PRIORITY ISSUES IN RAIL SAFETY

SUMMARY

Railways are receiving increasing attention at the European level, because they are a major asset, and they offer the prospect of meeting transport needs with less environmental damage than roads. Their safety record is good, and has been improving.

Europe cannot develop its policies for rail without actively including safety. However, the major current problem is the lack of comprehensive rail safety information at the European level on which to base safety policy. Member States generally take rail safety seriously: they investigate accidents and record data domestically, but there is no effective mechanism by which the results and findings reach the European level: indeed, there is no central knowledge of what Member States actually do. ETSC sees this as the major priority area.

A number of recommendations for actions by the EU have been made in this briefing. For the short to medium term, however, ETSC sees the following as being of key importance:

- to provide clear definitions of railways, railway casualties, and train accidents for use at the European level;
- to compile an inventory of what data are collected in member states on fatalities and fatal train accidents;
- to assemble information on railway fatalities and fatal train accidents at the European level, using common definitions and coverage.

Key changes are now taking place throughout Europe in the organisation of railways. The separation of infrastructure management from rail operation, and the entry of newcomers to the railway scene potentially increase railway risks. However, these risks can be controlled with suitable safety management. ETSC recommends that the EU:

- should facilitate the exchange of best practice in the management of safety in multi-organisational railway systems.
- take steps to ensure that all railway accidents are investigated by independent bodies.

1 Introduction

Until recently, railways and railway safety have not been prominent on the European agenda. They have been regarded primarily as domestic matters for each member state. However, railways have been rising up the European agenda, notably with the publication of the White Paper A strategy for revitalising the Community's Railways by the European Commission in 1996. Safety issues are inextricably involved in railway operation, and if railways rise up the European agenda, so must railway safety.

Because railway operation has been primarily a domestic matter, each country has developed its own procedures for railway safety regulation, and for investigating and recording railway accidents. There has been less international co-operation in rail safety

than in other modes: aviation and maritime transport are more international by their nature, and road safety is recognised to be a common issue in all countries. One consequence is a lack of reliable and comparable international information on rail safety: that in turn makes it difficult to quantify the key railway safety problems at a European level, and difficult for the different states to learn from the successes and failures of each other.

This briefing has been compiled by the members of ETSC's rail safety working party sharing their knowledge of the key rail safety issues in their own countries; we also present data on rail casualties assembled by the Union Internationale des Chemins de Fer (UIC). Our discussions have demonstrated that there is much in common between the rail safety problems in different countries, which are evident in the issues discussed in the briefing. We have also discovered some apparent differences, and there are certainly differences in the safety policies of the different railways. However, we have not been able to explore and learn as much from the differences as we would like. That remains for the future.

Following this introduction, the briefing continues as follows. Section 2 considers the available data on railway casualties and accidents at the European level, presenting the casualty data assembled by the UIC, and noting the large gaps in the data that are available for Europe. Section 3 considers the implications for safety of the trend evident throughout Europe of breaking up the large vertically-integrated public railway operators into a number of smaller more specialist, and sometimes privatised, companies. Section 4 identifies key railway safety issues common to many European countries. Section 5 is the conclusion.

2 Railway safety data

2.1 UIC data

The UIC is the leading international body concerned with main-line railways, whose members were traditionally the main national railway system in each state. The UIC has for many years set the international technical standards allowing cross-border operation of passenger and freight railway vehicles. Traction units and crew are now also increasingly crossing international borders. The UIC also assembles data on railway casualties submitted by its members.

Table 1 presents the UIC data on railway fatalities for the period 1970 to 1996 for the fifteen member states of the EU. Figure 1 shows the trends in the numbers of fatalities, subdivided into passengers, railway staff, and third parties, who are people not actually travelling or working on the railway. Figure 2 shows the trend in passenger fatalities per billion passenger-kilometres.

Table 1: Railway fatalities: fifteen countries of EU: 1970 to 1996

	Fatalities by type of person				Passenger-kilometres	Passenger Fatalities
	Pass-engers	Staff	Third parties	All	(billion)	per billion pass-km
1970	376	346	1,248	1,970	191.428	1.96
1971	387	357	1,365	2,109	193.583	2.00

1972	433	302	936	1,671	184.698	2.34
1973	302	263	1,058	1,623	184.841	1.63
1974	299	175	864	1,338	192.970	1.55
1975	268	152	857	1,277	191.869	1.40
1976	276	184	723	1,183	192.994	1.43
1977	211	168	868	1,247	193.949	1.09
1978	257	167	912	1,336	199.831	1.29
1979	228	149	881	1,258	204.660	1.11
1980	313	142	963	1,418	225.456	1.39
1981	214	129	913	1,256	214.287	1.00
1982	246	120	891	1,257	209.176	1.18
1983	203	105	770	1,078	207.868	0.97
1984	195	70	767	1,032	228.089	0.85
1985	290	110	783	1,183	234.125	1.24
1986	152	73	748	973	232.934	0.65
1987	162	97	691	950	235.175	0.69
1988	268	82	746	1,096	244.595	1.10
1989	195	101	672	968	246.168	0.79
1990	162	79	711	952	251.011	0.65
1991	171	72	774	1,017	255.059	0.67
1992	140	46	748	934	259.262	0.54
1993	114	60	971	1,145	236.599	0.48
1994	100	39	931	1,070	245.256	0.41
1995	98	34	756	888	257.781	0.38
1996	84	48	710	842	264.379	0.32
1970-96	6,144	3,670	23,257	33,071	5,978.043	1.03

Source: Union Internationale des Chemins de Fer (UIC)

Figure 1: Railway fatalities: EU Countries: 1970-1996 (UIC)

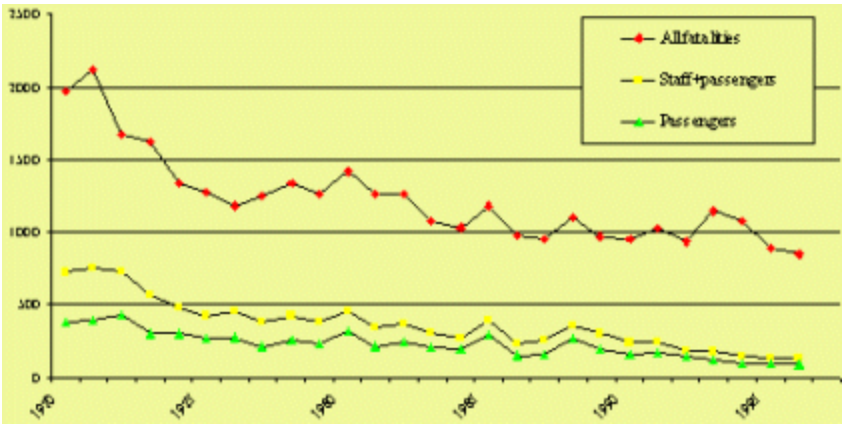
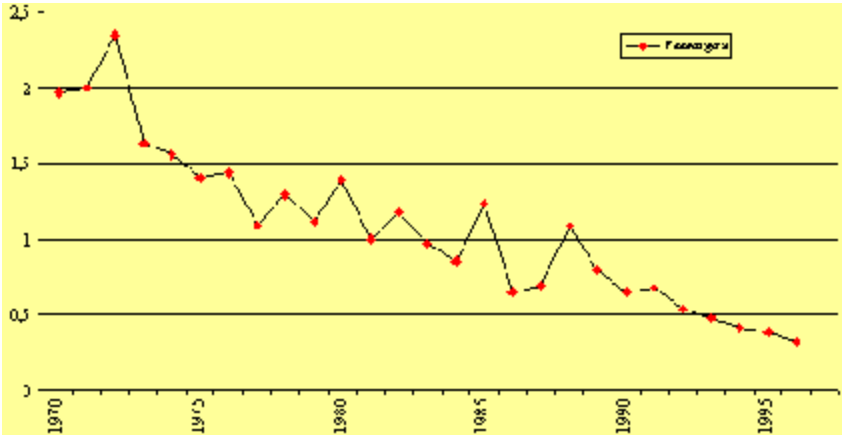


Figure 2: Railway passenger fatalities per billion passenger-km 1970-1996 (UIC)



(a) The majority of railway fatalities are not to passengers or staff, but to third parties: 70 per cent of the fatalities in Table 1 are to third parties; 19 per cent are to passengers; and 11 per cent are to staff. Most of the third-party fatalities are individuals being struck by trains: some are users of level crossings; some are 'trespassers', that is illegally on the railway, and some are suicides, though the railways vary on whether suicides are counted as railway fatalities.
(b) Contrary to popular belief, most railway casualties do not occur in spectacular multiple-fatality train collisions and derailments, but in more ordinary small-scale accidents. Most of the third parties fatalities mentioned above are individual accidents, but even the fatalities among passengers and staff are mostly individual, such as passengers falling from platforms, or staff working on the track being struck by trains.
(c) Figure 1 presents the trends over time in the total fatalities. It can be seen that there have been long-term falls in fatalities to passengers, staff and third parties. However, the proportionate falls have been much greater for passengers and staff than for third parties. The railways have more control over passenger and staff than over third-party accidents.
(d) Figure 2 presents the trend in passenger fatalities per passenger-kilometre: this can be regarded as a measure of passenger risk. On this measure, passenger risk fell even more sharply than passenger fatalities, by about a factor of 5 between 1970 and 1996. This is probably the consequence of a large number of different safety improvements, ranging from better signalling systems and improved crashworthiness of rail vehicles to more humdrum measures such as better platform surfaces.

2.2 Problems in the UIC data

Although the UIC data are useful, and are good enough clearly to indicate the features of railway casualties above, they have many limitations, and will not bear too detailed analysis. The weaknesses stem from the fact that they are non-official and contributed only by UIC's members. The UIC is the international organisation for main-line railways, not for metropolitan and regional railways. Therefore its members are typically the main national railway system of each country, and casualties on other railways are not included in the data. In future, this problem may become worse as the national systems are broken up into separate infrastructure and operating companies. Furthermore, each railway system contributes data according to its own definitions: these may differ markedly from each other, especially with respect to third-party casualties. Finally, there is some non-reporting in the UIC data.

2.3 Improving European railway accident data

Definitions. Definitions are always important for data collection. Two are crucial for rail data at the European level: (a) What is to be counted as a railway? (b) What is to be counted as a railway casualty? On (a), it is clear that all 'heavy' railways, including metros if possible, should be included in the definition, but it is less clear whether light railways and tramways should be. ETSC has no particular view on this, other than that a definition is needed. On (b), all passenger, staff, and 'legitimate' third-party casualties should be included, but there is a question as to whether 'trespassers' and suicides should be. ETSC feels that all accidental casualties, including trespassers, should be included, but not suicides, though it is realised that it is sometimes difficult to distinguish suicides from accidents.

The purpose of having clear definitions is not to try and impose them on all states, but to provide a standard for European-level data, and a basis for adjusting data collected on differing definitions.

Inventory of current data. Although both UIC and Eurostat collect some data on railway casualties, there appears to be no collective knowledge of what data are collected in the different member states, and on what definitions. For example, in some states rail accident data are assembled for all railways in the state by a single railway safety inspectorate, whereas in others there is no single inspectorate, and therefore no mechanism by which, for example, data for metros are combined with data for the national system. It is therefore important to know what is covered by existing data collection systems, and where the gaps are.

Accidents. The data assembled by UIC and Eurostat are of casualties rather than accidents. However, accidents are also important, especially accidents to trains that can lead to many fatalities. Data on train accidents are collected within member states by railway operators or accident investigating bodies, often in great detail. However, there is no mechanism by which such data are assembled at the European level. It is only with such data that analysis of the frequencies of train accidents can be carried out, and the occasional serious accident, such as the recent tragic derailment at Eschede, can be placed in context. Again, definitions are required of precisely what accidents would be counted, and how they are to be classified.

Fatalities or all casualties? Accidents cause both fatalities and injuries. However, ETSC believes that it is best to concentrate on fatalities and fatal accidents in the first instance, because these raise fewer problems of definition and data reliability.

3 Safety implications of railway reorganisation

There is now a general trend, encouraged by the Commission, towards the separation of the former vertically-integrated national railways into distinct train operators and infrastructure managers. While these changes may assist the economic health of the railways, unless they are handled carefully, they may not be helpful for safety. Safe railway operation requires very close co-operation between train control, train operation and station operation. The main problems are that there could be confusion about the location of safety responsibilities, and that some newcomers to the industry might be inexperienced in railway safety.

The general approach when separating railway activities has been to allocate general responsibility for the safe operation of railways to the track authorities, or 'infrastructure controllers' as they are known in the UK. The infrastructure controllers must not only ensure that their own track and signalling systems are safe, but are also often required to check the safety competence of any train operator who wishes to use their systems. The infrastructure controllers are in turn responsible to the government or railway inspectorate for carrying out these functions.

Railway fragmentation requires more formal safety processes than in the past. The most important formal process is the production by every railway operator of a general document reviewing all their responsibilities for safety. Such documents are labelled 'safety cases'. The aims of such documents are:

(a) to give confidence that the operator has the ability, commitment and resources to assess and effectively control risks; and
(b) to provide a document against which it is possible to check that the accepted risk control measures and safety systems have been properly put into place and operate in the way in which they are intended.
Safety cases or comparable documents should include:
(a) the operator's safety policy;
(b) an assessment of the risks generated by the activity; and
(c) a description of the safety management system;
(d) a basis for safety auditing.

There are also many other ways in which rail fragmentation requires more formality in safety management. For example, with a single national operator driver training and certification of competence could be carried out internally. That is no longer possible, because staff may move from one company to another, and they now require formal documents which prove their competence both to their new employer, and to the infrastructure controller.

Privatisation of railways also sometimes creates a fear that operators will take greater risks than public operators in order to enhance their profits, and 'put commercial considerations ahead of safety'. Given the limited extent of rail privatisation so far in Europe, there is little evidence one way or the other whether this fear is justified. Moreover, the argument can also go the other way, because a good safety reputation is a commercial asset.

Some countries now have independent railway accident investigation bodies, whereas others do not. Not all the new railway operators will be in a position to carry out high-quality accident investigation, so independent bodies will be more needed in future. ETSC recommends that the EU takes steps to ensure that all railway accidents are investigated by independent bodies.

4 Other priority issues in rail safety

This section describes other priority areas in rail safety, as identified by the ETSC. They are not placed in order of priority. There is a high degree of agreement between ETSC's representatives from different member states that these are all important, though the relative importance of each differs somewhat between them.

4.1 Train protection

As noted above, train collisions and derailments account for only a minority of casualties. However, they do account for almost all the multiple-fatality and high-profile accidents, and all countries have a sombre roll-call of places where serious railway accidents have occurred.

Train accidents have a wide variety of causes, including vehicle or track defects, defects in the signalling systems, and errors by operating staff. Accidents due to errors by signalling staff in normal operation have now become rare, because modern signalling systems have automatic protection against such errors. However, accidents due to errors by drivers, such as passing signals at danger are more common, because it has been more difficult to develop automatic protection against these. Such errors are never deliberate, and they are very infrequent for each individual driver, but for systems as a whole they are a persistent problem.

With the development of modern processors, it has become possible to protect against drivers' errors; the generic label for systems to do this is Automatic Train Protection (ATP). ATP systems continually calculate the maximum safe speed of a train in the light of current track and signal conditions, compare the actual speed with the maximum, and apply the brakes automatically if the train is going too fast. However, the main problem about current ATP systems is that, if they are installed as an overlay on the existing trains and signalling systems, they have high costs in relation to the relatively small number of casualties they save. Therefore different countries have different policies towards ATP. Many countries have installed it (Sweden, the Netherlands); some are in the process of installing it (Italy), and some have decided against it, except in special circumstances (Britain). It is less costly to install ATP on new trains and lines than on existing ones: most of Europe's new-built high speed lines have it, as does the Channel Tunnel.

In the longer term, new train control systems can have ATP built-in at no extra cost. ETSC recommends this. It is desirable to make new systems interoperable. It is desirable that new systems are independently assessed.

4.2 Driver alertness

Driver alertness is closely related to the continuing problem of errors by drivers. The pressure for greater efficiency in the use of staff is tending to lead to fewer and longer work duty periods, and to the use of single-operator shifts. There is little evidence so far on the impact on risk; medical and psychological research suggests that some shift patterns are better than others. The results of such research should be applied when designing new working patterns. Ergonomic principles should be applied to the design of drivers' cabs.

Medical and psychological assessments are also seen as important in the selection of drivers, in monitoring performance, and after incidents and accidents.

4.3 Drugs and alcohol

Alcohol abuse is recognised to be a problem in parts of the industry. When possible, it is desirable that drivers sign on for duty in the presence of a supervisor trained to detect signs of alcohol consumption. However, this is not always possible, especially where drivers sign on in remote locations. If necessary, breath tests may then be used to measure blood alcohol

levels. Supervisors should also be trained in the detection of drug use, and employees should be provided with a list of all types of prescribed drugs that may impair performance.

4.4 Training

Training of safety-critical staff is becoming increasingly important. Because of the long-term trend towards single-driver and single-operator trains, there is less opportunity for knowledge transfer on the job. Multi-media train centres and driving simulators are recommended. Staff should be advised of new safety recommendations and the results of accident investigations.

Increasing privatisation makes it necessary to have a system of recognised transferable competencies, backed by law. Increasing cross-border operation means that train crew need an increasing knowledge of more than their own national systems. There is a need for harmonisation in operating systems, but this can be achieved only in the long term.

4.5 Communication

The history of railways contains many accidents and fatalities that were caused by errors in communication. Communication errors take many forms, including the misunderstanding of oral messages and misinterpretation of written instructions, especially during abnormal or emergency working. These in turn have many causes, such as regional variations in the use of language, poor voice quality in radio messages, and lack of clear standards in the formulation of messages.

The issue of communication has surfaced again with the increasing use of mobile phones within the industry. In Sweden mobile phones are used extensively, and all communication is recorded. In Italy mobile phones are used, but only when a train is stationary. In Germany, the UK and Ireland, mobile phones are not used for operational communications, but all these countries have secure radio systems, in which safety messages are received only by the person to whom they are sent.

A further issue to be considered is the language to be used for international trains. Train drivers of different nationalities will in future have to communicate with different national control centres. A VTT (Finnish) study concluded that better technical quality of radio equipment and improved clarity of the contents of communications were important accident prevention measures.

4.6 Train boarding and alighting

The severity of this problem varies from country to country within the EU. In the UK, these accidents account for the majority of passenger fatalities. There are still many vehicles in use in Europe with passenger operated doors, which can be opened while the train is moving. This can lead both to falls from trains, and to unwise attempts by passengers to attempt to board or alight from moving trains. The trend now is towards trains with automatic doors, which can be opened in normal service only when released by the train crew, and only when the train is stationary. This trend is to be encouraged. In Finland, all older trains are being fitted with central door locking by 2001, and there is a similar proposal for Britain by 2003. However, it should be noted that automatic doors do not remove all risk, and serious accidents involving automatic doors do sometimes occur.

Different countries have different traditions about platform heights. Some have heights that enable passengers to board trains on the level; others have low platforms from which passengers have to climb into trains. Increasing inter-state travel may require more harmonisation in this area.

4.7 Dangerous goods

Railways are a relatively safe mode of transport for dangerous goods, and are significant carriers of them. Their main disadvantage is that for historical reasons railways tend to pass through the centres of towns and cities, where there are populations nearby, whereas the newer motorways tend to go round the outside of towns.

Communication and information management are key aspects of the safe carriage of dangerous goods, especially in relation to the contents of vehicles and containers.

A VTI (Swedish) study found that loading and unloading of dangerous goods is generally more dangerous than the actual movement. Dangerous working conditions often exist, such as dirty or slippery conditions for staff who have to climb on and off tank vehicles. Poor repair of railway tracks in yards can also cause problems. Staff training, especially in dealing with emergencies, and personal protective equipment are important.

4.8 People working on or about the track

Railway operation and maintenance requires several groups of staff to work on or about the track: these include track, overhead line, and signal maintenance staff, and shunters or couplers. This type of railway work has long been recognised as a relatively high-risk occupation, and deaths among such people still regularly occur in almost all countries.

The key to reducing such accidents is careful planning and management of these activities. Wherever possible the requirement for staff to be on the track should be eliminated: examples are the increasing use of automatic couplers, which reduces the need for shunters on the track, and the use of radio communications, which reduces the need both for drivers to use lineside telephones and for staff to maintain them. Track maintenance work should be separated from the running of trains, and increasingly sophisticated planning allows this with minimum disruption to services. Where staff do have to be on the track when the railway is operating, good safety systems are needed: proper lookouts, warning procedures, and personal protective equipment.

Railway maintenance is increasingly being carried out by contractors, rather than by railway staff. This places additional responsibilities on the client for ensuring the contractors are familiar with all the railway safety requirements.

4.9 Level Crossings

Almost all railway systems have large numbers of level crossings, especially those in flat terrain. The vast majority of casualties at level crossings are to road users: motor vehicle occupants, cyclists and pedestrians. Many such accidents are due to unwise actions by road users; it is not clear whether road users' take more risks at level crossings than at other road intersections, or whether level crossings stand out as hazardous simply in comparison to other railway risks.

Most countries have statutory or non-statutory rules for the application and operation of level crossings. Such rules cover the type of crossing that is to be used for specified road and rail traffic levels, the maximum permitted train speeds for the different types of crossing, the protective equipment required, video surveillance, road layouts and gradients, and the warning sequences for road users. However, each country's rules have developed separately, and are different from each other. It is possible that a number of lessons could be learned by the interchange of information. The long-term trend has been away from railway-controlled crossing towards automatic operation: these put the responsibility for safety primarily on the road user. They are not safer than railway-controlled crossings, but they reduce delays and costs.

The best solution to level crossings is to replace them with bridges or underpasses. Several countries, including Sweden, Italy and the Netherlands have rolling long-term programmes for this. The priorities for these programmes are railway lines with relatively high speeds, lines where increases in speeds are planned, lines in urban areas, lines on which dangerous goods are carried, and locations with poor visibility. New high-speed lines are always built without level crossings. However, level crossings are so numerous, with many on lightly-used roads and railways, that there is no prospect of eliminating them entirely.

5 Conclusions

Railways are receiving increasing attention at the European level, because they are a major asset, and they offer the prospect of meeting transport needs with less environmental damage than roads. Their safety record is good, and has been improving.

Europe cannot develop its policies for rail without actively including safety. However, the major current problem is the lack of comprehensive rail safety information at the European level on which to base safety policy. Member states generally take rail safety seriously: they investigate accidents and record data domestically, but there is no effective mechanism by which the results and findings reach the European level: indeed, there is no central knowledge of what member states actually do. ETSC sees this as the major priority area.

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Key changes are now taking place throughout Europe in the organisation of railways. The separation of infrastructure management from rail operation, and the entry of newcomers to the railway scene potentially increase railway risks. However, these risks can be controlled with suitable safety management. ETSC recommends that the EU:

- should facilitate the exchange of best practice in the management of safety in multi-organisational railway systems.
- take steps to ensure that all railway accidents are investigated by independent bodies.

Section 4 above identifies a number of other priority rail safety issues that are common to many member states. There is scope for countries to learn from each other, and ETSC recommends this.

6 Acknowledgement

ETSC gratefully acknowledges the contributions of members of ETSC's Rail Safety Working Party to this briefing:

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