The European Road Assessment Programme – completing the pilot phase – 2001 & 2002

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The pilot phase of EuroRAP produced maps of fatal and serious accident rates in four countries and began the development of a standard road inspection score of road safety features. In Great Britain, the Netherlands, Sweden and Catalonia the distribution and rates of fatal and serious accidents on road sections were compared, the effect of high-level design factors on accident rates demonstrated and potential applications of this information examined. Fatal and serious accident rates per billion vehicle-kilometre on motorways for Britain, Sweden and the Netherlands were roughly similar, but rates for Catalan motorways were much higher. Rates for each road type studied were higher in Catalonia, reflecting in part different driving behaviour. Rates for single carriageway roads in Britain were almost 50% higher than in Sweden.

EUORAP’S TWIN PROTOCOLS

In 2001 the AA Foundation for Road Safety Research, on behalf of the European Road Assessment Programme (EuroRAP), commissioned TRL to develop and pilot a process for assessing the relative safety performance of European roads, which could be developed into a regular programme benchmarking the safety of roads being achieved in different countries.

EuroRAP has been designed as a complementary activity to the European New Car Assessment Programme (EuroNCAP) that was developed to crash-test cars and award cars a star rating. EuroRAP has been piloted to rate Europe’s various roads for safety in a similar way.

EuroRAP development work led to the definition of two new standard test protocols:

• measurement and mapping of the rate at which people are killed and seriously injured;

• a standard road inspection for safety features (the Road Protection Score).

The pilot phase of EuroRAP dealt with major roads outside built-up areas, because an early conclusion of the work has been that it is on these roads that most deaths in Europe occur. The pilot programme has also shown that, generally, there is good information available on the busiest and ‘fastest’ of these roads – the motorways – but that these roads are also the safest. There is generally much less information readily available on the non-motorway roads where road-users are more likely to be killed.

The need to benchmark roads across Europe on a regular and routine basis meant that it was important for the pilot programme not only to develop a potentially reliable and robust way of comparing road performance, but also to demonstrate that such comparisons produce results that will be useful to the motoring public, policy makers, highway providers and operators alike.

The pilot programme was planned in three parts:

• general international comparisons of death rates on the road networks of different European countries;

• analysis and mapping of fatal and serious accident rates occurring on major roads outside built-up areas in Great Britain, the Netherlands, Sweden and Catalonia (see Figures 1a, 1b and 2); and

• an inspection of the safety quality of the road infrastructure in different countries to identify the extent to which roads protect road-users from accidents, and from death and serious injury when accidents do occur.

The full technical report (Lynam et al., 2003) from the pilot phase shows the various messages that can be obtained from presenting mapping data in different ways.

The mapping exercise is not simply restricted to portraying risk to the individual (as in Figure 1a). Maps of Britain have also been produced for:

• accident rates based on fatal and serious injuries per kilometre;

• accident rates relative to the average for road sections of...
that type:
• accident rates that show the potential for accident reduction. (This combines the results from the rate per kilometre map with the accident rate per vehicle kilometre relative to the average for road sections of a similar type. It enables an estimate to be made of the potential savings in accidents (Figure 1b), assuming that all road sections could be improved to rates similar to the current average for their groups. A good discussion of some of the issues in this type of approach is offered by McGuigan (1982).)

Different maps can be produced to show different aspects of the safety situation. Figure 1a, for example, differs from that on the EuroRAP website in that it includes accidents on both low and high speed sections of the route, to give a rate including all types of fatal and serious accidents. The website material focussed on the accident rates on the higher speed sections of the routes. (To emphasise the differences between Figures 1a and 1b, a simpler risk banding has been used than in Figure 2; Figure 1a also uses an updated accident search algorithm.)

INTERNATIONAL COMPARISONS

The preliminary international comparisons used data from the International Road Traffic and Accident Database (IRTAD) maintained by the German Federal Highway Research Institute, BASt. The comparisons are restricted to fatality rates because of the significant differences between countries in the reporting of non-fatal accidents. Data are generally for the period 1999-2001.

The results have demonstrated that wide differences exist between countries. Motorway fatality rates ranged from 2.1 deaths per billion vehicle-km in Britain to 14.1 in Portugal. Rates for A-level roads outside urban areas showed a similarly wide range: from 6.2 deaths per billion veh-km in Britain to 22.9 in Austria. A supplementary analysis calculated the average daily flow on these two types of road. Both comparisons showed both road categories to be busier in Britain than in other countries.

For the comparison of accident rates for individual road sections within and between countries, a process was needed by which accident and traffic flow data could be assigned to road sections. The networks being investigated needed to be divided into these road sections such that, as far as possible, the design of the road within the sections was uniform, and the traffic flow over this length was consistent. The key policy target across Europe is the reduction of death and serious injuries on the roads. To give a good chance of obtaining repeatable results, separate sections should ideally have a total of at least 20 accidents resulting in death or serious injury. This means that the network in Britain, for example, was typically divided into road sections of 10-20 kms, providing a data set of 833 sections. To allow for the known difference in definition of serious accidents between countries, and for the different reporting rates, for future work the number of fatal and serious accidents per billion vehicle-kms in Britain is shown for each group in Figure 1a. Potential accident savings in fatal and serious accidents if group average rates achieved is shown in Figure 1b.
serious accidents will be standardised against their ratio to the reported number of fatalities for each country.

**DISTRIBUTION OF FATAL AND SERIOUS INJURY ACCIDENTS**

Reflecting the policy requirements, the analysis in EuroRAP focuses on the analysis of fatal and serious accidents. The majority of deaths in Europe occur on roads outside built-up areas. The majority of deaths on roads outside built-up areas are on single carriageway roads.

In **Britain**

Nine per cent of deaths outside built-up areas are on the motorways, 19 per cent on dual carriageways, 38 per cent on single carriageways of national or regional importance and 34 per cent on other single carriageways.

The fatal and serious accident rate of the ‘A’ road network is about four times that of the national motorway network.

In overall terms, the average fatal and serious accident rate on the British national ‘A’ road network is significantly lower (about 37 per cent lower) than that on the regional (local authority) ‘A’ road network. This is mainly due to the greater occurrence of small urban areas on the latter network.

There is a significant difference between the fatal and serious accident rates for dual, single and mixed dual/single road sections, with the dual carriageway rates averaging less than half that for the single carriageways, and the mixed sections about 70 per cent of the single carriageway rate (Figure 3). The error bars in Figure 3 indicate twice the standard error either side of the mean. The standard errors are based on rates weighted by the proportion of veh-kms using each road section.

Within the dual carriageway group, sections with grade-separated junctions have significantly lower fatal and serious accident rates than those with at-grade junctions, averaging about half the rate for the latter sections.

In **the Netherlands**

The fatal and serious accident rates on non-motorway national roads are about four times those on motorways (Table 1). Within this non-motorway national road group, rates on divided roads and single carriageway roads are about 3 times and 5 times respectively those on motorways. Rates
on single carriageway roads where slower traffic is excluded are 50 per cent lower than other single carriageway roads.

**In Sweden**

Rates on national ‘A’ roads are about three times those on Swedish motorways. Flows on Swedish roads are much lower than flows on equivalent road types in Britain and the Netherlands. Rates on divided roads with grade-separated junctions are only 50 per cent higher than rates on motorways. Rates on single carriageways are about three times those of motorways. Rates on multilane roads are similar to those on wide single carriageways.

**In Catalonia**

Rates on national ‘A’ roads are less than double the rates on motorways. The network examined included a much wider range of regional roads than in the other countries.

The rates in Table 1 have been adjusted, based on a single overall national factor reflecting the relative ratio between number of fatalities and number of fatal and serious accidents in each country. This correction removes the major differences in definition and reporting rates of serious injuries between the countries.

In all four areas (Britain, the Netherlands, Sweden, and Catalonia) the general pattern of rates between different parts of the road system is relatively similar (Table 1); further investigation is needed in the next stage of the programme to assess whether the differences that do exist reflect design differences within the various general road types. After adjusting for reporting differences, the motorway rates for Britain, Sweden and the Netherlands are roughly similar, but rates for Catalan motorways are much higher. Rates for each road type are higher in Catalonia reflecting in part different driving behaviour. Rates for single carriageway roads in Britain are almost 50 per cent higher than rates in Sweden, probably reflecting the greater density of small populated areas along the British routes.

### HIGH RISK ROAD SECTIONS IN BRITAIN

Accident rates on the 833 road sections of the British trunk and primary network are skewed (see Figure 4), with most showing an accident rate better than the average but some having a rate more than three times the average rate. The technical report has analysed the high risk road sections in Britain. It shows that the three significantly different flow groups within the ‘A’ class roads described above should be analysed separately when identifying road sections with relatively high or low accident rates for their group, insofar as the flows indicate different functional demands for these roads.

Fatal and serious accident rates for the short road sections are substantially different from the group averages. These need to be treated with caution as they may vary between time periods. But these short links, sometimes linking main routes, may also carry real higher risks than longer sections within the main part of the network.

Sections of non-motorway roads in Britain with higher than average fatal and serious accident rates are distributed throughout the national and regional networks. About 3000kms of regional road and 900kms of national road have rates at least twice the average rate for ‘A’ class roads, representing about 30 per cent and 10 per cent of the network lengths respectively. Over 100kms of motorway sections have rates about twice the average rate for motorways, representing 4 per cent of the motorway network.

### ADDITIONAL USES OF THE DATA

EuroRAP is concerned with identifying stretches of road with poor safety performance resulting in significant death and serious injury. The data does, however, provide scope, if required, to investigate road sections of much smaller length that show particularly high accident rates. The analyses could also support procedures to set standards for hierarchies and appropriate speed for different road section design. In addition, the potential for fatal and serious accident reduction from improvements in road network design and management can be identified. For example, if those road sections with accident rates above the group average in Britain were brought up to the standard of the group average, an annual total of some 1700 fatal and serious accidents (ie 20 per cent of the total accidents in this network) would be saved. The data sets being assembled are

**Table 1: Fatal and serious accident rates (per billion vehicle km) for Britain, and for the Netherlands, Sweden and Catalonia relative to the British rates.**

<table>
<thead>
<tr>
<th>Country</th>
<th>Head on collisions</th>
<th>Single vehicle run off the road</th>
<th>Junction</th>
<th>Involving pedestrian or pedal cyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>34</td>
<td>30</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Denmark</td>
<td>26</td>
<td>25</td>
<td>27</td>
<td>11</td>
</tr>
<tr>
<td>France</td>
<td>20</td>
<td>40</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>Hungary</td>
<td>31</td>
<td>23</td>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td>Switzerland</td>
<td>16</td>
<td>51</td>
<td>21</td>
<td>6</td>
</tr>
<tr>
<td>Britain</td>
<td>19</td>
<td>26</td>
<td>27</td>
<td>9</td>
</tr>
</tbody>
</table>

**Table 2: Distribution of fatal accidents types on rural roads within different European countries**

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**Figure 4: Distribution of risk for the 833 British road sections**

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Benchmarking the safety of roads

The third stage of the pilot programme involved a direct visual inspection of road quality. This is different from a normal road safety or road-user audit (e.g., Automobile Association, 1999) in that its aim is to assess the general standard of a route, not identify individual sites of concern. A survey such as this may identify individual sites, or short lengths of road, which would benefit from improvement, but these are unlikely to have a substantial effect on overall accident rates along the route unless they occur frequently or the local risk is very high. (See Barker et al. (1999) for discussion of some of the relevant issues.)

An initial protocol has been developed, in collaboration with the Swedish National Road Administration and others with international expertise, for a procedure for ‘drive through’ inspection of routes, and the programme includes trials on roads in seven European countries. This protocol is being refined and developed further during the first main year of the project, and will allow allocation of a ‘Road Protection Score’ to these roads.

The aim of this survey is to produce a score for each route section that enables it to be compared with other sections. The comparison of routes on the basis of this Road Protection Score (RPS) is likely to be different from that produced by comparison of accident rates for several reasons—for example, because the latter will also include the rate of seat-belt wearing which differs between countries.

The RPS focuses on the road design and the standard of road-based safety features. ‘Protection’ in this sense describes protection from accidents (elements of primary safety) and protection from injury when collisions do occur (secondary safety). The RPS should therefore be related as closely as possible to:

1. the design elements known to affect the likelihood of an accident occurring;
2. the safety features known to mitigate injury severity.

The score is based on the extent to which roads protect against severe injury in four main types of impact: ‘head to head’ impacts; impacts at junctions; impacts with objects close to the road; and impacts with vulnerable road-user. These four accident types account for most death and serious injury on interurban roads in Europe see, for example, Table 2 (based on OECD, 1999).

The aim of the assessment is to evaluate the safety that is ‘built in’ to the road through its design, in combination with the way traffic is managed on it.

The fundamental philosophy underpinning this is that the development of a Safe Road System is a shared responsibility between road authorities, vehicle manufacturers, and road-users. An approach can be represented in terms of the biomechanical outcome from any impacts, that is the forces which the impact exerts on the human body, will provide a common basis for rating systems for vehicles and roads and help optimise their combined effect.

The effectiveness of different infrastructure designs, and particularly the protective systems, in providing a safe environment is strongly related to the speeds of traffic on those roads. Both the biomechanical outcomes and the likelihood of an accident occurring will depend heavily on

the speed that drivers adopt. The likelihood of an accident occurring will also depend on the behaviour that the road-users adopt in response to the road design. These aspects, therefore, also need to be encapsulated in the rating system.

This approach recognises that road-user errors cannot be removed completely, and therefore the design needs to provide a forgiving environment for those who are involved in accidents whilst driving within the law.

Full details of this aspect of the programme will be published later in 2003.

REFERENCES

- Automobile Association (1999). What goes wrong in highway design and how to put it right. TMS Consultancy for the AA.
- Lynam D, T Sutch, J Broughton and S D Lawson, European Road Assessment Programme (EuroRAP) pilot phase technical report, AA Foundation for Road Safety Research, Farnborough, May 2003. (available at www.eurorap.org)

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John Dawson of the AA Foundation, and Rod Kimber as Advisor to the Foundation, have made major contributions to the development of the philosophy behind the programme, the procedures being used, and the interpretation of the data, as well as overseeing the management of study.

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