicle occupant fatality in multi-vehicle crashes, illustrating the danger that crashes involving heavy commercial vehicles pose for other road users.

Using the data in Table 4.6, an estimate of total fatalities in bus and lorry-involved crashes can be obtained by multiplying the fatality counts in Table 4.5 by factor of 5.6. Finally, for this analysis, the estimate of total fatalities should be adjusted to exclude fatalities in crashes involving vehicles not subject to the regulations of interest. These regulations cover nearly all lorries over 3.5t with few exceptions, and this analysis assumes that 95% of all lorries are subject to regulation. With buses, there is major exception for buses used for local services of less than 50km. Therefore, the analysis assumes that 50% of buses are covered by the regulations.

The result of the adjustment for fatalities other than bus and lorry occupants, and for vehicles not covered by regulation is shown is Table 4.7, giving fatalities in crashes involving lorries and buses subject to regulation. Also shown in Table 4.7 is an estimate of the number of injuries in crashes involving regulated lorries and buses. This is derived from an estimate of 56 injuries for every fatality, including estimated undercounting of injuries, as discussed in Section 2.

Member State	Estimated Fatalities			Estimated Injuries		
	Lorry	Bus	Total	Lorry	Bus	Total
Austria	81	8	89	4 538	421	4 959
Belgium	91	25	116	5 072	1405	6 477
Denmark	10	3	12	534	140	674
Finland	24	5	29	1 335	281	1 616
France	553	90	643	30 965	5 058	36 022
Germany	707	80	787	39 582	4 464	44 046
Greece	95	29	124	5 323	1 648	6 971
Ireland	48	5	53	2 669	281	950
Italy	524	63	587	29 363	3 512	32 875
Luxembourg	0	3	3	0	140	140
Netherlands	52	8	60	2 936	421	3 358
Portugal	218	11	229	12 200	612	12 811
Spain	965	158	1 123	54 028	8 867	62 895
Sweden	38	0	38	2 135	0	2 135
United Kingdom	224	73	297	12 546	4 074	16 620
Totals	3 629	559	4 188	203 225	31 326	234 551

Table 4.7: Estimated fatalities and injuries in crashes involving regulated lorries and buses

Finally it is necessary to estimate the costs of these crashes, using the cost data developed in Section 3.3. The starting point for the estimates is the cost data for all road crashes contained in Table 3.6 and repeated below as Table 4.8.

Crash/ Injury Severity	Lost Output	Human Costs	Medical Costs	Property Damage	Insurance Admin.	Police Cost	Delay Cost	Total per Crash
Fatal Crash	598 408	1 150 000	8 056	11 172	314	1 999	15 000	1 789 754
Injury Crash	6 632	35 000	3,524	3 445	130	91	5 000	53 736
Individual Fatality	520 355	1 000 000	7 005	NA	NA	NA	NA	1 527 360
Individual Injury	4 877	26 000	2 591	NA	NA	AN	NA	33 468

Table 4.8: Summary of average crash costs for all crashes (from Table 3.6)

Since available data for commercial vehicle crash consequences are in terms of injuries and fatalities rather than the number of crashes, it is most straightforward to express other crash costs (property damage, congestion, etc) in terms of a share per injury or fatality. Because buses and lorries are bigger, heavier and more valuable that the light vehicles involved in most crashes, these other costs

will tend to be higher than those shown in Table 4.8. Other costs for this analysis were estimated as follows:

- Per-crash costs converted to per injury and per fatality costs assuming 1.15 fatalities per fatal crash and 1.36 injuries per injury crash, as discussed in Section 3.3
- Medical costs were increased by a factor of 1.5 from those in Table 4.8 to reflect the possibility of more severe injuries in bus and lorry-involved crashes
- All other costs were increased by a factor of 2.5, to account for greater damage in bus and lorry-involved crashes and the likely greater time and effort required to clear the road after an crash. The resulting per injury and per fatality costs are given in Table 4.9.

Injury Severity	Lost Output	Human Costs	Medical Costs	Share of costs per injury or fatality				
				Property Damage	Insurance Admin.	Police Cost	Delay Cost	Total per Crash
Individual Fatality	520 355	1 000 000	8 756	24 287	682	4 346	32 609	1 591 035
Individual Injury	4 877	26 000	3 239	6 333	239	162	9 191	50 041

Table 4.9: Summary of average per-injury and per-fatality costs for lorry and bus-involved crashes (all costs in euros)

Table 4.10 gives the resulting costs by Member State and in total for crashes involving regulated lorries and buses. These estimates take into account the adjustments for local costs for labour and equipment detailed in Table 3.7. Total cost of these crashes is approximately 16.5 billion Euros, about 10% of the cost of all crashes in the fifteen Member States. The cost is divided approximately equally between injuries and fatalities. The proposed more intensive enforcement of safety and social regulations is aimed at reducing this amount. The following section develops estimates of the reduction in crashes and, therefore, the reduction in costs that would results from implementation of the proposed regulations.

Member State	Estimated Crash Costs (million euros)		
	Lorry	Bus	Total
Austria	374	35	409
Belgium	458	127	584
Denmark	50	13	63
Finland	116	24	141
France	2 259	369	2 628
Germany	3 540	399	3 939
Greece	259	80	339
Ireland	182	19	201
Italy	2 004	240	2 244
Luxembourg	0	11	11
Netherlands	230	33	263
Portugal	479	24	503
Spain	3 179	522	3 701
Sweden	176	0	176
United Kingdom	984	320	1 304
Total	14 290	2 216	16 506

Table 4.10: Costs of crashes involving regulated lorries and buses (million euros)

4.4 Development of Crash Reduction Estimates

A number of factors need to be considered in developing an estimate of the reduction in crashes and crash costs that would result from greater compliance with driving time, working time and rest period regulations. These factors are:

- The extent of non-compliance with current regulations

- The fraction of crashes involving lorries and buses are caused by the bus or lorry, as compared with crashes caused by other vehicle types

- The extent to which driver fatigue causes or contributes to crashes caused by lorries or buses

- The extent to which mechanical faults cause or contribute to crashes involving lorries or buses

- Even if a crash is caused by another type of vehicle, to what extent does driver fatigue affect the lorry or bus driver's response to a hazardous situation caused by the other vehicle

- If working conditions for commercial vehicle drivers improve as a result of stricter enforcement of the regulations, especially with regard to weekly rest periods, could this affect safety indirectly by improving the stability and experience of drivers working in the industry.

Each of these factors is discussed in the following paragraphs.

Compliance with regulations

There is no doubt that there is widespread lack of compliance with the driving and rest period regulations among lorry and bus drivers. ETSC 2001 quotes a study that found that 84% of a sample of drivers were in violation of drive hours regulations. Data from Member States on the numbers of checks and the number of infringements found show that between one and five percent of drivers are in violation of the regulations (from EC biannual reports on implementation of the regulations, COM(97) 698 Final, COM(2000) 84 Final and COM(2001) 767 Final). Furthermore, the various problems with interpretation of the regulations, the inability to properly check on or sanction violations in international trips, and the possibility of tampering with mechanical tachographs means that many violations go undetected. Finally, the present regulations and enforcement practices do not cover all the working situations that could lead to excessive fatigue, especially the lack of regulation of total working time as distinct from driving time.

Fraction of crashes where lorry or bus driver is at-fault

Two sources provide estimates of the fraction of fatal crashes where the lorry or bus driver is at fault. Hakkanen and Summala (2001) analysed a sample of crashes in Finland to show that the lorry or bus driver is at fault in approximately 17% of multi-vehicle crashes. Council et al. (2003) found that 16% of multi-vehicle crashes were caused by the commercial vehicle alone, with another 14% where responsibility was shared between the commercial and other vehicles. Taken together, these data suggest that about 20% of multiple vehicle crashes are the fault of the commercial vehicle driver. In addition, the commercial driver is usually responsible for all crashes that involve only a single vehicle. Single vehicle crashes comprise about 20% of total commercial vehicle crashes. This means that, overall, the commercial vehicle driver is responsible for about 36% of fatal crashes involving a commercial vehicle. Analysis of non-fatal crashes, however, yields a different result. Council et al. (2003) found that fault in these crashes was more evenly divided between commercial and light vehicles.

Effect of fatigue where lorry or bus is at-fault

The effects of driver fatigue on the occurrence of crashes has been extensively researched, although it is often difficult to determine whether a driver involved in an crash is, in fact, fatigued and whether fatigue actually caused or contributed to the crash. ETSC 2001 provides a review of the evidence, which suggests that fatigue is a significant factor in 15-20% of all crashes, and a higher percentage in serious or fatal crashes and for single-vehicle crashes. Analysis of US lorry crashes (NTSB 1999, Hanowski et al. 2002) indicates that fatigue is a significant factor in up to 30% of heavy lorry crashes. Overall, an estimate that fatigue is a significant factor in about 25% of at-fault injury or fatal crashes will be used in this analysis. The authors also observe that the level of fatigue is not just a function of work and rest cycles. The drivers' lifestyle off the job is a significant factor, and cannot be completely controlled by regulations or the employer. For example, fatigued drivers were often found to have had less sleep the previous night for reasons unconnected with the demands of the job.

Effect of mechanical faults of the lorry or bus

Hakkanen and Summala found that mechanical defects were responsible for about 7% of at-fault crashes or about 2% of all crashes, based on a small sample of crashes in Finland. Moses and Savage, reviewing US literature, found that mechanical defects, mostly of brakes, caused 6 to 13% of lorry crashes. An estimate that mechanical defects cause 4% of all commercial vehicle crashes was used for this analysis.

Effect of fatigue where another vehicle type is at fault

There is no direct evidence in the literature, but it is logical to suppose that a rested and alert driver has a better chance of responding to a hazardous situation caused by another driver than a fatigued driver. Thus, effective enforcement of well-formulated driving, work and rest time regulations would likely reduce the occurrence of these crashes. Very tentatively, it is suggested that 5% of such crashes are potentially avoidable.

Effects of better driver working conditions and safety management practices by transport firms

Three studies (Rienstra et al. 2000, Moses & Savage 1995 and Belzer et al. 2002) all suggest that the management practices by transport firms have a very substantial effect on safety performance. Belzer et al showed that firms that offered higher pay and more paid time off had a crash rate 21% lower that the base-case firms. The authors believe this is because the higher paying firm attracts more experienced and skilful drivers. Both Moses & Savage and Rienstra et al. observe that firms introducing effective safety management approaches realize substantial reductions in crash risk, on the order of 25 to 50%, and such efforts are highly cost-effective. A related observation from Hanowski et al. is that a small percentage of drivers are responsible for a high proportion of the crashes: in their sample 5% of drivers were responsible for 20% of crashes and 20% of drivers for 60% of crashes. Clearly, targeting poorly-performing drivers for additional attention and training, and in extreme cases removal from the occupation, can be highly effective. This evidence also suggests that premises checks and targeting poorly performing firms is more effective than random roadside checks. Also it would appear that the benefits extent beyond reducing at-fault crashes to reductions in crashes where initiated by light vehicles. This probably arises from the effectiveness of defensive driving techniques adopted by experienced drivers

The research reviewed in the above paragraphs can be used to estimate the potential reduction in crashes, injuries and fatalities from the effective enforcement of well formulated drive time, work time and rest period regulations. However, there is little information in the literature to link enforcement effectiveness to specific plans for roadside and premises checks. Only Moses and Savage discuss this issue, in the context of US rather than European commercial vehicle regulations. The authors estimate that a roadside inspection of a given driver or vehicle will ensure compliance for 3 months for the driver and 6 months for vehicle mechanical condition. This means that effectively checking about 2% of workdays should ensure compliance. This is similar to present European practice, which is considered inadequate. It does suggest, however, that the difficulty may lie more with the effectiveness of the checks than the number of checks.

The proposed measures aimed at improving check effectiveness – use of the digital tachograph, international cooperation in checks, resolving ambiguities in the regulations, more certain and dissuasive sanctions and similar measures may be more effective than large increases in the number of checks. Moses and Savage also consider that checks at the premises of transport firms are much more effective than roadside inspections. Firms given a poor rating reduced their crash rate by 43%, a much higher percentage than was observed for lorries and drivers caught violating regulations in roadside inspections. Of course, the potential for industry-wide improvement is less than that obtainable at poorly-performing firms, possibly on the order of 15 to 20%. The improvements resulting from premises checks were also judged to be longer lasting.

The approach taken to link the reduction in crashes and crash costs to enforcement practice was to first estimate the best that could be achieved with a highly effective programme, and then estimate the

fraction of this benefit that would be achieved under a small number of alternative enforcement scenarios.

Based on the above discussions, the benefits from a highly effective enforcement programme can be estimated as follows:

- Commercial vehicle and its driver is at fault in 36% of lorry and bus-involved fatal crashes and 50% of non-fatal crashes
- Fatigue is a significant factor in 25% at-fault lorry and bus involved fatal crashes and 20% of non-fatal crashes
- A 60% reduction in fatigue related crashes can be achieved when the commercial vehicle driver is at fault. This figure takes into account that unregulated off-duty lifestyle is an important factor in fatigue-related crashes
- A 80% reduction in crashes due to mechanical failures of the commercial vehicle can be achieved
- A 10% reduction in lorry and bus involved crashes where a light vehicle is at fault can be achieved, due to more alert and experienced drivers
- A 30% reduction in remaining at-fault crashes (not fatigue related) can be achieved due to better safety programmes at road transport firms and the benefits of better social conditions for drivers.

Tables 4.11a and b detail calculations of the overall benefit from the combination of these individual benefits for fatal and injury crashes. These tables show that the maximum potential benefit is a 23% reduction in fatal crashes and a 25% reduction in injury crashes.

Parameter	Commercial vehicle driver at fault			Mechanical Defects	Other vehicle at fault	Percentage Totals
	Fatigue	Other	Total			
Percent Crashes	9%	27%	36%	4%	60%	100
Potential Reduction	60%	30%	NA	80%	10%	NA
After Reduction (%)	3.6%	18.9%	22.5%	0.8%	54%	77.3%

Table 4.11a: Potential percentage reduction in fatal crashes

Parameter	Commercial vehicle driver at fault			Mechanical Defects	Other vehicle at fault	Percentage Totals
	Fatigue	Other	Total			
Percent Crashes	9.6%	38.4%	48%	4%	48%	100
Potential Reduction	60%	30%	NA	80%	10%	NA
After Reduction (%)	3.84%	26.88%	30.72%	0.8%	43.2%	74.72%

Table 4.11b: Potential percentage reduction in injury crashes

The key lesson from this analysis is that the major benefits come more from ensuring that transport firms have good safety management practices and provide good social conditions for their drivers than from reducing fatigue due to excessive hours of work.

Applying the percent reductions in crashes to the crash costs detailed in Table 4.10 leads to an estimate of the maximum cost savings achievable by reducing lorry and bus crashes, as shown in Table 4.12. Applying the same percentage reductions to the total of injuries and fatalities in lorry and bus-involved crashes from Table 4.7 gives the following reductions in injuries and fatalities from the proposed measures:

Reduction in fatalities: 951
Reduction in injuries: 59 529

Member State	Estimated Crash Cost Reduction (million euros)		
	Lorry	Bus	Total
Austria	91	8	99
Belgium	111	31	142
Denmark	12	3	15
Finland	28	6	34
France	550	90	640
Germany	862	97	959
Greece	63	20	83
Ireland	44	5	49
Italy	488	58	546
Luxembourg	0	3	3
Netherlands	56	8	64
Portugal	117	6	122
Spain	774	127	901
Sweden	43	0	43
United Kingdom	240	78	317
Total	3 479	540	4 018

Table 4.12: Maximum reduction in costs of crashes involving regulated lorries and buses

The EC proposes three alternative enforcement scenarios, each with a steady increase in the number of checks, reaching maxima of 10%, 20% and 30% of commercial driver workdays, as detailed in Table 4.1. In addition, there are two scenarios for the distribution of checks between roadside and at the premises of transport firms (Table 4.2), and a number of actions to improve the effectiveness of checks. The literature discussed above suggests that improving the effectiveness of checks and concentrating on checks at firms' premises is likely to be more effective than a large increase in the number of roadside checks. Based on these findings, we estimate that the maximum reduction in crash costs can be achieved with a combination of 10% total workdays checked, 50% of checks at firms' premises and full implementation of measures 3 to 24 to improve the effectiveness of checks and sanctions. At this level, driver records are being checked approximately monthly both at the roadside and at the firm. Since the digital tachograph data will be checked for 180 hours of data (about 4 weeks), this amounts to almost 100% checking of driver working, driving and resting times. Increasing the number of checks beyond the 10% level will likely add very little in additional crash reduction and cost savings.

4.5 Enforcement Costs and Benefit to Cost Ratios

Enforcement costs include the costs for checks themselves and the costs of implementing each of the effectiveness-improving measures. Based on the discussion above, costs are estimated up to a 10% checking level. Given this limit, the primary difference between the scenarios proposed by the EC is in the implementation timescale, in that the maximum of 10% checks is reached after 10 years in Scenario A, after about 5 years in Scenario B and after 3 years in Scenario C.

The procedure for estimating costs and cost to benefit ratios is as follows:

- Estimate unit costs for inspections and for implementing the proposed improvement measures, including an estimate of how unit inspection costs will change with application of the digital tachometer and more standardized and complete checking measures

- Estimate additional checks required, up to 10% of driver days, and the corresponding annual cost

- Calculate a simple benefit to cost ratio comparing ongoing annual costs with annual benefits expected when the improvements are fully implemented

- Calculate the present value of costs and benefits for each implementation scenario, including initial planning and implementation costs and the effect of any lag between implementation and realizing the benefits

Unit Costs

- Present checking costs, assume inspectors on average are able to carry out 2 checks/hour, and an inspector costs 40 euros/hour including equipment and indirect costs. Therefore, one check costs 20 euros.

- In the future, inspectors will be equipped with a laptop computer or equivalent for checking digital tachometer data and recording other inspection information for downloading to a central database. This will greatly speed up the inspectors work, but the inspector will be required to perform more thorough checks on other matters, for example regarding contracting arrangements and whether the lorry is overloaded. In addition, the costs of the new equipment and associated technical support costs has to be added. On balance, we estimate that the time and cost per check will reduce to 75% of present amounts, i.e. to 15 euros/check.

- There is a substantial amount of up-front planning required to implement the proposed improvement, including establishing the new checking procedures and a new system of sanctions. An initial "investment" of 20% of final checking costs is assumed, excluding costs for information and communication systems.

- The proposed measures include new initial and ongoing requirements to train inspectors in the new equipment and procedures. An one-time cost of 10% of final annual inspection costs will be assumed for initiating the training programme, including planning and designing training courses, and an annual cost of 2% of inspection costs for refresher training, the work of the proposed committee of Member States, and annual reporting.

- Under the heading of organizational aspects, there are requirements for better coordination enforcement authorities within and between Member States, including central coordination for all checks and ability to exchange data between enforcement authorities. This means that a substantial effort is required to set up appropriate database and data exchange procedures, including software to be used in central databases of drivers, commercial vehicles and firms, and on inspectors' laptops. All this will require substantial technical efforts and an ongoing expense for maintenance and technical support. Annual maintenance and support costs for computers, a network and databases will add about 10% to checking costs, and one-time initial costs are estimated to be about 30% of final annual checking costs.

In summary, unit costs used in the cost and benefit calculations are:

Present checking costs:	20 euros/check
Future checking costs:	15 euros/check
Initial costs to set up new procedures and systems:	
Planning, legal and administrative preparations	20% of final annual checking costs
Initial training of inspection staff:	10% of final annual checking costs
Databases, communications and software:	30% of final annual checking costs
Total initial costs:	60% of final annual checking costs
Ongoing support costs for training, systems, etc:	12% of annual checking costs

Additional Checks and Incremental Checking Costs

Table 4.13 shows the present number of checks per year being carried out by Member States and the number of additional checks that would be required to meet the different target percentages.

Member State	Number of checks/year (1000s)					
	Target (1%/yr)	Present (2002)	Additional checks to meet future targets			
			3%	5%	7%	10%
Austria	299	461	435	1 032	1 630	2 526
Belgium	341	592	431	1 113	1 795	2 818
Denmark	99	198	99	297	495	792
Finland	106	190	127	338	549	866
France	1 250	3 614	136	2636	5 136	8 886
Germany	1 769	7 823	0	1 023	4 561	9 868
Greece	300	50	900	1 500	2 050	3 000
Ireland	189	520	48	426	804	1 372
Italy	1 275	2 436	1 389	3 938	6 488	10 312
Luxembourg	37	35	75	148	221	331
Netherlands	275	432	393	943	1 493	2318
Portugal	296	128	759	1 350	1 941	2828
Spain	840	2 678	0	1 522	3 202	5 722
Sweden	200	367	233	633	1 033	1 633
United Kingdom	1 003	1 914	1 095	3 101	5 107	8 116
Totals	8 278	21 438	3 445	20 000	36 506	61 389

Table: 4.13: Incremental number of checks to meet proposed target percentages

The incremental cost of these checks over present costs, using the estimated per-check costs detailed above is given in Table 4.14. This includes the costs of checks, taking into account the reduction in per-check cost and the ongoing support costs for training and technical support. Cost savings, indicated by a figure in brackets (for example (9.28)) in the 3% column mean that the cost saving from the reduction in the unit cost of a check more than offsets the added cost of additional checks, where these are required.

Member State	Percent of working days checked			
	3%	5%	7%	10%
Austria	5.83	15.87	25.91	40.96
Belgium	5.35	16.81	28.27	45.45
Denmark	1.03	4.36	7.68	12.67
Finland	1.52	5.07	8.61	13.94
France	(9.28)	32.72	74.72	137.72
Germany	(25.03)	(7.85)	51.59	140.75
Greece	14.12	24.20	34.28	49.40
Ireland	(0.87)	5.49	11.85	21.38
Italy	15.53	58.36	101.20	165.44
Luxembourg	1.15	2.38	3.61	5.45
Netherlands	5.21	14.45	23.69	37.55
Portugal	12.34	22.27	32.21	47.11
Spain	(8.57)	16.99	45.22	87.55
Sweden	2.75	9.47	16.19	26.27
United Kingdom	12.27	45.97	79.67	130.23
Totals	33	267	545	962

Table 4.14: Annual incremental cost (million euros) by percent working days checked

Comparison of annual costs and benefits after full implementation

The annual benefits and costs after full implementation are compared in Table 4.15, giving benefit to cost ratio, net benefit and net benefit as a percent of annual GDP in Member States. Costs do not include the up-front cost of establishing improved checking and sanction practices and procedures.

The results show that aggregate benefits are about four times the costs. Benefit to cost ratios vary widely between Member States. States that already have intensive checking programmes benefit the most from improvements that increase the effectiveness of the checks at the same time as reducing the cost. Member States with limited checking programmes incur large new checking costs to obtain the benefits, and thus have a low benefit-to-cost ratio.

Member State	Annual Benefit (million euros)	Annual Cost (million euros)	Benefit/Cost Ratio	Net Benefit (million euros)	Net Benefit as percent of GDP
Austria	99	40.96	2.43	58	0.0285
Belgium	142	45.45	3.13	97	0.0394
Denmark	15	12.67	1.21	3	0.0015
Finland	34	13.94	2.46	20	0.0154
France	640	137.72	4.65	502	0.0358
Germany	959	140.75	6.81	818	0.0403
Greece	83	49.40	1.67	33	0.0271
Ireland	49	21.38	2.29	28	0.0271
Italy	546	165.44	3.30	381	0.0327
Luxembourg	3	5.45	0.50	-3	(0.0132)
Netherlands	64	37.55	1.71	27	0.0067
Portugal	122	47.11	2.60	75	0.0660
Spain	901	87.55	10.29	813	0.1342
Sweden	43	26.27	1.63	17	0.0067
United Kingdom	317	130.23	2.44	187	0.0122
All States	4018	962	4.18	3057	0.0359

Table 4.15: Comparison of costs and benefits after full implementation

Present value analysis

As in the analyses of measures to reduce speeding, drunk driving and non-use of seatbelts, the simple cost and benefit calculation fails to take into account up-front costs and the lag between incurring costs and realising benefits. An analysis of the present costs and benefits of a fifteen year stream of costs and benefits has been carried out to present a more realistic assessment. The results are shown in Table 4.16 for two scenarios: reaching full implementation in five years and in ten years

Member State	Implementation over six years			Implementation over ten years		
	Present Values (million euros)		Benefit to Cost Ratio	Present Values (million euros)		Benefit to Cost Ratio
	Costs	Benefits		Costs	Benefits	
Austria	372	753	2.03	320	638	1.99
Belgium	413	1 080	2.62	356	915	2.57
Denmark	115	114	0.99	99	97	0.98
Finland	127	259	2.04	109	219	2.01
France	1 250	4 869	3.89	1 078	4 126	3.83
Germany	1 320	7 546	5.71	1 140	6 408	5.62
Greece	525	649	1.24	456	551	1.21
Ireland	194	373	1.92	167	316	1.89
Italy	1 502	4 154	2.77	1 295	3 520	2.72
Luxembourg	49	23	0.46	43	19	0.45
Netherlands	341	487	1.43	294	413	1.40
Portugal	461	917	1.99	399	777	1.95
Spain	821	6 498	7.91	709	5487	7.74
Sweden	238	327	1.37	206	277	1.35
United Kingdom	1 182	3 453	2.92	1 019	3 453	3.39
All States	8 910	31 502	3.54	7 689	27 214	3.54

Table 4.16: Fifteen-year comparison of costs and benefits (2003-2018)

The results in Table 4.16 show that the slower implementation reduces both costs and benefits, but there is no difference in the benefit to cost ratio. At 3.54 the benefit cost ratio is favourable, but as expected, it is lower than the value of 4.16 calculated from the simple comparison of annual checking costs and benefits after full implementation.

4.6 Conclusions

The primary conclusions from this analysis are as follows:

- The total cost of crashes involving regulated buses and lorries is on the order of 15.6 billion euros, about 10% of the cost of all road crashes in the EU.

- The estimated maximum cost reduction through implementation of the EC's proposed enforcement programmes is estimated to be 4 billion euros. The relatively low fraction of total cost is primarily because about 70% of bus and lorry-involved crashes are caused by another type of road user (car driver, motorcyclist, cyclist or pedestrian).

- A fifteen year comparison of benefits and costs yields an attractive benefit to cost ratio of 3.54. This result is independent of the pace of implementation of the enforcement actions.

- Implementation of the proposed measures will save an estimated 951 lives and 59 529 injuries due to the reduction in crashes involving regulated buses and lorries.

- The research literature suggests that the most effective measures for reducing commercial vehicle crashes is to improve the effectiveness of checks through implementation of the proposed measures concerning the content of checks, international cooperation, automated checking of digital tachometers and related actions.

- Increasing the number of checks beyond 10% of working days is unlikely to add to benefits.

- The research literature suggests that checks at the premises of transport firms are more effective than roadside checks, and more generally, encouraging transport firms to maintain good safety management practices is highly effective in reducing lorry and bus involved crashes.

- Strict enforcement of driving, work and rest times will undoubtedly improve the social conditions for drivers, and level the playing field with respect to competition between transport firms. The effects on driver wages and freight charges is less easy to predict. Transport firms will experience a complex mix of cost increases and cost savings, and their behaviour will depend on market conditions for labour and for transport services. Variations among the different sectors in the industry are likely.

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Attachment A: Draft Working Paper of the European Commission on Proposed Road Safety Enforcement Actions

Draft 23.09.02

WORKING PAPER OF THE COMMISSION

on enforcement in the field of road safety

Introductory provisions

Objective

To improve road safety and reduce the deaths and injuries rate on the roads in the European Union, through minimum requirements of checks and enforcement in the field of speeding, drink-driving and non-use of seat belts and child restraints.

Definitions

(a) "speeding" means driving faster than the maximum speed limit in force for the road concerned;
(b) "automated speed enforcement equipment" means a technical recording device that is triggered automatically by a speed violation to record information about the violating vehicle, making possible the subsequent identification of the vehicle for the purpose of sanctioning the owner or driver[1];
(b) "drink-driving means driving with a blood alcohol level higher than the maximum level in force;
(c) "non-use of a seat belt" means being in a vehicle in circulation without wearing a seat belt or without being in a child restraint in cases where the use of such equipment is mandatory.

Speeding

Use of automated speed enforcement equipment

1. Member States shall ensure that automated speed enforcement equipment is used to check speeding on high ways, trunk roads and roads in built-up areas.
2. Member States shall ensure that the checks are carried out in such a way as to guarantee their effectiveness. With a view to this, Member States shall in any event ensure that checks are carried out regularly where non-compliance is suspected and where this brings about an increased risk of accidents.
3. Member States shall ensure that the use of automated speed enforcement equipment complies with the specifications laid down in an annex. These specifications will in any event concern the extent of application of the equipment (number of cameras, also divided in fixed and mobile cameras and in cameras visible for drivers or not, and the total camera operating time per site; number of sites, also divided according to the different types of road mentioned

[1] Based on ESCAPE Working Paper 7 'Automatic enforcement technologies and systems', March 2000; p. 2.

in paragraph 1), what must be recorded (e.g. the back of the car showing the number plate), and the number of citations it should at least be able to handle each year[2].

Simplified administrative procedures

Member States shall ensure that the use of automated speed enforcement equipment is followed up by simplified administrative procedures through which speeding violations are systematically enforced. These procedures need to comply with the specifications laid down in an annex.

Drink-driving

Random breath testing

1. Member States shall ensure the application of random breath testing as a leading principle for surveillance of drink-driving and in such a way as to guarantee its effectiveness. With a view to this, Member States shall in any event ensure that random breath testing is carried out regularly where non-compliance is suspected and where this brings about an increased risk of accidents. It has to be based on a selection of times and places when and where drinking drivers are to be expected.
2. Member States shall ensure that officers carrying out random breath testing controls use evidential breath test devices whenever they suspect drink-driving.
3. Member States shall ensure that 40 % of the drivers on their territory are tested for drink-driving each year[3] [and the same provision but with 30% in stead of 40%].

Non-use of seat belts or child restraints

Enforcement of restraint use

1. Member States shall ensure that intensive separate enforcement actions concerning the non-use of seat belts with a duration of at least two weeks take place at least three times a year [and the same provision but with a duration of at least three weeks, at least four times a year].
2. Moreover, Member States shall ensure that use of seat belts is also enforced on the occasion of each random breath testing (see above on that subject).
3. Member States shall apply as a general policy that non-use of a seat belt is subject to a sanction rather than just a warning.

Publicity campaigns

1. The enhanced enforcement actions prescribed above for speeding, drink-driving and non-use of seat belts shall be combined with publicity campaigns. These campaigns shall be held for each of the three subjects of enhanced enforcement actions separately.
2. Member States shall ensure that each publicity campaign complies with the relevant specifications laid down in an annex.[4]

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[2] Based on ESCAPE Deliverable/Working Paper 1 'Enforcement needs on European roads', March 2000; table 23, pp. 85/86.

[3] GADGET final report 4.5.4.1, p. 73: this is the % in Finland, where the proportion of drink/drivers is among the lowest in the world.

[4] These specifications will concern in any event, for each subject of enforcement action, the form and means, the contents, the geographical area, the frequency and the duration of the campaigns. (The magazine La

Monitoring and reporting procedures

Standard form for information gathering from the Member States

Member States, using the standard form set out in an annex, shall communicate the necessary information to the Commission by the end of every year to enable it to draw up every three years a report on the application of this Directive and developments in the fields in question.
With respect to the contents of this annex: the standard form meant in the previous paragraph will in any event contain:
1. Questions concerning the performance of the Member State concerned in terms of number of deaths per million inhabitants, due to one or more of the traffic violations dealt with above, over the past year.
2. Questions concerning information from which it appears that automated speed camera checks and random breath testing were carried out regularly where non-compliance is suspected and where this brings about an increased risk of accidents.
3. Questions concerning the specifications laid down in the other annexes.

4. Questions with respect to:

- the number of speed offences registered by automated speed cameras
- the total number of speed offences
- the number of speed offences registered by automated speed cameras that have resulted in the execution of a sanction, also divided in numbers according to different types of sanction (fines; total amount of fines paid; withdrawal driving licence, reducing/adding points; prohibition to continue driving, etc.).
5. Questions concerning the simplified administrative procedures for following up the use of automated speed enforcement equipment.
6. Similar questions for drink-driving and non-use of seat belts as mentioned with respect to speeding.

Sanctions

Member States shall ensure that sanctions applicable to speeding, drink-driving and non-use of seat belts are effective, proportionate and dissuasive.

Comitology

The Commission is assisted by a Committee to adapt the annexes mentioned above.

Prévention Routière Internationale of March 2002 contains an article 'Some criteria for Running Successful Campaigns' in the field of road safety which can inspire the drafting of these specifications.)

Attachment B: Incidence Of Speeding On EU Roads

The table in this attachment combines speeding data for most Member States from a variety of sources. Most of the data are percentages of speeding vehicles for different road and vehicle types but in some cases the source data provide mean speed and (in most cases) a standard deviation. Data are from different time periods in different States, usually in the early to mid-1990s. Two sources have been used to develop this table (Draskoczy & Moscari 1997 and ETSC 1995), each of which compiled data from a number of individual primary sources.

Important information about comparing data across countries is as follows (Draskocz & Moscariy, pp.17-31):

- Data collected in the Draskoczy study was through a voluntary survey. Of the ten EU countries responding, seven gave information on present road speeds. The seven countries are those listing Draskoczy as the source in the first column of the table.
- Speeds are measured using various methods, which may yield non-comparable data.
- Methods include Doppler radar, laser radar, weight-in-motion, loops and tubes.
- Current information does not provide a systematic comparison of present speeds on different parts of the road network, nor of speeds on different road surfaces or in different weather and visibility conditions.
- Also difficult to compare figures across countries because both the indicators collected and the roads are difficult to compare.

Information specific to UK data:

- The figures for HGV were calculated using simple averages of the five types of vehicles (i.e. not a weighted average).
- The automatic counters used for the UK data are able to identify rigid 2 axle trucks but cannot distinguish between vehicles weighing less than 7.5 tonnes gross and those weighing more. The weight of this type of vehicle determines its speed limit on non-built-up roads. Consequently it is not possible to tell how many rigid 2 axle HGVs are speeding. Therefore the figures on speeding for HGV do not include rigid 2 axle trucks (which represent a large proportion of the population of trucks). [Source: Vehicle Speeds in Great Britain: 1998]

Note: The following abbreviations are used in the table:

SD	Standard deviation of average speed over the stated number of observation periods
Obs	Number of observations
V_{xx}	Speed not exceeded by xx% of vehicle**s**

Country	Type of Road	Speed Limit	Vehicle Type	Speeding Statistics as Compiled by Each Member State				Original Data Source
				Statistic 1	Statistic 2	Statistic 3	Statistic 4	
Austria (Draskoczy)	Motorway Rural main road Built-up Area	130 100 50	Cars Cars Cars	Mean = 116 Mean = 90.5 Mean = 53.4	SD=17.6 SD=13.8 SD=8	V_{85} =134 V_{85} =104 V_{85} =61	Obs =15000 Obs =24000 Obs =16000	1996, FACTUM
Denmark (Draskoczy)	Rural Road (Avg May/Oct) Motor Road (Avg May/Oct) Motorway (Avg May/Oct)	70/80 70/80 70/80/ 110	Not listed Not listed Not listed	Mean=112.1 Mean=93.9 Mean=88.6				Danish Road Directorate 1995
Denmark (ETSC)	Single Lane Rural Motorway	89/90 100-130	Cars Cars	67% over limit 40% over limit				Danish Road Directorate 1994
Finland (Draskoczy)	Rural (averaged winter / summer) Rural Motorways Motorways	80 100 100 120	All All All All	Mean=82.5 Mean=90 Mean=98.4 Mean=111.6	Over 80kmh = 66.1% Over 100kmh = 19.8% Over 100kmh = 49% Over 120kmh = 33.4	Over 90kmh = 18.7% Over 110kmh = 4.2% Over 110kmh = 18.3% Over 130kmh = 10.7%	Over 100kmh = 3.7% Over 120kmh = 0.8% Over 120kmh = 4.2% Over 140kmh = 0.5%	1995 Finnish Road Admin.
Finland (ETSC)	Single Lane Rural Motorway Motorway	80/90 100/110 100-130	Cars Cars Cars	52% over limit 23% over limit 15% over limit				Mäkinen 1990
France (ETSC)	Urban Single Lane Rural Motorway Motorway	50 80/90 100/110 100-130	Cars Cars Cars Cars	64% over limit 58% over limit 44% over limit 40% over limit				ONSR 1994
Germany (ETSC)	Residential	30	Cars	74% over limit				Blanke 1993
Ireland (ETSC)	Single Lane Rural	80/90	Cars	36% over limit				Crowley 1991
Netherlands (Draskoczy)	Two-lane rural Two-lane rural (avg of three)	100 80	All All	Mean=85 Mean=75	SD=12.5 SD=12.9	V_{90}=100 V_{90}=89	%speeding=15 %speeding=28	1996
	Motorways Motorways	100 120	Not listed Not listed	Mean=104.1 Mean=111.5				1994 Project Bureau IVVS

Country	Type of Road	Speed Limit	Vehicle Type	Speeding Statistics as Compiled by Each Member State				Original Data Source
				Statistic 1	Statistic 2	Statistic 3	Statistic 4	
Netherlands (ETSC)	Single Lane Rural	80/90	Cars	40% over limit				SVOV 1994
	Motorway	100	Cars	55% over limit				
	Motorway	120	Cars	20% over limit				
Portugal (Draskoczy)	Two-lane rural	90	Cars	90kmh or more = 5.5%	95kmh or more = 2.9%	No cars >/= 110 km/h	Obs=15380	1996 TRANS-POR
Spain (ETSC)	Residential in Catalonia	30/40	Cars	97-98% over limit				GdeC 1992/1993
	Urban	50	Cars	71% over limit				DGT 1993
	Single Lane Rural	80/90	Cars	16% over limit				
	Motorway	100/110	Cars	22% over limit				
	Motorway	100-130	Cars	25% over limit				
Sweden (Draskoczy)	Not listed	30	All	30kmh or more = 76%	40kmh or more = 24%	50kmh or more = 6%		1996 Vägverket
	Not listed	50	All	50kmh or more = 58%	60kmh or more = 12%	70kmh or more = 2%		
	Rural	70	All	70kmh or more = 75%	80kmh or more = 40%	90kmh or more = 14%	100kmh or more = 2%	
	Rural	90	All	90kmh or more = 50%	100kmh or more = 17%	110kmh or more = 5%	120kmh or more = 1%	
	Rural	110	All	110kmh or more = 33%	120kmh or more = 11%	130kmh or more = 2%	140kmh or more = 1%	
	Motorway	90	All	90kmh or more = 80%	100kmh or more = 46%	110kmh or more = 17%	120kmh or more = 3%	
	Motorway	110	All	110kmh or more = 50%	120kmh or more = 22%	130kmh or more = 7%	140kmh or more = 1%	
United Kingdom (Draskoczy)	Urban	30 mph	Cars	Mean=33	72% >limit	38% > 35mph	Obs.=2515000	1996 Transport Statistics GB
	Urban	30 mph	Trucks[1]	Mean=30	55% >limit	21% > 35mph	Obs.=101000	
	Urban	40 mph	Cars	Mean=37	28% >limit	10% > 45mph	Obs.=1251000	
	Urban	40 mph	Trucks	Mean=33	14% >limit	3% > 45mph	Obs.=73000	
	Single-lane rural	60 mph	Cars	Mean=47	10% >limit	2% > 70mph	Obs.=13156000	
	Single-lane rural	40 mph	Trucks	Mean=44	68% >limit	22% > 50mph	Obs.=2125000	
	Two-lane rural	70 mph	Cars	Mean=68	47% >limit	11% > 80mph	Obs.=11093000	
	Two-lane rural	50 mph	Trucks	Mean=55	85% >limit	12% > 60mph	Obs.=1645000	
	Motorways	70 mph	Cars	Mean=70	55% >limit	18% > 80mph	Obs.=71218000	
	Motorways	60 mph	Trucks	Mean=57	24% >limit	1% > 70mph	Obs.=18724000	

Attachment C: Proposed Changes to Commercial Road Transport Directive 88/599/EC and Associated Cost/Benefit Implications

Current Measures (Directive 88/599/EEC as of 11/23/88)	Proposed Changes (Item numbers refer to proposed measures as listed in the TOR)	Cost/Benefit Implications
Article 2 (1) Member States (MS) must have a system that ensures annual checks on a "large and representative cross-section of drivers, undertakings and vehicles," as described in Article 4 of Regulation 3820/85.	No specific changes, but proposal to better randomise checks (item 3) will help ensure that checks reach a representative selection of drivers	Reduces the chance that violations of the regulations will remain undetected
Article 2 (2) (part a) Checks must cover at least 1% of days worked by drivers who fall within the scope of the 3820/85.[5]	1. As soon as the revised directive becomes active, checks must cover at least 3% of days worked by these same drivers. This percentage will then be raised progressively over 3, 6, and 10 years to levels matching one of three scenarios: a. 5% -- 7% -- 10% b. 8% -- 14% -- 20% c. 10% -- 20% -- 30%	Costs: More inspector person-hours and equipment, "dead" time for truck drivers. EC reports detail the increase from current practice for each MS. Benefits: Identify more non-compliant vehicles/drivers, which will bring them into compliance or get them off the road. In addition, a stronger perception of enforcement will raise compliance. Result will be fewer crashes due to tired drivers and better social conditions for drivers
Article 2 (2) (part b) Of the checks conducted, at least 15% must be roadside checks, and at least 25% must be carried out at the premises of the undertakings.	2. Of the checks conducted, the minimum percentage required at the roadside versus those required at the premises of undertakings will follow one of two scenarios: a. At least 20% at the roadside, and at least 35% on premises b. At least 30% at the roadside, and at least 50% on premises	Inspectors will have less discretion over the ratio of roadside vs premises checks. Commission reports show that most MS are currently carrying out most checks at the roadside. Premises checks may be more involved/expensive than roadside, but EC Reports and other sources suggest that they result in higher "catch" rates (and thus different safety benefits). Drivers' and companies' perception of new standards may also change compliance rates.
Article 2 (3) Certain basic data describing the checking effort must be submitted every two years to the Commission.	Requirement to add reports of working hours (as required in Directive 2002/15/EC)	New requirement to track working hours. Modest additional costs to initiate system, record data and add to reports. See also item 7.
Article 3 (1) Roadside checks must occur at different places at any time, and be spread over enough of the road network to hinder avoidance.	3. Every service station along the highways should be prepared for use as a checkpoint, and checkpoints must be used randomly. 5. Introduce rating system to allow preferential treatment of high-compliance companies	3. MS must develop a system of randomisation. Becomes harder for violators to escape detection, leading to increased compliance and fewer accidents. 5. New requirement. MS will be responsible for developing this system. Two Member States already use targeted checks. Will reduce ongoing costs after initial costs to develop system.

[1] The applicable vehicles are explicitly defined in 3820/85, Article 4.b

Article 3 (2) Roadside checks must include daily driving periods, breaks and daily resting periods; also, in case of clear indication of irregularities, the logbook (paper or electronic) from the preceding day.	6. Introduce additional checking procedure: working time (as defined in Dir. 2002/15/EC)[6], and introduce use of digital tachograph for this purpose. 7. Delete "in case of clear indication of irregularities". 10. Cumulative daily and weekly rest is evaluated on the basis of a 180-hour (or 4-week) period (with digital tachograph).	6. New requirement. Requires additional training, duties for inspectors in work/drive time requirements, use of computer to analyse digital tachograph data. Increases duration of a check . Would reduce excessive work hours and chance of fatigue related accidents. 7. Logbooks must now be presented at all roadside checks. Increases costs of check insofar as logbook must be reviewed. Safety benefits due to increased catch rates, leading to increased compliance, fewer fatigue related accidents 10. Needs computer-based checking procedures and associated investment and training. Will improve effectiveness of checks and uniformity of interpretation, leading to greater compliance and fewer fatigue-related accidents.
Article 3 (2) Roadside checks must include speeding, and may include weekly rest periods, operability and use of recording equipment, and/or presence of required documents.	Weekly rest to be evaluated on the basis of a 180-hour (or 4-week) period (see Proposed Change #10 above).	Costs and benefits covered as part of Proposed Change #10 (above).
Article 3 (3) Roadside checks must be applied without discrimination of vehicles, drivers, and residency.	None.	Randomisation requirements address this point. Also use of digital tacheograph and better international cooperation in checks will help ensure consist application of Regulations to both local and international drivers.
Article 3 (4) Officers must be given a list of principal points to be checked and a chart of road transport terminology in all EU languages (the latter provided by the Commission).	4. Introduce standardized checklist for inspectors 8. Provide inspectors with language chart. 9. Impose use by every inspector of standard checking equipment (interoperable between Member States)	4. Will improve consistency and completeness of checks 8. Will improve effectiveness of checks through better communication between inspectors and drivers 9. Costs will vary depending on each Member State's current equipment and the required standards. Benefits will be ease of information transfer and sharing, and greater chance of catching habitual offenders. .
Article 3 (5) MS must work together to clarify possible trans-national infringements e.g. a driver from one MS found to be out of compliance while in another MS.	See items 13, 14 and 15 below.	Five or six countries do this pretty effectively with neighbouring countries. Germany says that current system does not enable effective enforcement of non-nationals.

[6] Working time is defined as all the time spent on driving and other activities for the employer, including time spent waiting to take up normal work. Drivers may not exceed 48 hours of work per week. This may be extended to 60 hours as long as the average is 48 hours over a reference period of up to four months. A 30-minute break should be taken after six hours of work, or a 45-minute break after between six and nine hours of work. The working day (over a 24-hour period) must not exceed 10 hours for night workers.

Article 4 (1) Checks at the premises of undertakings shall be planned based on past experience with different categories of transport; also, checks at premises may follow when serious infractions are detected at a roadside check.	See Proposed Changes numbers 2 and 5 above.	Proposed change 5 will lead to greater pressure on" bad" firms to improve, through increased checks at premises. Also, proposed change 2 encourages more premises checks in place of roadside checks. Inspection costs will increase because of more checks overall
Article 4 (2) Checks at premises must include weekly rest periods, driving periods, 14-day limit of driving hours, compensation for reduced resting periods, use of record sheets, and/or organization of drivers' working times.	10. Cumulative weekly rest is evaluated on the basis of a 4-week period. Also, see Proposed Change #6 above. 11. Checks must also include co-liability of other players in the transport chain (e.g. subcontractors). 12. Checks must verify that transport contracts permit compliance with relevant regulations.	Costs and benefits covered as part of Proposed Changes #6 and #10 (above). 11 and 12. Will reduce occurrences of firms evading responsibility through subcontract arrangements, thus reducing the risk of accidents. Will require additional training of enforcement staff in procedures for these checks, development of the checking procedure and may increase the duration of a check
Article 4 (3) Checks carried out at inspectors' offices based on documents submitted by undertakings are equal to those carried out at the premises of the undertakings.	None.	None.
Article 5 (1) MS shall carry out concerted checking operations at roadsides and on premises at least twice per year.	13. Change this to at least six times per year. 14. Coordinate all the different enforcement authorities within each MS. 15. Designate a central coordinating entity (and POC for the Commission) for all checks	13. Will reduce the chance that drivers evade the Regulations due to poor coordination between neighbouring MS's. Costs will be to manage coordination efforts, exchange data and maintain international database, (per item 15). 14. Cost will vary by MS – each has a different slate of authorities, as explained in 2000 survey results, but will lead to greater chance of catching violations 15. Will reduce violations and accidents in international road transport. Costs will be to set up and maintain international databases and communications.
Article 5 (2) These concerted checking operations should be coordinated such that at least two MS are conducting checks at the same time.		Currently several countries are conducting coordinated checks with neighbouring countries. These are to be increased per items 13, 14 and 15 discussed above.

Article 6 (1) Certain information must be exchanged every 12 months and upon request by a MS.	16. Ensure collaboration among the enforcement and judicial authorities of different MS re: int'l transport (e.g., through existing databases).	Will reduce the chance of violators evading sanctions through lack of coordination between authorities in different MS's. May also reduce costs due to avoiding multiple checks on same driver by different authorities. Costs will be for additional hardware, software, and/or training, to ensure effective access to international data by all MS's
Article 6 (2) This information exchange must use a standard form provided by the Commission.	None.	None.
[New proposed rules: Sanctions]	17. Introduce a system of efficient administrative sanctions and enforcement (e.g. spot fines) 18. Set min and max sanctions for various infringement (or at least state that sanctions must be effective, proportionate and dissuasive). 19. Introduce sanction of vehicle immobilization or intervention in usage of operator/driving license. 20. Introduce economic sanctions (or at least require payment of unlawfully obtained profits). 21. MS to agree to apply similar sanctions to similar infringements.	Proposed Changes 17-21 will carry initial development and implementation costs, but are likely to have a minor impact on operating costs. Could increase revenue from fines, but most importantly will increase compliance with regulations due to greater certainty and severity of sanctions. The size of safety benefits of Proposed Changes 17-21 are a function on how compliance changes in response to various sanction structures and/or perceived uniformity of enforcement.
[New proposed rules: Training]	22. MS to train inspectors (program to be developed in consultation with transport sector). MS to report yearly to the Commission on training. 23. MS shall establish joint training programs for different authorities within one MS and/or with different MS. 24. A Committee of MS representatives to advise the Commission on best practices (to become standards in the enforcement directive).	22. Training programs may be costly to develop, especially for checks for compliance with complicated driving and rest time requirements, but will reduce overall costs in the long run. 23. Joint training between multiple MS may be complicated by varying interpretation of the regulations. However, Regulation 3820/85 is to be refined to reduce potential for multiple interpretations. 24. Minimal cost. Best practices advice will likely reduce costs and increase check effectiveness for Member States