Recommended safety measures for application on interurban roads in the short term

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Report of the Working Party 4: Infrastructure, to the High Level Group of Representatives of the Member States on Road Safety and to the Directorate-General for Transport of the European Commission

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Summary

Ten road safety countermeasures are recommended for application on non-motorway interurban roads in Europe in the short term. The selection was mainly based on the answers to a questionnaire that were given by the Member States of the European Union. A distinction is made between countermeasures on three levels: analyses, traffic engineering and traffic operation.
On the analysing level are recommended: road, traffic and accident data collection; road safety inspection; black spot analysis and treatment; road safety impact assessment (RIA).
On the traffic engineering level are recommended: traffic calming on thoroughfares through small towns and villages; building roundabouts instead of intersections; safety barriers at hazardous locations; restricting the possibility of overtaking.
On the operational level are recommended: consistency in the signing and marking of (sharp) bends; alternative routing of slow traffic.
As far as possible, some rough indication is given of the cost-effectiveness of the countermeasures.

This report was compiled by SWOV Institute for Road Safety Research, The Netherlands, on behalf of the European Road Safety Federation (ERSF).

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1. Introduction

After consultation with the High Level Group of Representatives of the EU Member States on road safety the European Commission - DG VII Transport - decided to set up a Working Party #4 (WP4): 'Infrastructure', to recommend a limited number of road safety measures suitable for application in the short term.

The activities should focus on *interurban roads*. This 'category' is assumed to include:
- Major roads outside built-up areas being non-motorways (width mostly > 6 m);
- Minor rural roads (width mostly < 6 m);
- Thoroughfares through small towns and villages.

The choice for interurban roads was made because these roads are relatively dangerous. According to the country, between 50 and 70% of all road *fatalities* occur on them. An international review of the road safety situation is given in *Annex 2*.

WP4 first sent out a questionnaire to the Member States asking for relevant information on the subject. It was the intention to base the subsequent selection of the measures mainly on the answers to this questionnaire. The measures (in the broad sense of the word) to be selected must be those most likely to lead to a decrease in the number of road victims in the short term. An indication of the effect of each measure on road safety should possibly be given, together with the preferred order of priority among the measures. An international review of the road safety situation must be added, to show the scope and the nature of the problem.

The role of the International Road Federation (IRF) in keeping the secretariat of the working party, designing a questionnaire and processing the answers, as well as drafting part of the interim documents is high-lighted. The ERSF secretariat has contributed to a large extent to the communications management within the WP.

2. Selection of road safety countermeasures

From several sources it has become clear that about 90% of all casualties on non-motorway roads outside built-up areas can be connected with just four kinds of manoeuvre:

	Part of driving task	*Nature of most accidents*	*Approx.%*
A	Keeping course	Going off the road	35
B	Intersecting	Collisions with intersecting vehicles	20
C	Following	Rear-end collisions	15
D	Overtaking	Head-on collisions	20

These percentages may differ between countries and also between major and minor roads. For instance, on minor roads, the percentage of A and D type accidents is generally higher, and the percentage of C type accidents lower than on major roads.

All percentages mentioned are slightly lower on roads passing through villages because, there, a fifth type of accident (E), i.e. collisions with vulnerable road users such as pedestrians or cyclists, occur more often (around 15%). The average consequence of this type of accident is usually more serious.

Measures to combat road hazard, mostly called 'countermeasures' hereafter, should focus on the prevention of these five kinds of accidents.

The selection of the countermeasures was mainly based on the answers to the questionnaires distributed by WP4. Some of SWOV's expertise was added. An attempt to gather additional relevant information from OECD and PIARC was unsuccessful.

The study has resulted in the selection of the ten countermeasures listed below. A distinction is made between countermeasures on three levels: analyses, traffic engineering and traffic operation.

A separate column indicates which of the five manoeuvre categories mentioned might be addressed by each countermeasure. The last column indicates for each countermeasure which countries have mentioned it as a useful one. If this information was taken from the recommendations found on the questionnaires, the country name is printed in bold type.

No.	Countermeasure	Manoeuvre	Countries
Analyses			
1	Road, traffic and accident data collection	all	B D DK E F FIN **GB** GR **I L** NL
2	Road safety inspection	all	DK E F FIN GB GR **L**
3	Black spot analysis and treatment	all	B D DK E F FIN **GB** GR **I L**
4	Road safety impact assessment (RIA)	all	**B** E **F** NL
Traffic Engineering			
5	Traffic calming on thoroughfares through small towns and villages	B E	D DK E F FIN **GB L**
6	Building roundabouts instead of intersections	B	B E F FIN **L NL**
7	Safety barriers at hazardous locations	A	**D** E F GB **I** NL
8	Restricting the possibility of overtaking	D	B D **I**
Traffic operation			
9	Consistency in the signing and marking of (sharp) bends	A	**D** E GB
10	Altenative routing of slow traffic	E	B **NL**

The various countermeasures are dealt with separately in the next chapter, where a short description of the problem is provided, together with the possible solution for this, the way to realize it, the expected effect and the cost-effectiveness.

The recommendations refer to fields of action and do not contain specified countermeasures in detail. Their implementation may differ from country to country. Also, the benefit of a certain measure may be larger on major roads than on minor roads.

For this reason, too, determining the cost-effectiveness of the respective countermeasures turned out to be very difficult. The way the figures were calculated is briefly explained in Annex 1. The reader should take notice of the introductory paragraphs in that annex so that the cost-effectiveness rates presented are treated with caution.

As a consequence of this, the idea of giving an individual priority rating to the various countermeasures on the basis of their cost-effectiveness was abandoned. A distinction is only made between three groups of countermeasures, i.e. those with a relatively large, a medium or a small cost-effectiveness (see Ch. 4).

Apart from the above countermeasures it should be noted that *road classification*, related closely to the functional use of each road, is an important means of improving road safety. The more typical a road the better the user of the road will recognize its type, and behave accordingly.

3. Short description of the countermeasures

3.1. Road, traffic and accident data collection

Problem: Sufficient data to establish relationships between road design and accidents are not available in all countries.
Solution: It must be possible to relate the data of each accident to the characteristics of the accident location.
Implementation: Creation of sound national databases with possible linkage between accident and accident location data.
Effect and cost-effectiveness: Cannot be determined in isolation, since the measure is a means of facilitating other countermeasures.

Note: Creation of national databases is also useful for comparing the accident figures of various countries, provided that registration practices match.
Note: A useful addition to the conventional registration of accident numbers could be a differentiated recording of carefully specified accident types, to be able to calculate reference figures for the various types, in order to monitor and evaluate safety programmes.

3.2. Road safety inspection

Problem: The actual layout of most existing roads is the result of a development in time during which proper attention to road safety requirements was not always paid to the same extent. Also, changing traffic conditions may call for a different design.
Solution: A precise knowledge of the present safety characteristics of every road depending on the traffic it carries can form the basis for a road improvement program.
Implementation: Systematic road inspection by safety experts.
Effect and cost-effectiveness: Dependent on subsequent countermeasures according to the recommendations of the experts as a result of their experiences.

Note: A road safety inspection may be carried out at three levels:
1. On the basis of good sense;
2. By comparing to guidelines in force;
3. After selection of accident prone situations.

If the inspection is carried out at level 2 by a person or body independent from the road administrator, it may take on the character of a safety audit. A safety audit combined with other methods of evaluating road safety may form a means of road safety impact assessment (see § 3.4). A road safety inspection at level 3 can be considered a component of black spot treatment (see § 3.3).
Note: It is worth remembering that shipping, aviation and railway operations are liable to - sometimes very strict - legal safety requirements. This may be one of the reasons why casualty rates in these fields of transport are hundreds to thousands of times lower than those in road transport. It may even be an argument for making road safety inspections obligatory.

Note: When road safety inspections are implemented the degree of qualification of the people carrying them out must be clearly defined; see also § 5.3.

3.3. Black spot analysis and treatment

Problem: Traffic accidents tend to concentrate at certain locations on the road network; the most hazardous locations are usually called 'black spots'.
Solution: Treatment of such black spots by reconstruction (or sometimes by taking more simple countermeasures) may result in a comparatively large improvement of road safety at those locations.
Implementation: Systematic black spot identification and analysis (a), resulting in a priority list for treatment, to be followed by appropriate infrastructural (or operational) countermeasures (b).
Effect: (a) No effect from the identification and the analysis themselves. (b) An average decrease in the number of casualties of 45% is reported in those cases when the analysis was followed by appropriate infrastructural (or operational) countermeasures.
Cost-effectiveness: Can be calculated at about 90 victims saved per million ECU when countermeasures are carried out.

Note: To be able to identify the black spots and to analyse the accidents that have occurred, a sound data base containing the accident, traffic and road layout data is needed; see Para. 3.1. Non-fatal and even non-injury accidents should also be taken into consideration when analysing the accident data.
Note: Criteria for identifying the black spots may differ between the various countries.
Note: It is to be expected that, when it comes to reconstruction, a start will be made with the most serious black spots. As a result of this, the cost-effectiveness of this countermeasure will accordingly decrease as more black spots have been treated. This effect has already markedly turned up in some countries.
Note: Black spots cater for only 10 to 20% of all accidents; many types of accidents rarely occur at black spots. Thus, black spot analysis and treatment should always be accompanied by other countermeasures.

3.4. Road safety impact assessment (RIA)

Problem: Infrastructural projects are often implemented without prior investigation of their effect on road safety; or the choice between alternative options is not based on differences in their safety effects.
Solution: An obligation to report on the impact of infrastructural projects on road safety. A road safety audit may form an element of RIA.
Implementation: Measures to ensure that such reports will be made; development of proper methods and instruction of the relevant people to draft the reports.
Effect: Cannot be determined in a general sense.

3.5. Traffic calming on thoroughfares through small towns and villages

Problem: Too high speeds on thoroughfares.
Solution: Reducing speed on thoroughfares.

Implementation: Measures of various kind to reduce speeds, like: narrowing the carriageway, building humps, plateaus and chicanes.
Effect: In the relevant range of speeds a reduction of 50% of the victims is theoretically possible if the average collision speed could be reduced by 13 km/h. With reference to the experiences in urban areas a reduction of between 0 and 35% in the number of victims may be expected in practice.
Cost-effectiveness: Will be about 40 victims saved per million ECU if low-cost infrastructural measures are applied.

Note: Although these measures are useful throughout the length of a thoroughfare they may also be effective if applied at the entrances of the town or village. However, there is some evidence that gateway treatments alone will not sustain a speed reduction throughout the village. Finally, their application on minor rural roads is also worth considering.
Note: When considering thoroughfares the possibility of rerouting heavy traffic through bypasses and the construction of bicycle and/or pedestrian lanes should also be recognized.

3.6. Building roundabouts instead of intersections

Problem: Large differences in direction and speed between vehicles occurring at traditional intersections cause serious conflicts.
Solution: Avoid large differences in speed and direction.
Implementation: Roundabouts of appropriate design reduce the approach speed of vehicles and the intersecting angle between vehicles entering and following the roundabout.
Effect: A reduction of about 86% in the number of casualties is reported when rural intersections were rebuilt into roundabouts.
Cost-effectiveness: Can be calculated to be about 100 victims saved per million ECU for small roundabouts (a), falling to about 10 for large roundabouts (b).

Note: A give way regulation in favour of the vehicles on the roundabout is a condition for a successful application. In addition, for the sake of uniformity, all existing roundabouts where such a regulation is lacking should be brought into line.
Note: Special attention should be devoted to cycle traffic at roundabouts and to the problems heavy vehicles may experience if the design is poor.
Note: A roundabout may also be of benefit in marking the entrance of a built-up area.

3.7. Safety barriers at hazardous locations

Problem: Vehicles going off the road collide with roadside objects (trees, lampposts, sign posts, etc.) or run off slopes.
Solution: Drivers can be protected from running into dangerous shoulders by redressing their course.
Implementation: Steel or concrete safety barriers constructed in such a way that high decelerations will not occur upon impact.
Effect: Although collisions against obstacles behind the barrier will almost fully be prevented a remaining hazard may be caused by the possibility of rebounding. Estimated saving effect: 50% of the victims.
Cost-effectiveness: Is estimated to be in the magnitude of 20 or more victims saved per million ECU.

Note: Large objects standing less than 4.5 m from the road are to be either eliminated, moved or protected.

3.8. Restricting the possibilities of overtaking

Problem: On two-lane two-way roads overtaking manoeuvres cause a hazard of collisions with oncoming vehicles.
Solution: Prevention of overtaking on sections where this manoeuvre is especially dangerous.
Implementation: Overtaking can simply be forbidden by applying proper marking. If this is done, however, the flow of traffic may be hindered by the presence of slow moving vehicles. Then, additional provisions are required in order to enable overtaking, p.e. by applying wider shoulders to which vehicles may turn aside when being overtaken, or by applying short road stretches with a regular overtaking lane.
Effect: Prevention of all dangerous overtaking manoeuvres would result in a possible reduction of about 20% of the casualties.
Cost-effectiveness: Is estimated to be about 1 or 2 victims saved per million ECU, depending on the nature of the additional provisions.

Note: The marking of the overtaking and non-overtaking zones urgently needs international harmonization.

3.9. Consistency in the signing and marking of (sharp) bends

Problem: Bends to be negotiated at lower speeds than can be maintained in the preceding road section are not marked as such in the same way in the various countries. Road users may misjudge the curvature of a bend and enter it at too high speed.
Solution: A sound and uniform system of the signing and marking of bends throughout Europe.
Implementation: A uniform system is still to be prepared. The use of retro-reflective materials for better perceptibility at night is strongly recommended.
Effect: A reduction to the same accident rate level as on straight sections may be achieved at most. A more modest option is realistic.
Cost-effectiveness: May be estimated to be about 150 victims saved per million ECU.

Note: Rebuilding the bend in accordance with the adjacent road sections may be a better solution.

3.10. Alternative routing of slow traffic

Problem: Interurban roads are, in principle, open for all vehicles, but they are sometimes dangerous for particular road users. The occurrence of both cars and slow moving vehicles (agricultural vehicles, bicycles) on the same road may cause hazardous situations.
Solution: Avoid the presence on a road of vehicles running at largely varying speeds.
Implementation: Relegate slow traffic to a suitable parallel link if existing; if not, create such a link.
Effect: From a comparison between the available figures for two-lane roads open and not open for slow traffic, but with the same volume of

motorized traffic, it can be deduced that the number of injury accidents may decrease by 30%.
Cost-effectiveness: Is estimated to be about 150 victims saved per million ECU if only signs are installed to relegate slow traffic (a); if a modest parallel road is needed to cater for the banned vehicles (b) the cost-effectiveness will drop to about 5 victims saved per million ECU.

Note: If no parallel road is present nor can be built, hard shoulders may be constructed to accommodate the slow traffic (cf Para. 3.8).
Note: In certain circumstances environmental considerations might rule against this option.

4. Attractiveness of the countermeasures

One of the factors - though definitely not the only one - determining the attractiveness of a countermeasure to be taken is its cost-effectiveness. Some rough indications on the cost-effectiveness are given with each countermeasure in Ch. 3. On the basis of these figures three groups of countermeasures can be formed, with different degrees of cost-effectiveness (N.B. A high cost-effectiveness means that the money is well spent). There is also a group for which no cost-effectiveness could be established.

No cost-effectiveness to be established

1 Road, traffic and accident data collection
2 Road safety inspection
3 (a) Black spot analysis
4 Road safety impact assessment (RIA)

Relatively high cost-effectiveness

3 (b) Black spot treatment
6 (a) Building small roundabouts instead of intersections
9 Consistency in the signing and marking of (sharp) bends
10 (a) Alternative routing of slow traffic without building parallel link

Medium cost-effectiveness

5 Traffic calming on thoroughfares through small towns and villages
7 Safety barriers at hazardous locations

Relatively low cost-effectiveness

6 (b) Building large roundabouts instead of intersections
8 Restricting the possibilities of overtaking
10 (b) Alternative routing of slow traffic with the building of parallel links

Note: There are two major factors influencing the ultimate cost-effectiveness of a countermeasure, i.e. the before level of safety: medium or low, and the cost of the countermeasure: expensive option or low-budget alternative. Priorities are to be set according to the available budgets.

Note: The time scale for implementation is not the same for all measures.

5. Additional remarks

The implementation of the countermeasures mentioned, or the improvement of their cost-effectiveness, is facilitated if other traffic safety activities of a more general nature are taken.

5.1. Implementation on national levels

The proposals in this report are of a general nature. The actual opportunities for implementation may be different in the various countries. In some countries, the implementation could be promoted by legal measures; other countries may prefer guidelines that are not compulsory.

However, the design of the infrastructural measures themselves should diverge as least as possible. In view of this, designers in the various countries should all have the same knowledge of current common opinions about proper road design. The impression prevails that improvement of the situation is possible. A full transfer of the latest knowledge by properly training the relevant personnel is recommended.

To this end, it would be useful to establish European technical guidelines for the safety of interurban roads, regarding their construction, improvement, and maintenance and signing system.

5.2. Matching function, design and use of roads

The background of many of the infrastructural countermeasures mentioned is to make it better comprehensible for the road user how to behave.
A situation favourable for road safety is present if the intended functions of the road match with both the design and the use that is made of the road.

Matching functions and design can be characterized as 'creating proper roads for the proper traffic'. This may imply that, in certain cases, interurban roads should be transformed into motorways. Care must be taken, then, that the interest of the slow traffic is guaranteed.

Matching design and use is promoted by making the roads 'self-explaining' (readable). To accomplish this, more research results are needed. A better knowledge of the requirements for self-explaining roads will also make it easier to carry out road safety inspections (see countermeasure # 2).

The foregoing remarks do not mean that all designs must be identical. New ideas for the layout of roads and junctions may still be developed. It is recommended that more contacts between designers and road users (and their trainers) be effected for this end. Occasionally, it may even be that the layout is adapted to the use that is made of a road.

5.3. Application of roadside and in-vehicle electronics

To improve flow and safety, electronic systems have successfully been introduced in some countries. The implementation has been restricted mainly to roadside equipment on motorways so far. A possible extension to in-vehicle equipment and to non-motorway interurban roads could create new prospects for improving road safety at locations or on road sections. Examples of application are speed control in various ways, and iciness and mist detection and warning. Further research in this field (known as intelligent vehicle/highway systems) is urgently needed. Much is being done within the framework of the DRIVE project.

Electronics are already in use with the automatic enforcement of speed violations and red light violations. There may be a possibility to use them also in the signing of bends (see countermeasure # 9).

Annex 1

Cost-effectiveness

The cost-effectiveness of each countermeasure was basically expressed as the number of road victims to be saved by that countermeasure, per million ECU spent. A limited amount of such data from previous research could be found in some cases only.

More often, both the numerator and the denominator had to be estimated, with large margins of uncertainty. A possible variation in the figures is indicated in some cases only; but it is easy to recognize that large variations may occur in the other cases as well. Investment costs may especially exceed the figures given. With some countermeasures, it will make a large difference if the countermeasure is taken on a large scale or at the most hazardous locations only. The cost-effectiveness of a measure may also vary between regions.

A period of 30 years after the countermeasure being carried out was taken as a basis for these calculations. To account for interest and depreciation during that period, the investment cost of the relevant countermeasure in the denominator was multiplied by 4. In case the investment cost could be neglected compared to the maintenance costs the maintenance costs were taken into account only, multiplied by 2. The same applies to the case in which the investment costs are expected to be staggered over the total period considered.

The economic benefits of the accidents that no longer happen were not taken into consideration.

It should be noted that a large difference in investment cost may also exist between *rebuilding* a situation according to the proposals mentioned and creating the preferable solution in *new* situations.

A brief explanation of the cost-effectiveness figure of each countermeasure is given below. From this it will be clear that not all cost-effectiveness rates that have been calculated are equally firm.

1 Road, traffic and accident data collection

This measure is a condition for proper monitoring of road safety and for implementing the countermeasures mentioned below; its effect and cost cannot be determined separately.

2 Road safety inspection

Unity considered: 10 km of road
Assumptions:
Inspection frequency: once a year, during one day
Personnel cost: 1,100 ECU
Additional cost: 400 ECU
Average cost: 150 ECU per km per year

Cost-effectiveness: Cannot be determined since the effect is depending on subsequent countermeasures according to the hints given by the experts as a result of their experiences

3 Black spot analysis and treatment

No calculation can be made of the cost-effectiveness of black spot *analysis* only. But figures are known for the cost-effectiveness of the countermeasures taken in connection with the analysis.

Unity considered: 1 black spot, monitored 30 years after
Real figures (C.R.O.W, 1991):
Number of locations: 145
Victims before: 791 per 3 years
Victims after: 441 per 3 years
Investment cost (price level 1994): 10,000,000 ECU
Cost-effectiveness: {(791 - 441)x10}:(10,000,000x4) = about 90 victims saved per million ECU
N.B. A study for the European Committee of Ministers of Transport resulted in a figure of about 45 victims saved per million ECU.

4 Road safety impact assessment (RIA)

This measure is an indirect way of improving road safety; its effect and cost cannot be determined separately.

5 Traffic calming on thoroughfares through small towns and villages

Unity considered: 1 km of road, monitored 30 years after
Assumptions:
Victims before: 2.4 per year, for traffic arteries inside built-up areas
Reduction: 22%
Investment cost: 100,000 ECU, for low-cost infrastructural measures
Cost-effectiveness: (2.4x0.22x30):(100,000x4) = about 40 victims saved per million ECU

6 Building roundabouts instead of intersections

Unity considered: an intersection rebuilt into a small roundabout (ø 25 m) or otherwise into a large one (ø > 50 m), monitored 30 years after
Figures from research:
Victims before: 1.3 per year
Reduction: 86%
Assumptions:
Investment cost: 100,000 ECU, for a small roundabout; 1,000,000 for a large roundabout
Cost-effectiveness: (1.3x0.86x30):(100,000 or 1,000,000)x4 = about 10 or 100 victims saved per million ECU

7 Safety barriers at hazardous locations

Unity considered: 1 km of road, monitored 30 years after
Assumptions:

Victims before: 0.5 per year, being about the average for all two-lane roads (SWOV, 1992)
Reduction: 50%
Investment cost: 120,000 ECU, for both sides of the road
Cost-effectiveness: (0.5×0.5×30):(120,000×4) = about 20 victims saved per million ECU; the rate may be higher if application of the barriers is restricted to the most hazardous road sections

8 Restricting the possibilities of overtaking

Unity considered: 1 km of road, monitored 30 years after
Assumptions:
Victims before: 0.5 per year, being about the average for all two-lane roads
Reduction: 20%
Investment cost: 350,000 to 700,000 ECU, depending on the nature of the additional provisions
Cost-effectiveness: (0.5×0.20×30):(350,000 to 700,000)×4 = about 1 to 2 victims saved per million ECU

9 Consistency in the signing and marking of (sharp) bends

Unity considered: a sharp bend, monitored 30 years after
Assumptions:
Victims before: 2 per year
Reduction: 50%
Investment cost per sharp bend: 50,000 ECU
Cost-effectiveness: (2×0.5×30):(50,000×4) = about 150 victims saved per million ECU

10 Alternative routing of slow traffic

Unity considered: 1 km of road, monitored 30 years after
Assumptions:
Victims before: 0.3 per year, for two-lane roads open for all vehicles (SWOV, 1992)
Reduction: 30%
Investment cost: 5,000 ECU if signs are installed only; 200,000 ECU if also a modest parallel road is built (with no more land use)
Cost-effectiveness: (0.3×0.3×30):(5,000 to 200,000)×4 = about 5 to 150 victims saved per million ECU

Annex 2

International review of the road safety situation

Three tables are produced containing road and accident data taken from the International Road Traffic and Accident Database (IRTAD). A distinction is made into 'country roads', motorways and roads inside builtup areas. It may be assumed that the category 'country roads' is to a large extent equal to the category of interurban roads that are dealt with in this report.

The figures represent total road length and number of injury accidents that have occurred on them (absolute figures, and figures per km of road and per vehicle kilometer).

It appears that many data are missing. Due to the lack of sufficient information and to diverging definitions the merit of these figures for international comparison is only relative.

country roads	road length [km]			number of injury accidents			injury accidents per 1,000 km of road			injury accidents per 10^8 vehicle km		
	year			year			year			year		
	91	92	93	91	92	93	91	92	93	91	92	93
D	.	.	.	112182	114370	116307	.	.	.	.	.	.
D(W)	256708	256829	256848	93140	93049	92952	363	362	362	0.49	0.49	0.45
I	.	.	.	36720	36512	33199	.	.	.	.	.	.
UK	225258	224777	224668	57209	56308	.	254	251	.	0.32	0.32	.
GB *)	205371	204719	204542	55016	53937	53465	268	263	261	0.33	0.32	0.32
F	.	.	763600	38648	37198	38036	.	.	50	.	.	.
TR	.	.	.	.	.	.	.	.	.	.	.	.
E	322724	323888	.	41435	36221	33401	128	112	.	.	.	.
D(O)	.	.	.	19042	21321	23355	.	.	.	.	.	.
NL	53923	54197	.	.	.	.	.	.	.	.	.	.
P	.	.	.	14946	14556	.	.	.	.	.	.	.
B	111052	111608	111527	.	.	.	.	.	.	.	.	.
GR	.	.	.	.	7464	7169	.	.	.	.	.	.
S	.	.	.	5842	5861	5458	.	.	.	.	.	.
A	.	.	.	15747	15056	14490	.	.	.	.	.	.
CH	.	.	.	6553	6634	6545	.	.	.	0.30	0.30	0.30
DK	50403	50491	50484	3060	3153	3108	61	62	62	0.18	0.21	0.21
SF	76560	76839	76937	3737	3291	2624	49	43	34	0.15	0.13	0.11
N	.	.	.	.	.	.	.	.	.	.	.	.
IRL	89247	89247	89247	2805	2975	2852	31	33	32	0.14	0.14	0.13
L	.	.	.	.	.	.	.	.	.	.	.	.
IS	.	.	.	.	.	.	.	.	.	.	.	.
USA	4969213	4933645	.	595700	605885	.	120	123	.	0.55	0.56	.
J	.	.	.	.	.	.	.	.	.	.	.	.
CDN	.	.	.	39636	38396	.	.	.	.	.	.	.
AUS	.	.	.	.	.	.	.	.	.	.	.	.
NZ	.	.	.	3876	3676	3546	.	.	.	.	.	.
H	50087	50202	.	7023	7069	6284	140	141	.	.	.	.

*) Figures for 1993 received from the Department of Transport

Source: IRTAD - SWOV

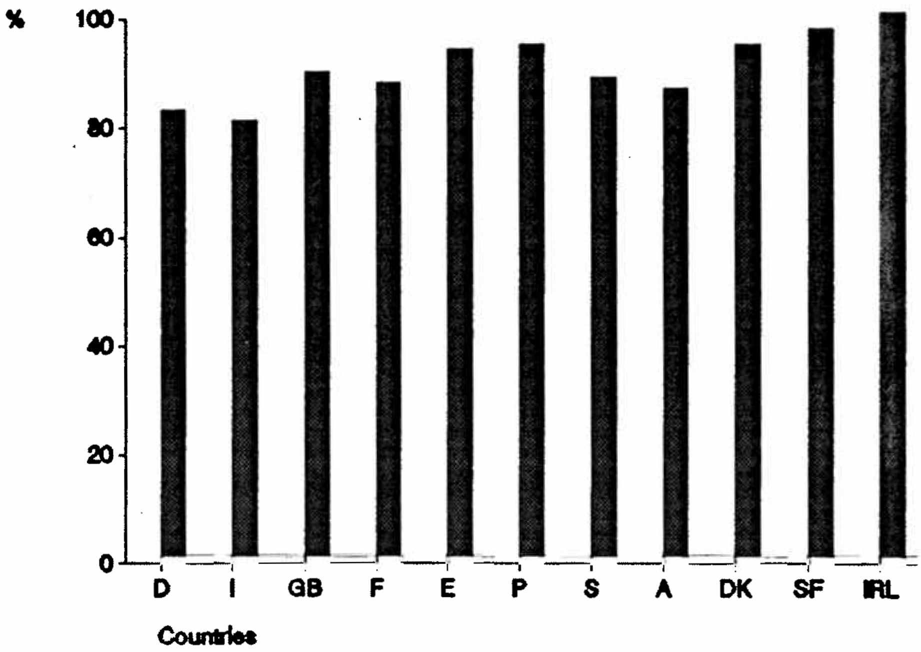
motor ways	road length [km]			number of injury accidents			injury accidents per 1,000 km of road			injury accidents per 10^6 vehicle km		
	year			year			year			year		
	91	92	93	91	92	93	91	92	93	91	92	93
D	10915	10955	11013	27348	26248	26103	2506	2396	2370	.	.	0.15
D(W)	9020	9069	9120	23062	22094	22120	2557	2436	2425	0.16	0.15	0.15
I	6185	6214	6301	9361	9723	8550	1514	1565	1357	0.15	.	.
UK	3211	3188	3174	6466	6736	.	2014	2113	.	0.10	0.11	.
GB *)	3100	3076	3062	6289	6630	6863	2029	2155	2241	0.10	0.11	0.11
F	6850	7110	7400	6259	6478	5727	914	911	774	0.09	0.09	0.08
TR	281	387	862	.	.	.	.	.	.	.	.	.
E	2609	2728	.	3059	2900	2413	1172	1063	.	0.17	0.16	.
D(O)	1895	1886	1893	4286	4154	3983	2262	2203	2104	.	.	0.19
NL	2105	2134	.	.	.	.	.	.	.	.	.	.
P	.	.	.	740	965	.	.	.	.	.	.	.
B	1666	1650	1658	3252	3531	3701	1952	2140	2232	0.15	0.16	0.16
GR	.	.	.	.	.	.	.	.	.	.	.	.
S	1000	1000	1000	703	748	755	703	748	755	.	.	.
A	1463	1532	1554	2319	2489	2351	1585	1625	1513	0.19	0.19	0.18
CH	1148	1152	1164	1823	1756	1711	1588	1524	1470	0.12	0.11	0.11
DK	663	704	748	194	181	199	293	257	266	0.04	0.03	0.03
SF	225	249	318	110	108	77	489	434	242	0.06	0.05	0.03
N	75	.	.	.	.	.	.	.	.	.	.	.
IRL	24	24	24	4	3	2	167	125	83	0.03	0.01	0.01
L	108	120	122	.	.	.	.	.	.	.	.	.
IS	0	0	0	0	0	0	.	.	.	.	.	.
USA	72448	72789	.	160648	163554	.	2217	2247	.	0.20	0.20	.
J	4869	5055	.	6016	5659	6295	1236	1119	.	0.12	0.10	.
CDN	.	.	.	10671	10509	.	.	.	.	.	.	.
AUS	.	.	.	.	.	.	.	.	.	.	.	.
NZ	156	156	158	361	404	340	2314	2590	2152	.	.	.
H	267	269	269	261	277	289	978	1030	1074	.	.	.

inside built-up areas	road length [km]			number of injury accidents			injury accidents per 1,000 km of road			injury accidents per 10^6 vehicle km		
	year			year			year			year		
	91	92	93	91	92	93	91	92	93	91	92	93
D	.	.	.	245617	254844	242974	.	.	.	.	.	.
D(W)	235324	235329	235086	205172	210158	197534	872	893	840	1.51	1.52	1.50
I	.	.	.	124621	124579	111644	.	.	.	.	.	.
UK	155592	158580	160871	178260	176502	.	1146	1113	.	0.96	0.96	.
GB *)	151577	154532	156793	174459	172329	168537	1151	1115	1075	0.95	.	0.90
F	.	.	60000	103983	99686	93737	.	.	1562	.	.	.
TR	.	.	.	.	.	.	.	.	.	.	.	.
E	.	.	.	53634	48172	44111	.	.	.	.	.	.
D(O)	.	.	.	40445	44686	45440	.	.	.	.	.	.
NL	48803	49486	.	28627	28560	27743	587	577	.	1.06	1.16	.
P	.	.	.	33267	35330	.	.	.	.	.	.	.
B	27423	27564	27544	34583	31355	30605	1261	1138	1111	.	.	.
GR	.	.	.	15055	16004	16200	.	.	.	.	.	.
S	.	.	.	9458	8990	8746	.	.	.	.	.	.
A	.	.	.	27947	27185	24950	.	.	.	.	.	.
CH	.	.	.	14445	14882	14596	.	.	.	0.73	0.74	0.72
DK	19976	19845	19879	5503	5631	5206	275	284	262	0.36	0.31	0.28
SF	.	.	.	5527	4483	3446	.	.	.	0.47	0.30	0.23
N	.	.	.	4232	4010	3970	.	.	.	.	.	.
IRL	3010	3010	3010	3685	3699	3522	1224	1229	1170	0.78	0.76	0.71
L	.	.	.	.	.	.	.	.	.	.	.	.
IS	171	170	170	544	671	780	3181	3947	4588	.	.	.
USA	1181218	1236310	.	1470705	1481734	.	1245	1199	.	0.92	0.88	.
J	.	.	.	.	.	.	.	.	.	.	.	.
CDN	.	.	.	108384	108040	.	.	.	.	.	.	.
AUS	.	.	.	.	.	.	.	.	.	.	.	.
NZ	.	.	.	7926	7559	7108	.	.	.	.	.	.
H	55071	55108	.	17305	17277	12953	314	314	.	.	.	.

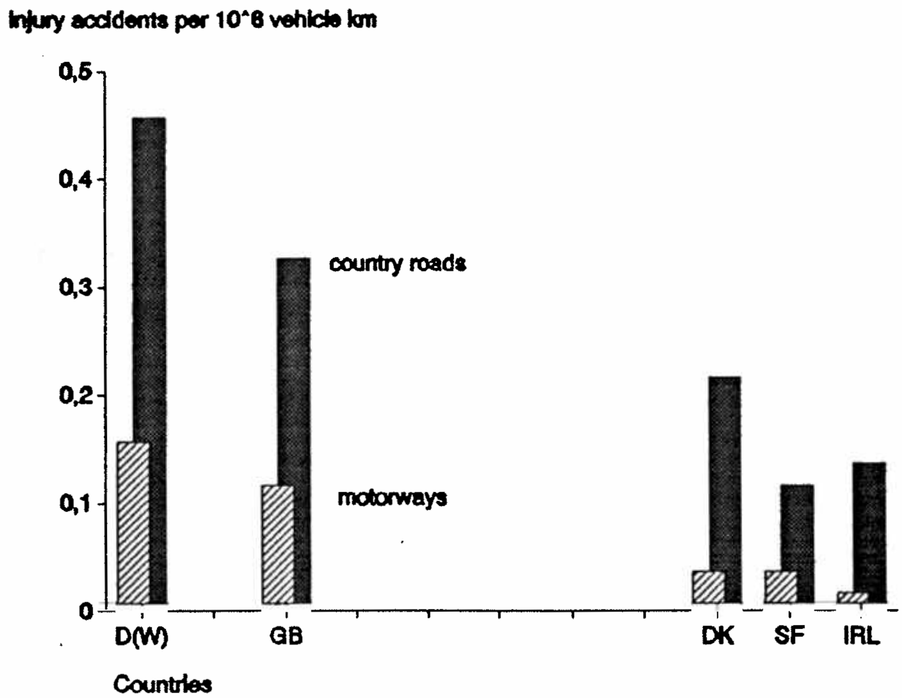
*) Figures for 1993 received from the Department of Transport

Source: IRTAD - SWOV

The next graph shows the number of injury accidents on *country roads* as a percentage of all injury accidents that occurred *outside built-up areas* in 11 of the 15 EU countries in 1993 (except for Portugal: 1992). Use was made of the figures from the previous tables. Data from the other four EU countries are missing.



In the next graph, for a number of countries, a comparison is made between the number of injury accidents per 10^6 vehicle km on country roads and on motorways. In this case, data are missing from 10 of all 15 EU countries.



Annex 3

List of Working Party participants

Following persons have participated in the Working Party #4: 'Infrastructure' of the European Commission - DG VII:

Peter Elsenaar	Research Centre AVV Ministery of Transport The Netherlands	Chairman
Christian Michaud	IRF - Geneva	Secretary
Beno Koens	ANWB - The Netherlands	Reporter
Pim Slop	SWOV Institute for Road Safety Research The Netherlands	Reporter
Jean Casier	A.R.C.I.- Direction D1 Ministère des Communications et de l'Infrastructure	Belgium
Michèle Guillaume	Institut Belge de Sécurité Routière	Belgium
Rudolf Ernst	Bundesanstalt für Straßewesen	Germany
Henrik S. Ludvigsen	Trafikministiriet	Denmark
SchÖller	Trafikministiriet	Denmark
Emiliano Moreno López	General Road Directorate	Spain
Christian Machu	Service d'Etudes Techniques de Routes et Autoroutes	France
Marie Rambeau	Direction Ministère de l'Equipement et des Transports	France
Jim Barton	Scottich Office, Roads Directorate	United Kingdom
Maria Sakki	Ministery of Public Works	Greece
Francesco Mazziotta	Ministero dei Lavori Publici	Italy
Paul Reimer	Ponts et Chaussées	Luxembourg
Luuk Schaap	Road Safety Department Ministry of Transport	The Nether-lands
Ms Ortins de Bettencourt	Dirçao de Viaçao	Portugal
A de Oliveira	Roads Directorate	Portugal
Christian Gerondeau	ERSF	Chairman ERSF

Rüdiger Linde	ADAC - Germany	ERSF expert
Micheal Bernhard	Com. Exé. GT Sign. + Equip. Sécurité IRF - Geneva	ERSF expert
Luc Werring	CEC - DG VII/B 3	Representative EU
Marie-Noëlle Poirier	CEC - DG VII/B 3	Representative EU
Eduardo Morere-Molinero	CEC - DG VII/B 3	Representative EU

Annex 4

Summary of the questionnaire

The next three pages contain a summary of the questionnaire as it was distributed among the EU Member States through the care of the International Road Federation.

European Road Safety Federation (ERSF)

WP 4 - Infrastructure

Questionnaire Part 1

Summary

IDENTIFICATION OF THE ANSWER	
Date:	
NAME of the answering official:	
Function:	
Organization:	
Department:	
Adress 1:	
Adress 2:	
Phone:	
Fax:	
Country:	

Simply enter your identification characteristics, in order to facilitate data classification.

Enter the average standard estimates for one death and one person injured in your country (1,000 ECU's).

REFERENCE PARAMETERS in 1,000 ECU's	
one death on the road costs in average (D)	
one person injured on the road costs in average (I)	

ANNUAL CASUALTIES on interurban roads	
Deaths	
Injured persons	

ACCIDENT COSTS in 1,000 ECU's	0

Enter the number of annual casualties on interurban roads for both categories in your country

Do not fill! This amount will be calculated by the computer.

* Answers are to be sent back to: Mr Christian MICHAUD	
IRF	
63 Rue de Lausanne , CH-1202 Genève (Switzerland)	
Tel: +41 22 731 71 50 - Fax: +41 22 731 71 58	
before:	*May 25, 1994*

European Road Safety Federation (ERSF)

WP 4 - Infrastructure

Questionnaire Part 2.1

Summary

page no .../...

LONG TERM STRATEGY Please make hereunder a short description of long term strategies in road safety being implemented or programmed in your country (Do not hesitate to include budget figures and a synthetical description of the impacts on operative plans)
MAIN RESEARCH THEMES Please list herunder current or programmed research items concerning interurban road safety
STUDIES - SHORT LIST Please make hereunder a short list of national or international studies totally or partially relevant to safety on interurban roads.
PROGRAMS / POLICIES Please list hereunder all measures and their reported effects under each relevant item. (if you have any doubt with regards to terminology, please refer to the minutes)
PREVENTIVE MEASURES - road geometry - road signalisation - others?
CURATIVE MEASURES (programs-policies cont'd) - accident auditing methods - police enforcement methods - safety inspection
ROAD MANAGEMENT (programs-policies cont'd) - authorities and organisations in charge of safety control (design, enforcement, construction, road inspection) => please draw an organigram
OTHER FACTS AND FIGURES - accident and casualties figures, from 1985 to 1993 - engagement in international cooperation for road safety
POSSIBLE RECOMMANDATIONS Please make hereunder possible recommandations to be discussed at our next meeting (15.6.94)

European Road Safety Federation (ERSF)

WP 4 - Infrastructure

Questionnaire Part 2.2

MEASURES	COSTS						BENEFITS								RESULTS			
	per unit (1)		quantity (2)		total value (3)		Gains per unit deaths (5)		injured pers. (6)		in value per unit (7) = (5 x D + 6 x I)		TOTAL (8) = (7 x 2) in value		BALANCE (9) =(8 - 3)		RATIO (10) = (7 / 1)	
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
This table aims at providing a cost-benefit analysis for road safety measures: please list relevant items to this question.																		
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					0	0					0	0	0	0	0	0	#DIV/0!	#DIV/0!
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......					0	0					0	0	0	0	0	0	#DIV/0!	#DIV/0!