Annual Safety Performance Report 2009/10

A reference guide to safety trends on GB railways

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Annual Safety Performance Report 2009/10

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Executive summary

Introduction

This report reviews the rail industry's safety performance over the financial year 2009/10. Recent reports have been on a calendar year basis, but RSSB has returned to financial years for consistency with Control Period 4, its associated High Level Output Specification (HLOS), and the Railway Strategic Safety Plan (SSP), all of which cover the period April 2009 to March 2014.

Headlines

- There were no passenger or workforce fatalities in train accidents in 2009/10. This is the fourth year in the last five with no such fatalities.
- There were 42 potentially higher-risk train accidents (PHRTAs); this is six lower than for 2008/09, and the lowest number recorded. At the end of 2009/10, train accident risk as measured by the Precursor Indicator Model (PIM) stood at 39% of its March 2002 baseline level, compared with 46% at the end of 2008/09. At 277, the number of category A signals passed at danger (SPADs) was a reduction of 15 on the number recorded for 2008/09, and represents the lowest financial year total since SPAD records began.
- There were 70 accidental fatalities, 395 major injuries, 10,753 minor injuries and 1,343 cases of shock/trauma. The total level of harm was 129.7 FWI, compared with 129.7 FWI recorded for 2008/09.
- Five passengers died in separate incidents, all at stations. This is equal to the figure for 2008/09; five is the lowest passenger fatality total recorded for single years. When non-fatal injuries are also taken into account, the total level of passenger harm was 38.9 fatalities and weighted injuries (FWI). While this is essentially unchanged from the previous year's total of 38.6, the rate of harm normalised by passenger journeys rose by 5% compared with 2008/09; a fall in passenger journeys has occurred during the current economic climate.
- Three members of the workforce were fatally injured in accidents during 2009/10; all were track workers. Including non-fatal injuries, the total level of workforce harm was 24.5 FWI. This is a reduction of 6% compared with the 25.9 FWI recorded for 2008/09. The rate of harm normalised by workforce hours reduced by 4% compared with 2008/09.
- There were 62 fatalities to members of the public, excluding those due to suicide or suspected suicide. Of the total, 49 were trespassers, 12 were level crossing users, and one was a member of the public who fell accidentally onto a rail line. Including non-fatal injuries, the total level of public harm was 66.3 FWI, which is 2% higher than the 65.2 FWI recorded for 2008/09. At 236, the number of suicides was above average.

Summary of injuries by person type

	2009/10						2008/09
	Fatal	Major	RIDDOR-reportable minor	Non-RIDDOR reportable minor	Shock & trauma	FWI	FWI
Passenger	5	238	1162	4104	197	**38.9**	38.6
Workforce	3	118	529	4776	1143	**24.5**	25.9
Public	62	39	52	130	3	**66.3**	65.2
Total	70	395	1743	9010	1343	**129.7**	129.7

Risk from train accidents

The past three years have seen no fatalities to passengers or workforce from train accidents. The last such event occurred in the derailment at Grayrigg, in February 2007, which resulted in the death of a passenger. Over time, there has been a falling trend in the rate of fatal train accidents involving train occupants; the current level, based on a ten-year moving average, remains below one per year.

The types of train accident with the greatest potential to cause harm are termed as 'potentially higher-risk train accidents', or PHRTAs. These account for around 6% of the total number of events that are classed under RIDDOR[1] as train accidents, but contribute around 93% of the train accident risk. Over time, the number of PHRTAs has also shown a decreasing trend; in 2009/10 there were 42 events, compared with 48 for 2008/09.

As serious train accidents are rare, RSSB also analyses trends in accident precursors, using the PIM. The PIM measure indicates that train accident risk has reduced significantly over the past decade. The most rapid improvement occurred over the period 2001/02 to the end of 2005/06, and was mostly due to the large reduction in SPAD risk brought about by the implementation of the Train Protection and Warning System (TPWS). The PIM now stands at 39% of its March 2002 baseline level, compared with 46% at the end of 2008/09.

Risk to passengers

Five passengers died in separate incidents, all at stations. Of the five, four occurred at the platform-train interface. Two were falls from the platform – in one event the person was electrocuted and in the other event the person was struck by a train – and two occurred as a result of being too close to the platform edge and coming in contact with a moving train. None of the passengers was boarding or alighting a train at the time of the accident. Based on RSSB's Safety Risk Model version 6 (SRMv6), the platform-train interface is the greatest source of passenger fatality risk. Most of the risk does not occur during boarding or alighting, but is due to the types of incident seen in 2009/10.

The fifth passenger fatality resulted from a fall on an escalator. In each of the past three years, an escalator fall has resulted in a passenger fatality, and in all three cases the person was elderly. Analysis shows that elderly people are over-represented in some types of accident on the railway, such as slips, trips and falls.

The total number of major injuries in 2009/10 was 238, compared with 236 recorded for 2008/09. The greatest cause of major injury is slips, trips and falls; just over 60% of passenger major injuries during the year were due to this cause. Slips, trips and falls also dominate the minor injury and FWI profiles.

The overall level of passenger harm in 2009/10 was 38.9 FWI, which is almost unchanged from the 38.6 FWI recorded for the previous year. However, after a period of consistent growth in passenger usage, the recent economic downturn has seen a 4% fall in passenger journeys. The normalised rate of passenger harm has risen, by 5%.

The overall level of passenger harm is based on data from the Safety Management Information System (SMIS), but passenger assaults are more frequently reported to the British Transport Police (BTP). BTP reports are therefore used to supplement analysis of

[1] The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995.

passenger safety in the area of personal security. The reports show reducing trends in both the absolute number and the normalised rate of assaults since 2005/06. The number of assaults recorded for 2009/10 was just over 3000, more than 10% lower than for the previous year. The current likelihood of being assaulted during the average journey is around one in 400,000.

Risk to the workforce

Three members of the workforce were killed in 2009/10. This is same number as in 2008/09. One fatality occurred to a look-out who was struck by a train. The other two fatalities both involved staff employed on bridge maintenance work, one on the Forth Bridge and one on the Tay Bridge.

Most workforce fatalities occur to track workers. Since 2001/02, there have been 36 workforce fatalities, 26 of whom were track workers. Track workers also dominate the major injury figure; since 2001/02 just under 60% of major injuries have occurred to this group of workers. However, track worker major injuries have generally shown an improving trend over time, and the number for 2009/10 (68) is the lowest recorded. This improvement is reflected in the workforce major injury total, which, at 118, is also the lowest recorded.

Workforce minor injuries also show an improving trend. The level of workforce harm from minor injuries is 5% lower than last year. In contrast to fatal and major injuries, minor injuries are not dominated by track workers: non-driving train crew report the most events.

In contrast to passengers, the main reporting mechanism for workforce assault is SMIS. Workforce assault is an important issue for the industry, and one that has been the focus of improved reporting as well as reduction and mitigation strategies. SMIS data shows that the number of assaults leading to physical injury, shock or trauma has been reducing in recent years. This is reflected in the trend in harm from assault, which has also decreased over the same period. In 2009/10, there were 2.3 FWI attributed to assault. Assault is of particular concern for those workforce groups that are outward facing to passengers and public, such as non-driving train crew, station staff and revenue protection officers.

The overall level of workforce harm in 2009/10 was 24.5 FWI, which is a reduction of 6% compared with the 25.9 FWI recorded for the previous year. There has been a recorded drop of 1.5% in workforce hours for the year, but the normalised rate of workforce harm still shows an improvement, of 4%.

Risk to members of the public

Excluding suicides and suspected suicides, there were 62 fatalities to members of the public in 2009/10, of which 49 were the result of trespass. Nearly 80% of trespasser fatalities are the result of being struck by trains. The majority of the remainder are electrocuted. A small proportion (5%) die as a result of train surfing, deliberately exiting trains in running, or falling onto the railway while engaged in prohibited behaviour such as climbing railway structures.

Most trespasser injuries are to pedestrians, but in 2009/10, two trespassers were in the act of riding quad bikes along the railway track. This caused a collision with a train, in which they were both fatally injured. The train was not carrying passengers at the time of the incident.

After two years with no child trespass fatalities, two such events, both boys, occurred in 2009/10. A third event occurred outside of the scope of the ASPR, to a teenage boy in a freight depot. Since 2001/02, three quarters of child trespass fatalities have been male.

There were 12 level crossing user fatalities. Seven were pedestrians, and five were road vehicle occupants, three of whom died in the same vehicle, at an accident at Halkirk.

The remaining accidental fatality to a member of the public occurred when a man walking alongside railway property fell down an embankment and onto the railway track, where he was subsequently hit by a train.

As well as the accidental public fatalities, there were 236 suicides and suspected suicides; this is above average.

Risk at the road-rail interface

The total level of harm at level crossings was 12.9 FWI, of which 12 were the public fatalities mentioned above.

There were 14 collisions between trains and road vehicles at level crossings during the year. This is fewer than the previous year, but broadly in line with the average of around 16 accidents per year since 2001/02. Most accidents are caused primarily by road user behaviour, which includes both errors and wilful misuse. However, a fatal collision at Moreton-on-Lugg in January 2010 occurred when the barriers were raised to road traffic; the incident is under investigation to ascertain the exact cause.

Away from level crossings, the other sources of road-rail interface risk are vehicle incursions and bridge strikes. At 51, the number of vehicle incursions onto the railway was fewer than last year, and continues a decreasing trend. Five of the events resulted in collisions with trains. In one instance this led to the derailment of a freight train, and in one instance this led to the death of the two quad bike riders mentioned above. For those events classed as serious or potentially serious, there was a reduction of three in the number of bridge strikes at rail over road bridges, but an increase of 13 in the number of road over rail bridge strikes.

Industry targets, trajectories and benchmarking

The overarching safety requirement for European railways, as stated in the European Safety Directive, is to maintain safety and, where reasonably practicable, improve it. The trajectories of the SSP are in keeping with this aim and meeting them will additionally ensure that the passenger and workforce safety targets laid out by the DfT in the HLOS are met. With one year of CP4 passed, safety performance satisfies most of the SSP trajectories and both the HLOS targets. In addition, performance satisfies each of the national targets set for the UK by the European Rail Agency, and Britain's railways compare very favourably against the rest of Europe. Rail continues to be one of the safest forms of transport.

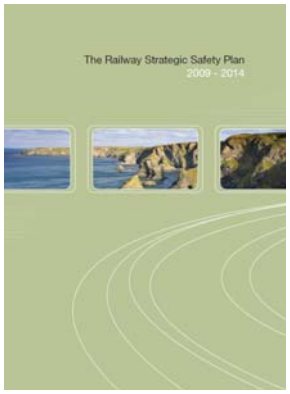
Summary

The overriding safety picture at the end of 2009/10 is one of safety being maintained in the areas where the railway has direct responsibility. Improvements in train accident risk and personal injury risk to passengers and workforce occurred during the first half of the past decade and have been sustained in the second half. A similar pattern has not been observed in the areas where the railway does not have direct control: suicide, trespass and level crossings.

1 Introduction

The rail industry learns from operational experience by investigating specific events and through the regular monitoring of trends. The RSSB Annual Safety Performance Report (ASPR) contributes to this process by providing decision-makers with wide-ranging analyses of safety performance on the mainline railway.

1.1 Purpose of the report



The primary purpose of the ASPR is to provide safety intelligence and risk information to RSSB members. However, it is also intended to inform rail employees, passengers, the government and its agencies, and the public at large.

The report reviews the performance levels achieved during 2009/10 across a number of topic areas and considers how key safety issues are being addressed by the industry. The areas covered include those identified in the Railway Strategic Safety Plan (SSP) for 2009 to 2014[2].

This ASPR presents the railway's safety trends for the financial year 2009/10, covering the period 1 April 2009 to 31 March 2010. Recent ASPRs have been on a calendar year basis, but, following discussion with industry, RSSB has returned to financial years for consistency with Control Period 4, its associated High Level Output Specification (HLOS) and the SSP.

1.2 Scope of the report

The analysis in the report relates to the mainline railway in Great Britain. Its scope is generally limited to incidents that occur in stations, on trains, or elsewhere on Network Rail managed infrastructure (NRMI), such as the track and the trackside. However, workforce fatalities that occur away from these locations, but during working time, are also included.

Most analysis in the ASPR is based on data from the Safety Management Information System (SMIS). However, SMIS data is supplemented where appropriate with data from other sources, such as British Transport Police (BTP), the Office of Rail Regulation (ORR) and Network Rail. Where a chart or table has been derived from a source other than SMIS, that source is stated.

The report includes comprehensive statistical analyses on a wide range of safety performance indicators: many concern the actual safety performance level that has been achieved; others provide a measure of the underlying risk.

1.3 How the report analyses safety

1.3.1 Fatalities, injuries and FWI

The ASPR analyses safety in terms of fatalities, injuries and shock and trauma. Injuries are categorised according to their seriousness. While some charts focus solely on fatalities or major injuries, others look at the total harm. Fatalities, injuries and shock and trauma are combined into a single figure, termed fatalities and weighted injuries (FWI). It should be

[2] The 2009–2014 SSP was developed by bringing together companies' own individual safety plans; a link has thus been created between the SSP and the duty holder planning process.

noted that in some charts, the subgroups may not sum exactly to the totals shown on the chart due to rounding error when showing figures to the same number of decimal places.

Table 1 shows the different injury classifications and their associated weightings. The figures in the ratio column represent the number of injuries of each type that are regarded as 'statistically equivalent' to one fatality.

Table 1. Injury degrees and weightings

Injury degree	Definition	Ratio
Fatality	Death occurs within one year of the accident.	1
Major injury	Injuries to passengers, staff or members of the public as defined in schedule 1 to RIDDOR[3] 1995. This includes losing consciousness, most fractures, major dislocations and loss of sight (temporary or permanent) and other injuries that resulted in hospital attendance for more than 24 hours.	10
RIDDOR-reportable minor injury	A physical injury to a passenger, staff or member of the public that is neither a fatality nor a major injury. Minor injuries to the workforce are RIDDOR-reportable if the injured person is incapacitated for work for more than three consecutive days. Minor injuries to the passengers and public are RIDDOR-reportable if the injured person was taken from the accident site to hospital.	200
Non RIDDOR-reportable minor injury	All other physical injuries.	1000
Class 1 shock/trauma	Caused by witnessing a fatality or being involved in a collision, derailment or train fire.	200
Class 2 shock/trauma	Other causes, such as verbal abuse and near misses	1000

Each injury is categorised by the *hazardous event* that caused it, and the major *precursor* to that event. The ASPR uses the same set of hazardous events and precursors as RSSB's Safety Risk Model (SRM). The SRM is based on a mathematical representation of the hazardous events that could lead directly to an injury or fatality, and provides a comprehensive snapshot of the underlying level of risk on the mainline railway. Charts and risk estimates based on the SRM are used within the ASPR to set the context for a particular area or topic.

There are 120 hazardous events within the SRM, ranging from slips, trips and falls to collisions between trains. To prevent the charts in the ASPR becoming too complex, hazardous events of a similar type are often grouped together.

The precursors allow risk and performance to be analysed in a number of different ways, for example by focussing on the type or cause of event, or the person type to whom it occurs: passenger, workforce or public.

[3] RIDDOR refers to the *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995*: a set of health and safety regulations that mandates the reporting of work-related accidents etc.

1.3.2 Methodology

Analysis of trends in incident data is provided for each topic – usually going back to 2001/02. This time period reflects the availability of consistently classified data. In the future, as more data is recorded, the ASPR will provide analyses based on a rolling ten years of data.

When considering trend analysis, it is important to differentiate between real changes in underlying safety and statistical fluctuations that can occur from one year to the next. For example, annual numbers of passenger fatalities can vary greatly depending on the occurrence (or not) of low-frequency, high-consequence events, such as train accidents. However, a year without a train accident does not necessarily indicate improvement in passenger safety, and a year with such an accident does not necessarily imply deterioration.

To address this, longer-term trends can be assessed using moving averages, for example over five or ten years. Further understanding of changes in the underlying system risk can also be gained by looking at trends in accident precursors or 'near misses'.

Statistical significance testing can also help to explain whether a genuine change has occurred or whether the data could be the result of chance fluctuations. Where statistical testing has been used in this report, the term *significant* refers to a change that is significant at the 95% confidence level; that is, we can be reasonably confident that there has been a real improvement or deterioration.

1.4 Data quality

The value of any safety performance report depends to a large degree on the quality of the data on which it is based. Poor data quality can be due to a number of factors, including under-reporting, late reporting or poor supply of information. RSSB is currently leading a data quality project, backed by the SMIS Programme Board and Association of Train Operating Companies (ATOC) Operations Council. More detail about data quality and the data quality project can be found in Chapter 10.

RSSB uses information from other sources to try to gain as much knowledge of an event as possible, especially if extra categorisation is applied to it (as in the case of fatalities, for example). As well as using the information supplied in SMIS, information from BTP, ORR and coroner's reports may be used. When we look at fatalities, we distinguish between those due to accidents and those due to suicide. A coroner's verdict is taken as the ultimate arbiter of this, but the verdict is often not reached until a year after the death, and even then may be returned as 'open'. In this situation, we make a judgment (using the Ovenstone criteria) as to whether the event is more likely to have been a suicide than an accident (see Appendix 3 for details). If there is no evidence to the contrary, we class fatalities as accidental. This means that the numbers of trespass-related deaths and suicides (including suspected suicide) can change as and when more information becomes available. RSSB seeks out historical coroners' reports with the aim of reviewing past classifications. As a general rule, the number of recorded accidental fatalities will decrease slightly as more information becomes available, while the number of suicides will increase slightly.

Taking all these factors into account, RSSB bases the analyses in the ASPR on the latest and most accurate information available at the time of production. We also continually update and revise previous years' data in the light of any new information. The data cut-off date for the 2009/10 ASPR was 30 April 2010 for SMIS data.

1.5 Report structure

As in previous ASPRs, the *Safety overview* immediately follows this introduction. This sets the overall context by presenting the current industry risk profile, as based on SRM version 6, together with an overview of performance during 2009/10 and consideration of the long-term changes in railway usage and performance.

The *Progress against trajectories and targets* chapter summarises industry progress against the trajectories set out in the 2009-2014 SSP, and against industry targets defined by the HLOS and within Europe.

The *Benchmarking* chapter compares the mainline railways in Britain with other modes of transport, railways in other countries and other industry sectors. The chapter also discusses the steps being taken to enable companies to benchmark their own performance against the rest of the industry.

The risk to passengers, the workforce and members of the public are dealt with separately, in Chapters 5 to 7.

The risk from train accidents is covered in Chapter 8, while the risk from the road-rail interface is covered in Chapter 9: in previous editions this chapter looked only at level crossings, but now includes analyses of railway incursions and bridge strikes.

In another departure from previous editions, separate chapters on personal security and station safety are no longer provided; the analyses that these sections contained have now been subsumed within the relevant parts of the passenger, workforce and public chapters.

The report closes with the *Data quality* chapter, which describes some of the general issues surrounding data collection and analysis, and reports on steps being taken to improve safety data within the rail industry.

Various appendices, including a list of definitions and a glossary, have also been provided to assist the reader. These may be found at the back of the document.

The ASPR is a document of considerable length but, even so, it has obviously not been possible to include all of RSSB's data or analysis. Therefore, if you are unable to find the answers to your safety performance questions here (or in our other publications), please contact us; we will be happy to be of assistance wherever possible. Contact details are provided on the title page.

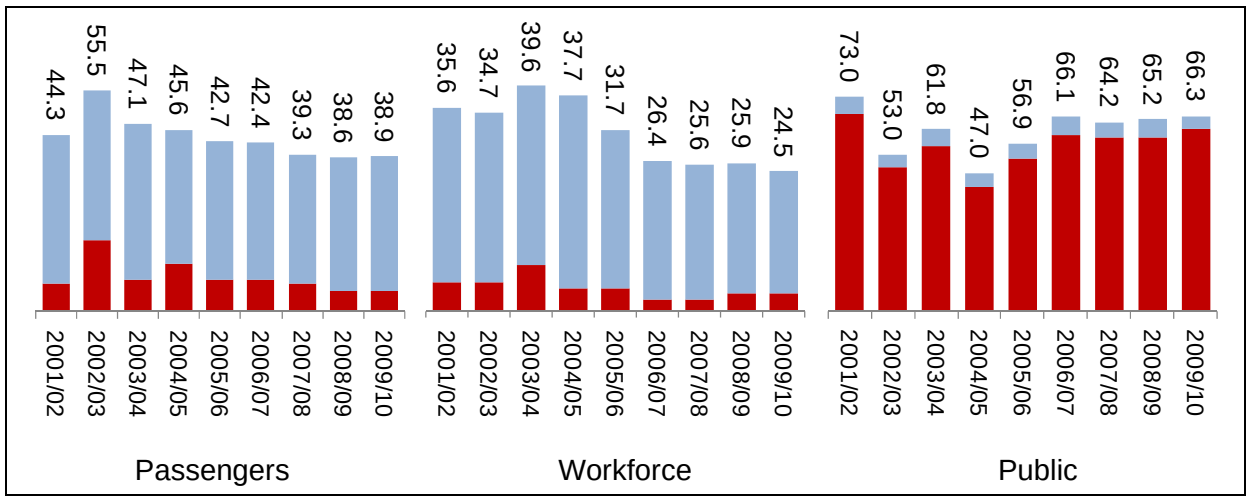
2 Safety overview

The overarching safety requirement for European railways, as stated in the European Safety Directive, is to maintain safety and improve it when reasonably practicable. Over the past decade, industry initiatives have led to improvements in the safety of both passengers and workforce from train accidents and personal accidents. Due to continuing efforts, the industry has maintained these lower levels of risk against a backdrop of generally increasing rail usage. However, over the past year, the economic downturn has led to a fall in both passenger journeys and workforce hours.

2009/10 Headlines

- There were no passenger or workforce fatalities in train accidents. This is the fourth year in the last five with no such fatalities.
- There were 70 accidental fatalities, 395 major injuries, 10,753 minor injuries and 1,343 cases of shock/trauma. The total level of harm was 129.7 FWI, which was the same as the level recorded for 2008/09.
- Of the 70 fatalities, five were passengers, three were members of the workforce and the remaining 62 were members of the public, 49 of whom were engaged in acts of trespass.
- In addition the injuries above, which were accidental in nature, a further 236 people died as a result of suicide or suspected suicide.
- Based on SRMv6, the FWI risk from all sources on the railway is estimated to be 141.3 FWI per year; 39% occurs to passengers, 21% to the workforce, and 40% to members of the public. The fatality risk from all sources on the railway is estimated to be 67.0 fatalities per year; 17% occurs to passengers, 7% occurs to the workforce, and 76% occurs to members of the public.
- Since 1994/95, there had been growth in passenger kilometres and journeys, reflecting changes in society, transport policy and the economic climate. However since 2007/08, passenger travel by rail has slowed, as the economy has entered a period of recession. Over 2009/10, passenger journeys fell by 4%. Passenger kilometres increased by 1%; this implies that fewer, but longer, journeys are being taken.

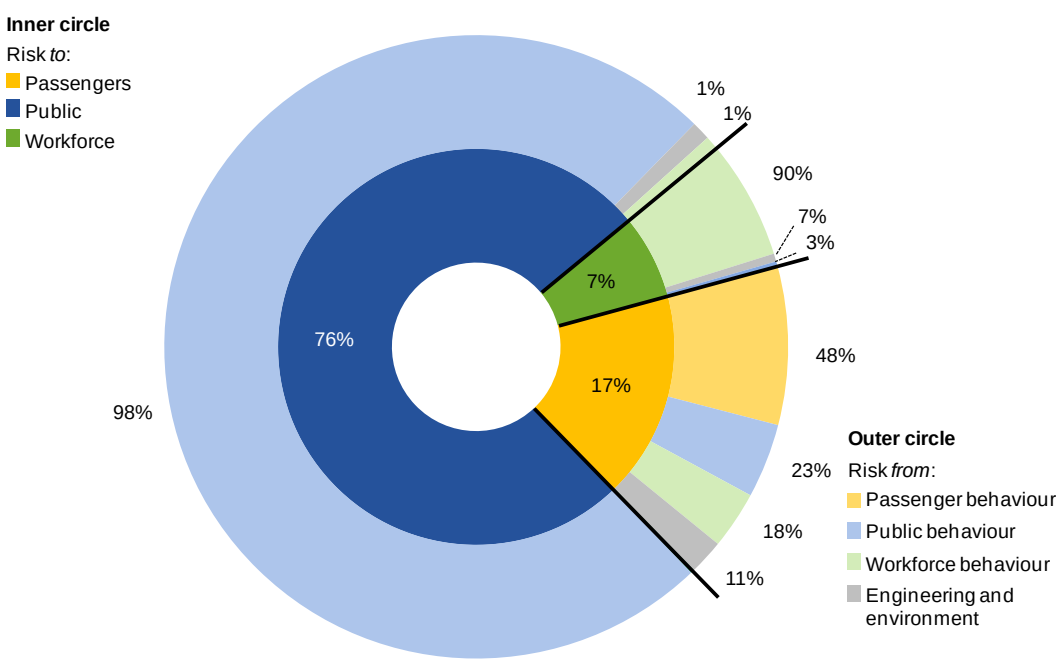
System safety at a glance



2.1 Risk profile – fatalities

This section presents the fatality risk profiles for passengers, the workforce and members of the public arising from the risk area groups identified in the 2009-14 SSP. The inner ring of the chart shows the breakdown of the risk occurring to each of the person types. The outer ring shows the breakdown of how the risk arises. Fatalities due to actual and suspected suicide are not included in the chart, although any shock/trauma suffered by the workforce or passengers in connection with these events is incorporated.

Chart 1. Fatality risk profile from SRMv6, excluding suicide (67.0 FWI/year)



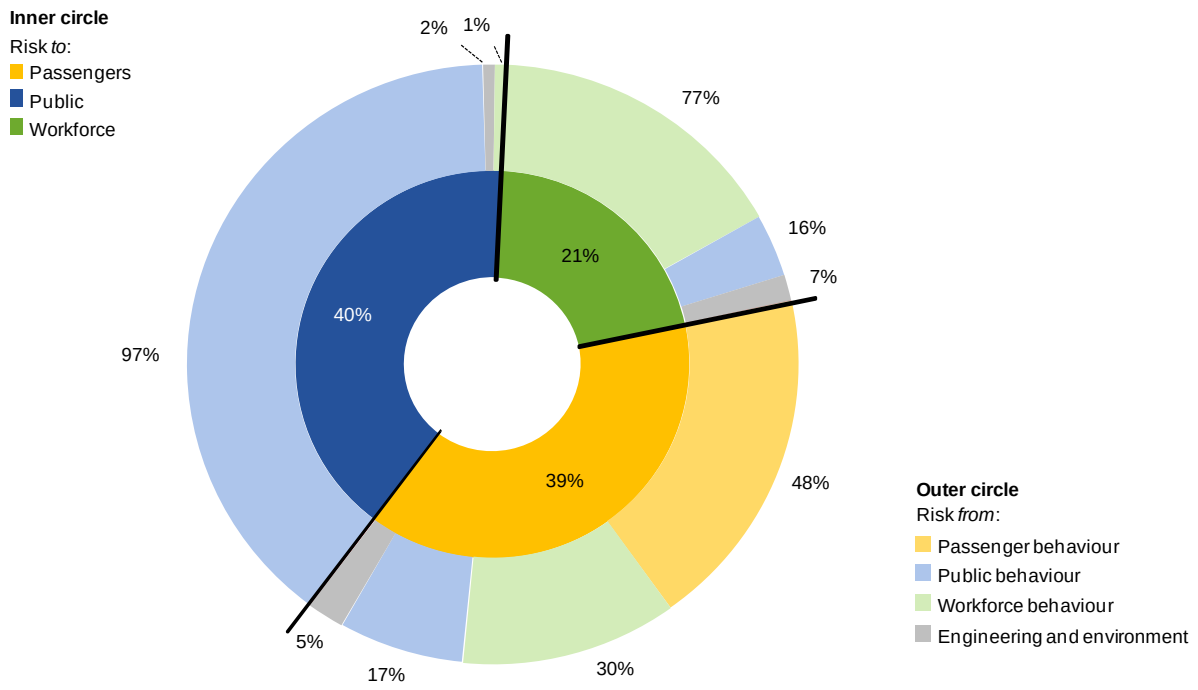
The accidental fatality risk from all sources on the railway is estimated to be 67.0 fatalities per year.

- More than three-quarters of fatality risk occurs to members of the public, almost entirely as a result of their own behaviour.
- 7% of the total fatality risk occurs to the workforce and, again, the majority of this is identified as being within the responsibility of the workforce.
- 17% occurs to passengers, and whereas some of this is caused by passenger behaviour, more than half is from sources outside their control.

2.2 Risk profile – fatalities and weighted injuries

This section presents a different view of the risk profile for passengers, the workforce and members of the public, this time based on fatalities and weighted injuries (FWI). Neither fatalities nor injuries due to suicide and suspected suicide are included in the chart, although any shock/trauma suffered by the workforce or passengers in connection with these events is incorporated. To give a complete picture of risk on the railway, the information includes the estimated risk from assaults.

Chart 2. FWI risk profile from SRMv6, excluding suicide (141.3 FWI/year)



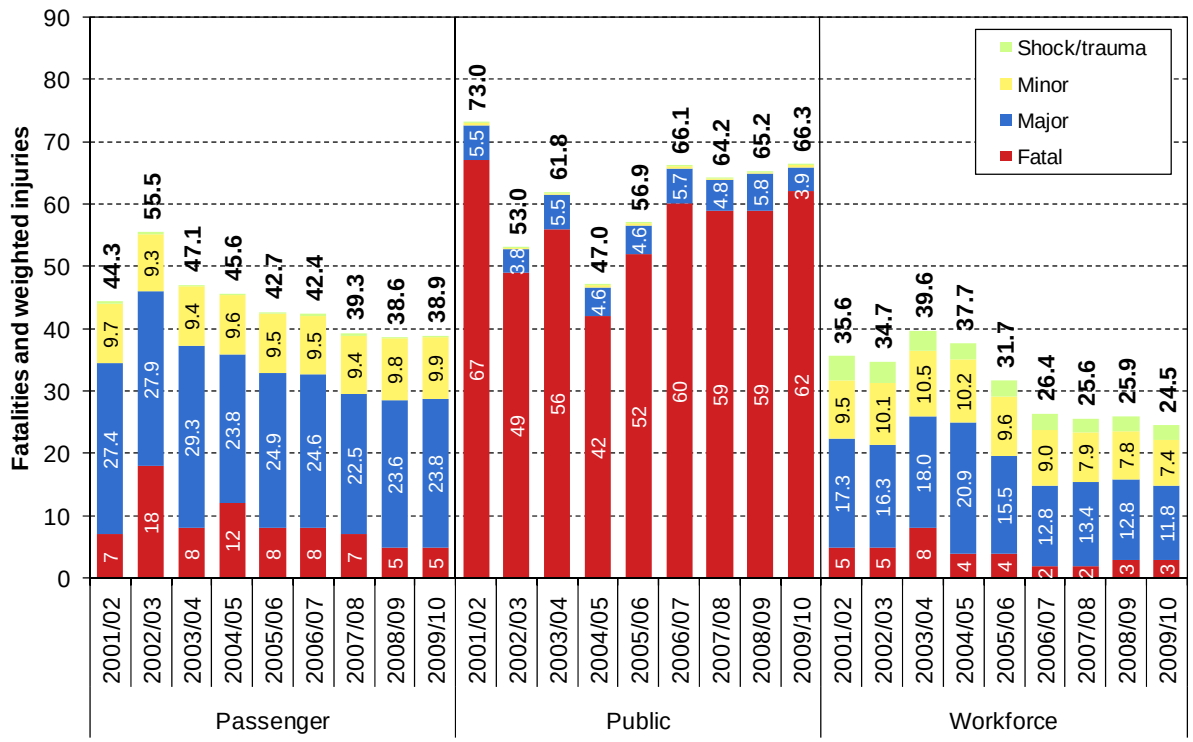
- The accidental FWI risk from all sources on the railway is estimated to be 141.3 FWI per year. FWI risk is split more evenly than fatality risk – 39% occurs to passengers, 21% to the workforce, and 40% to members of the public.
- Nearly half of the risk to passengers arises from passenger behaviour, but a notable proportion falls under the responsibility of the workforce. This is because events like slips, trips and falls are considered to be partly due to workforce station management issues.
- Most of the risk to passengers arising from the public is due to assaults,[4] with a much smaller part arising from road vehicle drivers at level crossings.
- Most of the risk to the workforce arises from the workforce itself. Around 3.5% is due to assaults from the public, with a lesser proportion arising from engineering causes.
- The risk to members of the public is almost entirely the result of their own actions, with only a very small proportion due to other causes.

[4] The 2009–14 SSP assigns all assaults to the *public* risk area, even if the offender was a passenger.

2.3 Fatalities and injuries in 2009/10

Chart 3 shows the accidental fatalities and weighted injuries (excluding those due to suicide or suspected suicide) that occurred during 2009/10 compared with each year since 2001/02.

Chart 3. Accidental fatalities and weighted injuries



- There were no passenger or workforce fatalities in train accidents during 2009/10. The overall harm to members of the workforce is at an historic low, with low levels also being maintained for passengers.
- Seventy people died accidentally on the railway in 2009/10. Five were passengers, three were members of the workforce and the remaining 62 were members of the public, 49 of whom were engaged in acts of trespass. When non-fatal injuries are taken into account, the total harm occurring during the year was 129.7 FWI.
- A further 236 people died as a result of suicide or suspected suicide.
- In any given year, the observed levels of harm may differ from SRM estimated values. One factor in this is statistical variation. Another is that the SRM provides an estimate of underlying risk, and includes the risk from events that may not have occurred during the year, such as train accidents with passenger or workforce injuries. SMIS data does not contain complete information on passenger assault, which is another reason for differences in passenger totals.

Table 2. Fatalities and major injuries due to suicide or suspected suicide

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
Fatality	194	201	191	194	228	222	205	215	236
Major injury	39	33	30	21	32	33	24	29	25

2.4 Notable safety-related occurrences of 2009/10

Here are some of the more high-profile safety-related stories of 2009/10.

April 2009

On-board fire at London Bridge

On 17 April, a fire broke out on board a passenger service to London Bridge. The train stopped at the platform to allow the 600 passengers to be evacuated. One passenger was treated for smoke inhalation.

May 2009

Incident at Fairfield level crossing

On 6 May, a woman walking two dogs sustained fatal injuries when she was struck by a train at Fairfield level crossing. The level crossing equipment was found to be in order. This incident was investigated by RAIB[5].

Fire at London Victoria

On 22 May, a fire broke out in a restaurant at London Victoria station. A number of platforms and the concourse area were evacuated. The fire was brought under control, although some platforms remained closed due to the risk from falling glass. There were no reported injuries.

Derailment at Windsor & Eton Riverside

On 22 May, a passenger train derailed at Windsor & Eton Riverside. Due to ongoing signalling problems in the area, the train was allowed to pass a signal at danger. This resulted in two carriages being derailed on ground-frame points at the buffer stops end of the platform. There were no injuries reported to either passengers or train crew.

June 2009

Flooding at Sheffield

On 10 June, excessive floodwaters were reported at the south end of Sheffield station, following heavy rainfall levels in the immediate area. Subsequent train movements were diverted to serve Sheffield station from the north end. There were multiple track circuit failures on the diversionary route and all train movements were suspended, with contingency train plans implemented.

Car pushed onto platform at Fairbourne

On 27 June, a passenger service struck a car on Fairbourne level crossing, between Tywyn and Barmouth. The impact pushed the car onto the station platform. The train driver was badly shaken, having been involved in a similar incident at the same crossing while working the same service the previous month.

[5] RAIB investigation reports can be found at www.raib.gov.uk.

July 2009

Roll-back incident at Faversham

On 7 July, a low-speed passenger train collision occurred at Faversham, when the rear portion of two units, which had been detached, rolled back and reattached. There were no reported injuries or damage to the units as a result of this incident.

Road vehicle incursion at Deepcar

On 17 July, a vehicle incursion took place at Deepcar. A freight train driver reported striking an empty vehicle which had been left on the line. The train did not derail as a result of the collision, and there were no reported injuries, but substantial damage occurred to the locomotive.

Freight allegedly uncoupled by trespassers

On 28 July, the driver of a freight train reported that the train had come to a stand at Peterborough after a brake application. On investigation, it was found that the rear two wagons had been uncoupled and that the brake pipes had parted as the locomotive moved off. The two portions came to a stand eight feet apart. Trespassing youths were reported to have been spotted adjacent to the train.

August 2009

Teenager fatality in Allerton Depot

On 9 August, a 13-year-old boy was electrocuted at Allerton Depot, Liverpool. He had been standing on top of a wagon when he came into contact with the overhead line equipment (OHLE). His two friends also suffered burns. This fatality is out of scope of the ASPR, which does not cover accidents in yards, depots and sidings except in the case of workforce fatality.

Teenage fatality at Hillington West

On 23 August, a 14-year-old boy walked on an elevated pipe above the OHLE at Hillington West station. It is believed that he was attempting to put graffiti on a bridge. He fell off the pipe, hit the OHLE and was electrocuted before landing on the tracks. An incoming train subsequently ran over the body.

September 2009

Road user killed on Penrhyndeudraeth UWC

On 2 September, a woman was killed after an unscheduled light locomotive struck her car on Penrhyndeudraeth level crossing. The vehicle had been pushed approximately 100 metres along the line.

Child killed at Fox Covert footpath crossing

On 7 September, a two-year-old boy was struck by a passenger train on Fox Covert footpath level crossing. The child had run onto the crossing as the train approached; the driver applied the emergency brake, but could not avoid the impact.

Road vehicle incursion near Salisbury

On 22 September, the driver of a passenger train reported striking a car that had been driven off the A338 road-over-rail bridge at Broken Cross (South East). The driver was still in the vehicle when he saw the train approaching. He managed to escape before the collision.

There were no reported passenger or train crew injuries, although the train driver was shaken.

OHL cable incident at St Pancras

On 24 September, a live overhead cable fell from a catenary on one of the Eurostar platforms at St Pancras International station. Passengers evacuated the platform, and the Fire Brigade was summoned, with Network Rail engineers working to shut down the short-circuiting cable. There were no reported injuries. The incident is being investigated by RAIB.

Multiple fatalities in level crossing collision at Halkirk

On 29 September, a passenger train collided with a car on Halkirk level crossings. All three occupants of the road vehicle were fatally injured. The incident is being investigated by RAIB.

October 2009

Rear-end collision at Darlington

On 3 October, a Bishop Auckland service collided with the rear of an Edinburgh Waverley service at Darlington station. The incident happened after the train passed a signal at red. One passenger sustained a major injury to his shoulder.

Two coupling incidents

On 1 October, a freight train became divided south of Copenhagen Tunnel. The two portions came to a stand 50 yards apart. On examination, the coupling on one of the vehicles was found to be broken. A similar incident occurred at Law Junction, in Scotland, on 14 October, with the two portions of the train coming to a stand 200 yards apart.

November 2009

Teenager killed after falling from platform at Angmering

On 21 November, a female passenger was fatally injured after alighting from a train at Angmering. The passenger was running alongside the moving train as it departed from the station and lost her footing, falling between the train and platform.

Landslip at Gillingham Tunnel

On 28 November, a passenger train derailed after striking a landslip on the approach to Gillingham Tunnel. The leading vehicle of the train came to a halt 250 yards inside the tunnel with all wheels derailed, leaning at an angle supported by the tunnel wall. There were no reported injuries. The incident is being investigated by RAIB.

December 2009

Lookout struck by train

On 2 December, a track worker was struck by an ECS formation at Whitehall junction in Wortley. The member of staff had been acting as a lookout at the time of the incident. This incident is being investigated by RAIB.

Quad bike incident near Newport

On 9 December, a quad bike being ridden along the track near Rumney River Bridge, between Cardiff Central and Newport, was struck by an ECS formation. The driver and rider of the quad bike were both fatally injured, and both the train and track sustained damage.

Collision at Tunstead Market Street AHB

On 10 December, a passenger train struck a car at Tunstead Market Street level crossing. There was no derailment and no injuries on board the train. The car came to rest in a nearby field, with the driver suffering severe leg injuries. The crossing equipment had been working correctly at the time of the incident.

SPAD in freezing conditions

On 22 December, a freight train passed signal at danger at Carstairs. The signaller set the points to avoid a potential collision with a train at the station ahead. It is believed the brakes had failed due to compacted snow and ice between the wheels and brakes. This incident is being investigated by RAIB.

January 2010

Passenger fatalities in the South East

On 3 January, a passenger fell from the platform at Carshalton Beeches station and was struck by a passing train.

On 30 January, a passenger fell from the platform at Streatham station and was electrocuted.

Low speed train collision

On 4 January, two passenger trains were involved in a low-speed collision at Exeter St Davids station. There were two major and four minor passenger injuries. Two members of the workforce also sustained minor injuries. The driver of one of the trains cited reduced braking capabilities as the cause of the incident. This incident is being investigated by RAIB.

SPAD and derailment at Carrbridge

On 4 January, a freight train passed a signal at danger and derailed at Carrbridge. The train derailed on the runoff loop with the loco and two wagons rolling down the bank. The two members of staff on board suffered minor injuries. There was considerable damage to the infrastructure, including the track and signalling. Wintry weather conditions at the time were a contributory factor. This incident is being investigated by RAIB.

Van hits train at Hoy AOCL

On 9 January, a transit van struck the side of a passenger train at Hoy level crossing. The crossing was working correctly at the time on the incident. The road vehicle occupant suffered minor injuries and two workforce members suffered shock.

Two cars struck by train on manned level crossing

On 16 January, a passenger train struck two cars on Moreton-on-Lugg level crossing. On the approach to the crossing, the railway signal reverted to danger and the road barriers rose. The train driver was unable to stop and entered the crossing, striking the two vehicles. One road vehicle occupant was fatally injured; the other sustained major injuries. This incident is being investigated by RAIB.

Two staff fatalities while working on rail bridges

On 27 and 28 January, two employees of contractors working for Network Rail were fatally injured, in two separate incidents, while working on bridges, both in Scotland. One occurred

on the Forth Bridge, and involved a fall from height. The other occurred on the Tay Bridge, and involved a worker being overcome by fumes.

February 2010

Member of the public killed near Gresford

On 19 February, a member of the public walking alongside the railway near Gresford fell down an embankment bank onto the rail line. He was struck by a train and suffered serious leg injuries. He was taken to hospital, but later died.

High-speed derailment at East Langton

On 20 February, a passenger train derailed at high speed near East Langton. The train remained upright after the event. One passenger suffered a minor injury. Early reports indicate that the incident occurred following a drive shaft failure, which locked the brakes causing the bogie to fail. There was extensive track damage, which required repairs over several days. Some 1,000 litres of diesel fuel was also spilled.

March 2010

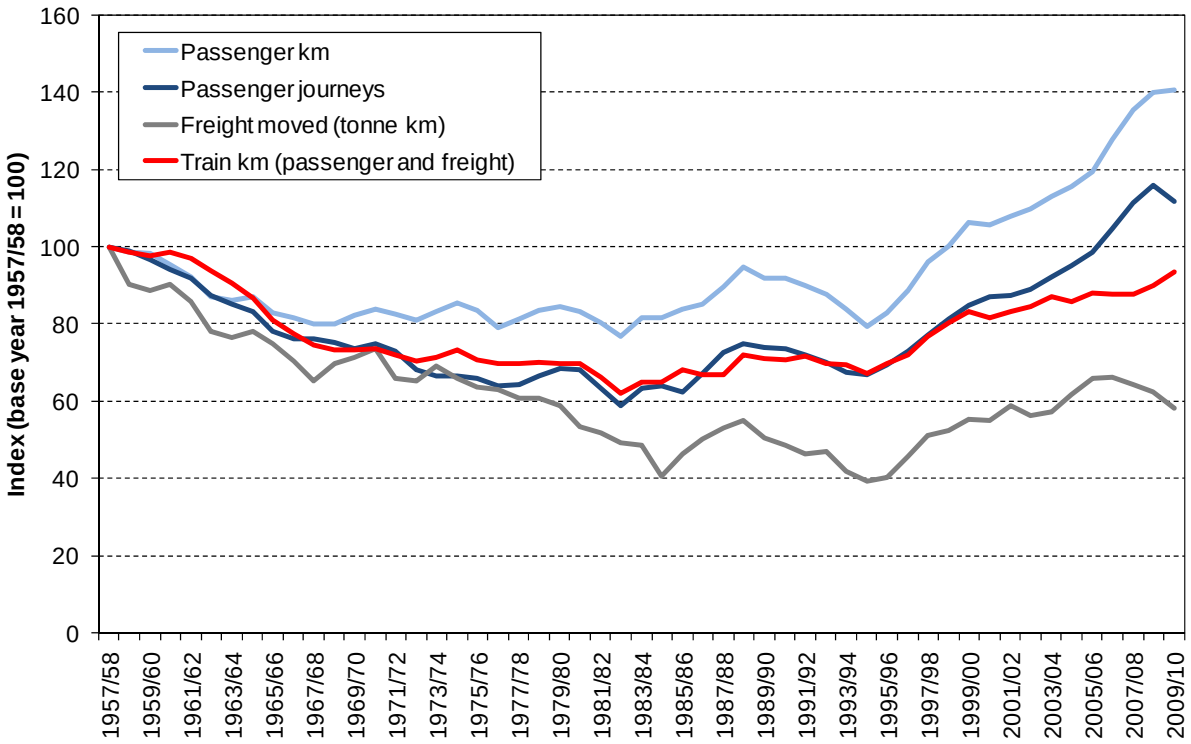
Fatal collision at Waterloo Road AHB

On 6 March, a passenger train struck a road vehicle at Waterloo Road crossing. The level crossing was working correctly at the time of the incident. The road vehicle occupant was fatally injured and is currently recorded as a suspected suicide.

2.5 Long-term historical trends

2.5.1 Rail usage

Chart 4. Trends in rail usage



Levels of rail usage have changed over the last five decades.

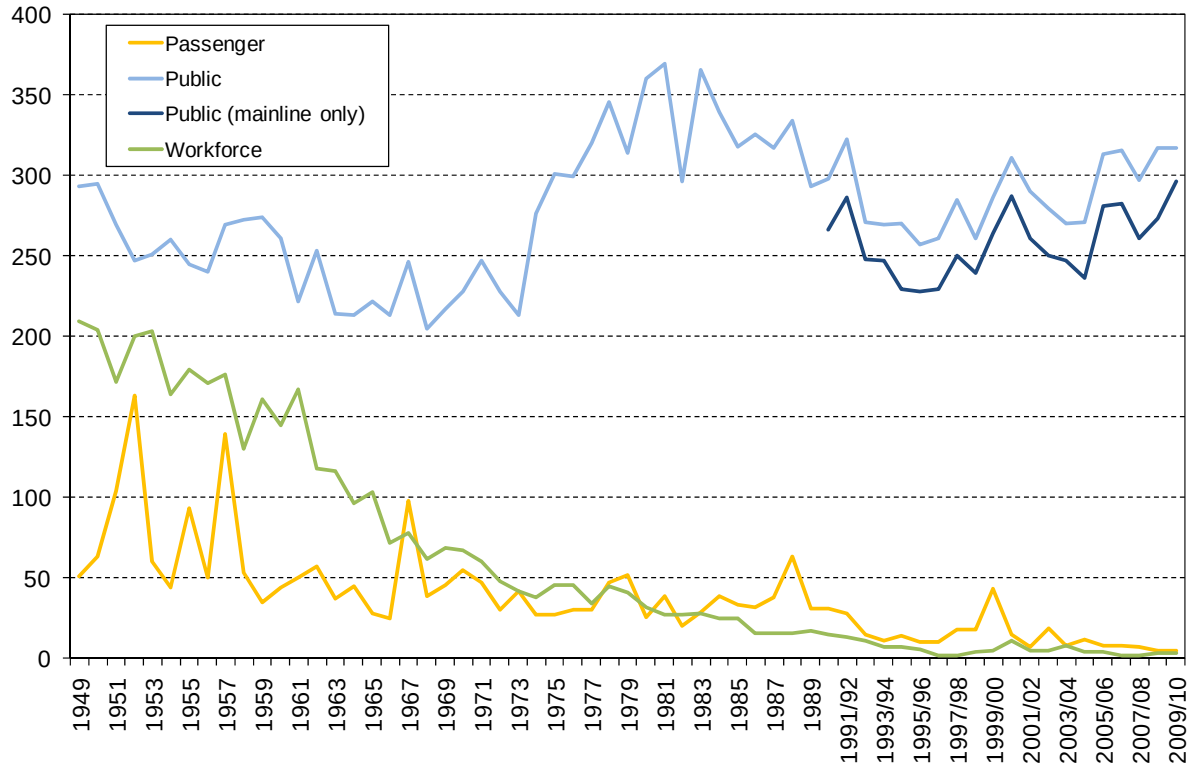
- Between the mid-1950s and early 1980s, passenger kilometres initially fell, and then stagnated, largely as a result of the increasing ownership of road vehicles.
- Since privatisation began in the period around 1994/95, there had been growth in passenger kilometres and journeys, reflecting changes in society, transport policy and the economic climate.
- However since 2007/08, passenger travel by rail has decreased. This is to be expected in a recession as changes in the economy have an impact on rail usage. Over 2009/10, passenger journeys decreased by 4%. Passenger kms increased by 1%; this implies that fewer, but longer, journeys are being made.
- The difference between these declines would suggest that longer journeys have been affected less by the recession than shorter journeys. A possible reason for this is an increase in domestic tourism[6] in that year, accounting for a greater number of long journeys. At the same time, higher unemployment might mean fewer commuting trips, which involve shorter journeys.
- Freight usage shows a similar pattern to passenger usage and, since the 1950s, has been affected by competition from road haulage. It appears the current recession has affected freight usage earlier than passenger usage.

Data source: ORR *National Rail Trends* and DfT *Transport Statistics Great Britain*

[6] Visit Britain *Headline Tourism Trends*

2.5.2 Fatalities

Chart 5. Number of fatalities



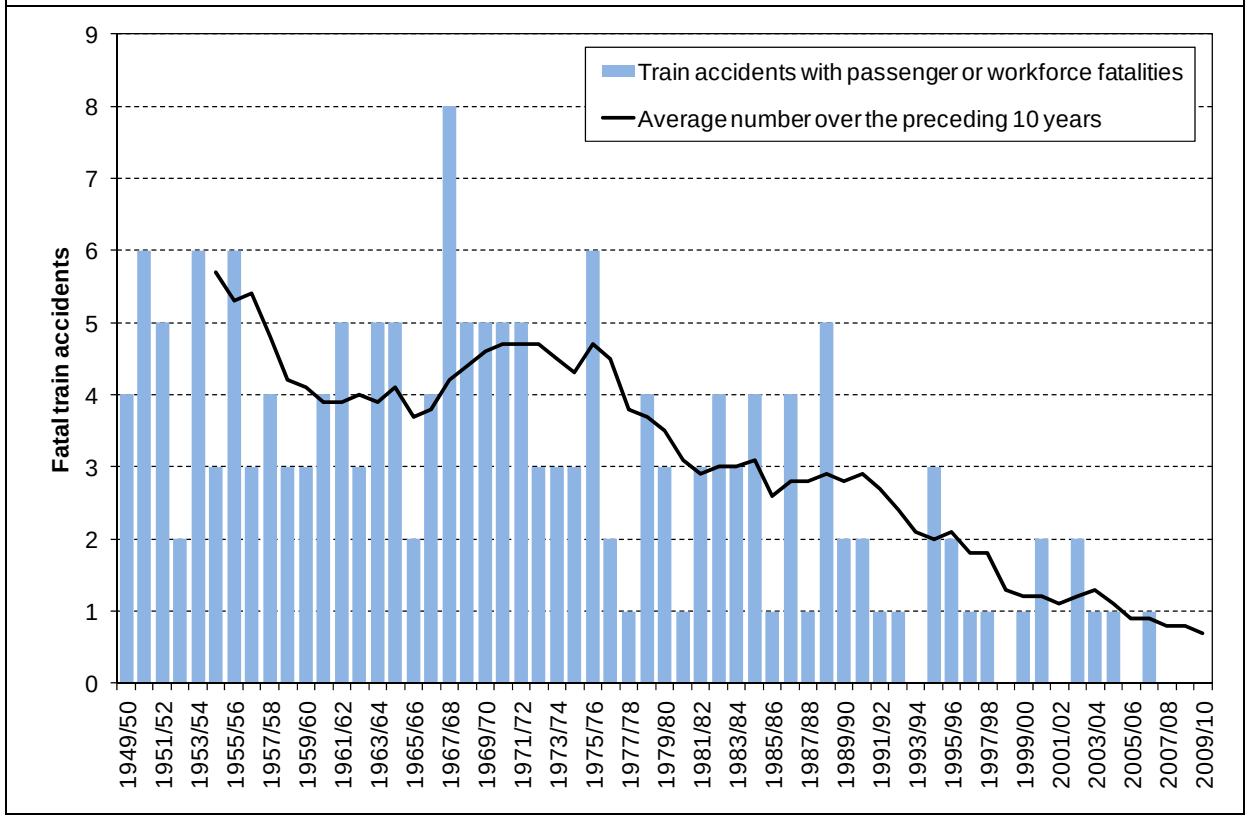
- The trend in passenger fatalities has continued downwards. It is currently at its lowest-ever level.
- The greatest improvement over the past 60 years has been in the number of workforce fatalities, which stood at high levels after the war.
  - The amount of maintenance work being performed during this time, as well as the more rudimentary (and labour-intensive) methods used, contributed to the higher-risk environment.
  - Subsequent technological and operational improvements not only reduced the railway's maintenance requirement, but also helped create better working conditions for staff.
- There has been no sustained reduction in the number of public trespass and suicide fatalities. Causes of trespass and suicide are not directly influenced by technological or methodological advancements in railway operations.
- Prior to 1990/91, the public fatality totals shown in the chart also included fatalities off the main line (eg London Underground and other rail systems).

Data source: Passengers and workforce – ORR data for mainline railway up to 1993/94, RSSB data from 1994/95 onwards. Public – ORR data. Public (mainline only) – ORR up to 1993/94, RSSB data from 1994/95 onwards.

2.5.3 Train accidents

Immediately after World War II, the railway was operating with equipment that had (from necessity) been overworked and under-maintained. As technologies improved, further safety schemes were developed, such as multi-aspect signalling and the Automatic Warning System. The many initiatives devised in more recent years to address SPAD risk, including the Train Protection and Warning System – together with improvements in the crashworthiness of rolling stock – have led to further reductions in train occupant risk.

Chart 6. Train accidents with passenger or workforce fatalities



- In 2009/10 and for the third consecutive year, there were no train accidents resulting in passenger or workforce fatalities.
- Over the last 60 years, the number of train accidents resulting in fatalities to passengers and/or members of the workforce has reduced.
- Based on a ten-year moving average, the current rate of train accidents with passenger or workforce fatalities is less than one per year.

Data source: ORR for historical data; SMIS for recent statistics.

2.6 Looking to the future

The future of safety on the railway will be influenced by a number of factors, both external and internal to the industry, but the underpinning of the Health and Safety at Work Act, and the collective commitment of the rail industry to put safety first, may be expected to consolidate past user experience of progressive improvement.

2.6.1 Future influences on safety

Although the recent economic downturn has affected railway usage, the industry continues to prepare for growth. The Rail Technical Strategy, published in 2007, brings together a long-term vision for the railway in 30 years, to meet the challenges set out in the 2007 White Paper *Delivering a Sustainable Railway*. These were for the railway to:

> *Expand its capacity to meet demand, reduce its environmental impact, and meet increasing customer expectations for reliability, comfort, safety, security and information, whilst at the same time continuing to improve its cost efficiency.*

Some of these changes are likely to affect the risk profile. For example, investment in new or replacement assets can result in improved safety performance. Increasing traffic might cause more wear and tear on the track, leading to a higher maintenance requirement. The consequences of a train accident may be higher if the trains involved are carrying more people.

Demographic change, and particularly the fact that the UK population is ageing, is also likely to have an impact. As the percentage of mature and elderly travellers increases, existing barriers to public transport use (such as mobility, and fears about personal security) are likely to become more prominent issues. The profile of the workforce is also changing. The railway industry may face the challenge of a skills shortage if there are fewer young workers, and a loss of existing expertise as older workers retire.[7]

It is hard to make accurate predictions about the way that societal changes will impact on the railway. Although the industry can take measures to minimise the impact of deliberate actions, the number of assaults, acts of vandalism, suicides and level crossing violations are more closely related to wider social trends.

Technology

The railway continues to explore the use of new technology for improving the operational railway, both in terms of safety and/or performance. For example, developments currently on the horizon include GSM-R (Global System for Mobile communications – Railway), ERTMS (European Rail Traffic Management System) and the use of obstacle detectors at level crossings.

The Technical Strategy Advisory Group, which is facilitated by RSSB, is now looking at the very long term technologies and opportunities for integration, to enable the railway to meet the needs of its users and funders better. More information on the group is given in section 2.6.2.

[7] RSSB R&D project T661, *The implications of an ageing population for the railway.*

Global System for Mobile Communications – Railway (GSM-R)

GSM-R allows direct communication between the signaller and train driver and is being rolled out nationally. This will reduce the risk introduced through third-party communication, and address many public and formal inquiry recommendations.

GSM-R also introduces a driver-initiated emergency call that alerts the controlling signaller and other drivers in the vicinity, allowing other drivers to react immediately. This reduces the risk from collisions with other trains and obstacles on the line.

The GSM-R National Voice Radio Programme is a cross-industry programme led by Network Rail. The national rollout programme is well underway with operation in Strathclyde and the southern end of the West Coast Main Line and a large part of the network will be operational by the end of 2012, with the remainder being brought into use a short while after that. Existing trains are also being progressively fitted and new trains are being delivered equipped with GSM-R.

The European Rail Traffic Management System (ERTMS)

A national ERTMS Programme is also being led by Network Rail. The first national standards and rules are being produced in time to support application on the Cambrian Line in Wales. ERTMS technology will be piloted on the Cambrian Line from just outside Shrewsbury to Aberystwyth and Pwllheli. Four partners, Arriva Trains Wales, Association of Train Operating Companies (ATOC), Network Rail and RSSB are working together with supplier Ansaldo STS to deliver the Cambrian Project to re-signal the route and mitigate the risks associated with national ERTMS fitment. ERTMS includes an Automatic Train Protection (ATP) system, reducing the likelihood of train collisions, and continual speed supervision, reducing the risk arising from overspeeding.

Obstacle detectors

In 2006, RSSB examined the options of using obstacle detection systems, based on radar technology, to improve safety at level crossings. Such devices are already used elsewhere in Europe to detect obstructions capable of causing substantial damage to a train, or to assist the signaller in charge of a CCTV-controlled crossing. However, such a system has to be sensitive enough to distinguish between a significant threat to a train (such as a car), from an insignificant one (like a shopping basket or a small animal) in order to avoid unacceptably high levels of safe-side (false) activations.

Further work is in progress exploring the advantages and disadvantages of using signaller inspection compared to obstacle detection systems. Network Rail has recently started a trial at Filey of an obstacle detector system that uses radar to detect objects.

2.6.2 Research and Development Programme

RSSB manages a cross-industry programme of research and development (R&D) on behalf of the railway industry. It is largely funded by the Department for Transport (DfT) and aims to assist the industry and its stakeholders to achieve the key objectives of improving performance and increasing capacity and availability while reducing cost.

The R&D programme focuses on industry-wide research that no individual company or sector of the industry can address on its own. It therefore includes research covering

'systems' issues across the whole railway, and the engineering interfaces within the railway, as well as the interfaces with other parts of the community.

The Technical Strategy Advisory Group (TSAG) is a cross-industry expert group facilitated by RSSB, drawn from the organisations directly responsible for funding, specifying, and operating the railway. It was created in response to the Department for Transport White Paper 'Delivering a Sustainable Railway'. This White Paper considers the potential future challenges for the railway over a 30-year horizon. It identifies several long-term agendas for Government and the rail industry working in partnership. These are underpinned by 4Cs - the need to increase Customer satisfaction and Capacity, whilst decreasing Cost and Carbon emissions.

TSAG is the industry client group for the Rail Industry Strategic Research Programme, and it has an overview of the work of System Interface Committees that assist the railway industry to manage all aspects of identified system interfaces in the most cost effective and efficient way.

For more information on the R&D programme, please see the R&D section of the RSSB website (www.rssb.co.uk).

2.6.3 Sustainable Rail Programme

The Sustainable Rail Programme's (SRP) purpose is to tackle sustainable development on behalf of the industry at system-wide level, focussing on those areas that require cross-industry coordination or involve government and policy input.

In February 2009, the SRP published the Rail Industry Sustainable Development Principles. Endorsed by a cross-industry group of senior executives, the Principles represent the core values of the rail industry.

Going forward, the integration of the Principles into industry operations, decisions and culture has become the key focus of the programme. To deliver this, a two-year plan of work was agreed by stakeholders in May 2009 which focuses on Government policy, industry decisions and organisational behaviour, as well as developing a baseline of industry performance against the Principles.

Key projects include:

- Working with industry and the DfT to integrate sustainable development into franchising policy and planning for HLOS2
- Groundbreaking research on how best to integrate sustainability consideration into business decisions
- Identifying the barriers and opportunities for encouraging innovation in sustainability through procurement
- Establishing how the industry, as a whole, currently performs in sustainable development.

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3 Progress against industry trajectories and targets

This chapter investigates safety performance against the industry trajectories laid out in the 2009-2014 Strategic Safety Plan (SSP). The chapter also looks at how performance is comparing with the targets defined by the Department for Transport (DfT) High Level Output Specification (HLOS), and with the National Reference Values (NRVs) set by the European Railway Agency in the context of Common Safety Targets (CSTs).

2009/10 Headlines

- For 13 of the 15 trajectories set out in the 2009-2014 SSP, performance currently satisfies the trajectory, with varying levels of stability.
- For two of the 15 SSP trajectories, current performance is not within the trajectory. These trajectories relate to train accident risk from rolling stock failure, and passenger risk at the platform-train interface. RSSB's data quality project has resulted in more rolling stock safety-related defects being reported
- Overall trends in passenger risk and workforce risk are both within the targets for improvement set by the DfT HLOS.
- GB performance is acceptable in all of the areas identified by the European Railway Agence, via the NRVs.

Performance at a glance

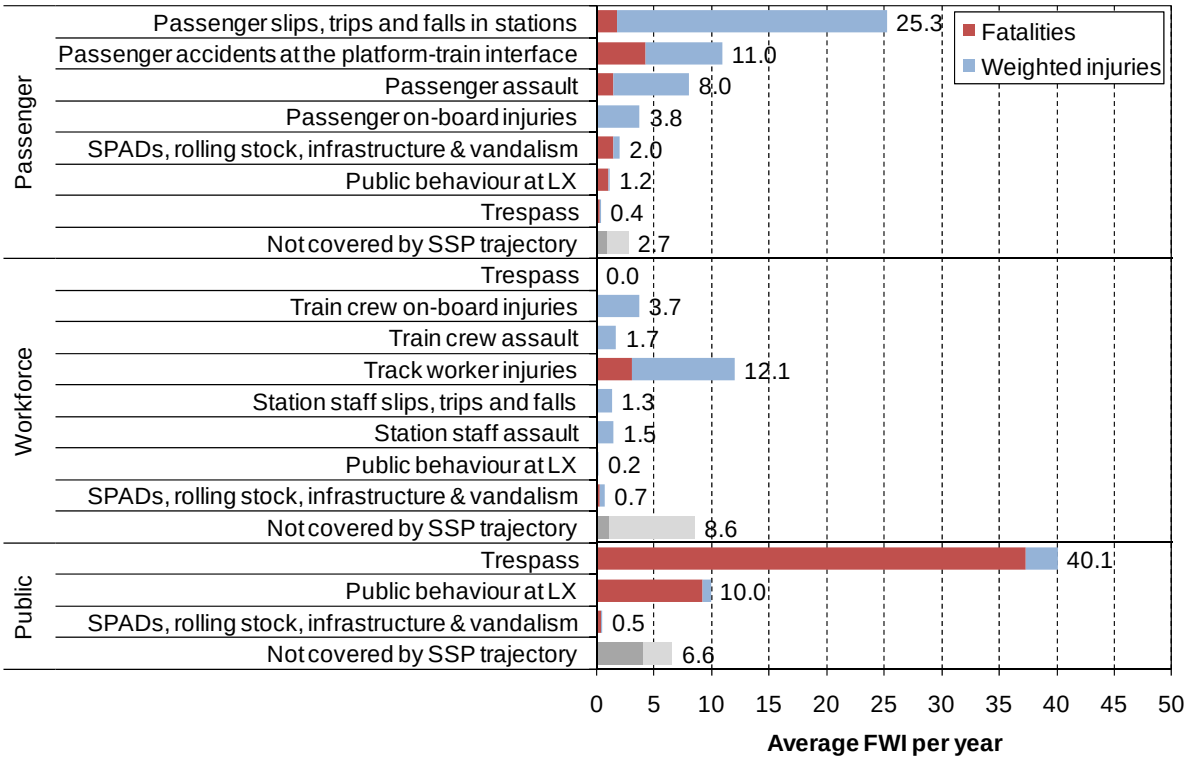
2009 – 2014 Strategic Safety Plan	Passenger slips, trips and falls in stations	Performance currently satisfies trajectories – i.e. is within or below trajectory range. Stability of performance varies for each trajectory; see charts for details.
	Passenger injuries on board trains	
	Train crew injuries on board trains	
	SPADs	
	Risk to track workers	
	Station staff slips, trips and falls	
	Train accidents due to infrastructure failure	
	Assaults on passengers	
	Assaults on train crew	
	Assaults on station staff	
	Trespass	
	Vandalism	
	Public behaviour at level crossings	
	Passenger accidents at the platform train interface	Performance currently not within trajectory.
	Train accidents due rolling stock failure	
High Level Output Specification	Passenger risk	Performance is in line to meet targets.
	Workforce risk	
National Reference Values	Passengers: NRV 1.1 and NRV 1.2	Performance is acceptable in every area covered by the NRVs. (ERA is not assessing NRV 3.2 or NRV 4 due to data quality issues across member states)
	Employees: NRV 2	
	Level crossing users: NRV 3.1 and NRV 3.2	
	Others: NRV 4	
	Unauthorised persons: NRV 5	
	Whole society: NRV 6	

3.1 Trajectories of the 2009 – 2014 SSP

Effective safety planning requires a detailed understanding of the activities or circumstances that result in the greatest risk to passengers, the workforce and members of the public. To identify the focus areas for the 2009 – 2014 SSP, the sources of risk were categorised into nine risk Key Risk Areas (KRAs), which together account for 95% of the total FWI risk as measured by SRMv6.

The 2009 – 2014 SSP also defines a number of trajectories, each related to a particular aspect of system risk. Trajectories are a way of illustrating expected changes in the level of risk as a result of the initiatives being undertaken or planned by the industry over the period covered by the SSP. Trajectories have, as their starting point, the level of risk as of April 2009, as estimated by SRMv6. Fifteen trajectories have been defined in total. Together, they cover 87% of the total FWI risk, and 91% of the fatality risk (excluding suicide and suspected suicide).

Chart 7. Risk profile by SSP trajectories (total FWI and fatalities)



Source: SRMv6

- The SSP trajectories cover 95% of risk to passengers, 71% of risk to the workforce and 88% of risk to members of the public.
- Nearly half of passenger FWI risk arises from slips, trips and falls, with passenger accidents at the platform-train interface being the next largest contributor. Platform-train interface accidents are the largest contributor to fatality risk.
- Track worker injuries are the largest contributor to the workforce risk profile.
- Most of the public risk arises from trespass, with a notable amount being due to public behaviour (misuse) at level crossings.

3.1.1 How progress towards the trajectories is measured

The SRM will be used as the primary means of measuring the performance of the industry against the SSP trajectories. However, full updates of the SRM are planned only at specific points during CP4. At interim points, an alternative methodology will be used, which is described below. The methodology was reviewed and endorsed by Safety Policy Group (SPG)[8] in October 2009, and is in line with the methodology being used for tracking progress against the HLOS, which was similarly endorsed by SPG.

The methodology differs for movement / non-movement accidents and train accidents due to modelling issues associated with low-frequency, high-consequence events.

For movement and non-movement accidents, the approach is based on the actual number of events occurring for each incident type, averaged over a three-year period, combined with the average expected consequence for that type of incident, as derived from the SRM. While not equal to a full SRM update, the methodology is in line with SRM modelling approaches.

For those hazardous events related to train accident risk, the Precursor Indicator Model (PIM) is used. The PIM monitors changes in train accident risk based on the actual number of precursor events, combined with the average expected consequence for that precursor event.

For some trajectories, two charts are shown. This has been done in those cases where the types of events that are covered by the trajectory fall into two distinct types, for example, train accidents and personal accidents.

Normalisation

Most of the measures have been normalised to account for changes to the use of the network. The main normalisers are the number of train miles (for measures which scale with the operation of trains, such as train crew on-board injuries) and passenger journeys, which is used for most other measures.

It should be noted that the statistics in other chapters of the report are not necessarily normalised. Hence it is not always possible to draw a direct comparison between the charts in this section and those in later chapters.

Establishing the benchmark for comparison

The benchmark for comparison for each trajectory is taken as its value estimated using the methodology, as of March 2009.

The types of event covered by each SSP trajectory, together with its means of assessment, are outlined in Table 3.

[8] SPG is a cross-industry body, facilitated by RSSB, and reporting to the RSSB Board.

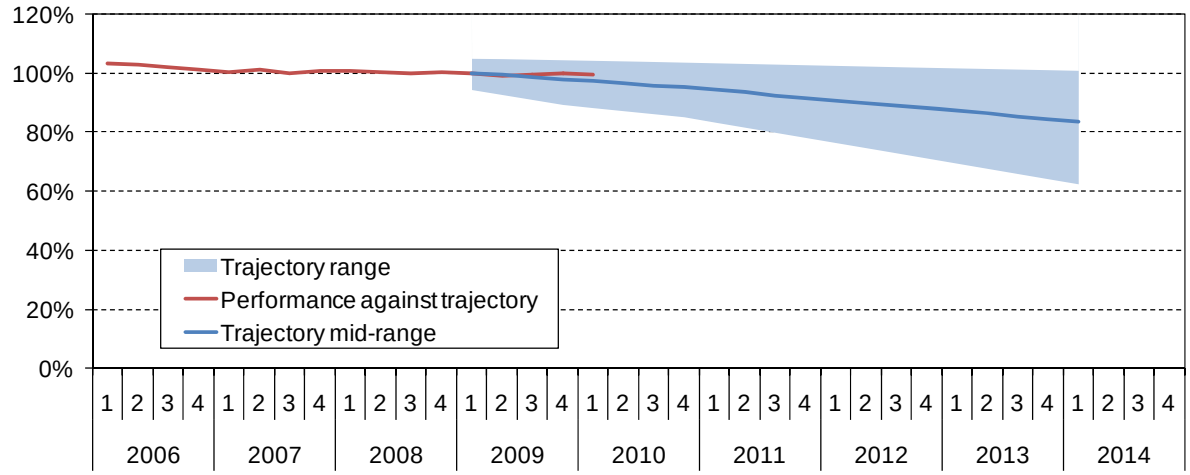
Table 3. Event types and assessment methodology for SSP trajectories

	March 2009 baseline risk (SRMv6)		Hazardous events (HEs) covered	Interim assessment methodology	Normaliser
	Fatalities	FWI			
Passenger slips, trips and falls in stations	1.8	25.3	Slips, trips and falls in stations, apart from those occurring during boarding/alighting or from the platform edge.	(i) For each hazardous event in trajectory, risk estimated by combining the actual three year moving average number of events with the SRM average consequence per event	Passenger journeys
Passenger accidents at the platform-train interface	4.3	11.0	Accidents during boarding/alighting, and falls from the platform, with or without a train present.	As (i)	Passenger journeys
Passenger on-board injuries	0.0	3.8	All injuries on-board trains, excluding assaults or resulting from train accidents.	As (i)	Passenger kms
Passenger assault	1.5	8.0	Assaults occurring anywhere on NRMI.	As (i) - number of events is taken from BTP data	Passenger journeys
Track worker injuries	3.1	12.1	All injuries occurring to track workers, wherever the location, and whatever the cause.	As (I)	Train kms
Train crew on-board injuries	0.0	3.7	All injuries on-board trains, excluding assaults or resulting from train accidents. Includes injuries to revenue protection staff on trains.	As (i)	Train kms
Station staff slips, trips and falls	0.0	1.3	Slips, trips and falls in stations, apart from those occurring during boarding/alighting or from the platform edge. Includes injuries to revenue protection staff in stations.	As (i)	Workforce hours
Train crew assault	0.0	1.7	Train crew assaults occurring anywhere on NRMI. Injuries to revenue protection staff on trains.	As (i)	Workforce hours
Station staff assault	0.0	1.5	Station staff assaults occurring anywhere on NRMI. Injuries to revenue protection staff in stations.	As (i)	Workforce hours
Public behaviour at LX	10.4	11.3	Injuries to all person types, including train accidents, occurring as a result of public misuse of level crossings, or during proper use, but where no railway cause (such as infrastructure defect or equipment failure) is implicated.	(ii) For train accidents, for each hazardous event in trajectory, risk is estimated using Precursor Indicator Model. For movement/non-movement accidents, as (i).	Train kms
Trespass	37.7	40.5	All injuries to people arising from trespass. Includes incidents of passenger trespass.	As (i)	No normaliser
Vandalism	0.2	0.4	Collisions, derailments or train fires due to vandalism.	As (ii) - all risk is train accident risk	Train kms
SPADs	0.6	0.8	Train accidents result from SPADs, where the cause of the SPAD is due to human error.	As (ii) - all risk is train accident risk	Train kms
Infrastructure failure	1.1	1.6	Personal accidents and train accidents resulting from infrastructure failure, including track defects, signalling failure, structural collapse.	For movement/non-movement accidents, as (i). For train accidents, as (ii).	Train kms
Rolling stock failure	0.3	0.5	Train accidents resulting from the failure of any rolling stock component.	As (ii) - all risk is train accident risk	Train kms
Not covered by SSP trajectory	6.1	17.9			
Total system risk	67.0	141.3			

3.1.2 Risk to passengers from slips, trips and falls in stations

Passenger slips, trips and falls at stations account for 25.3 FWI per year, which is 18% of the total system risk.

Chart 8. Progress against trajectory related to passenger slips, trips and falls in stations

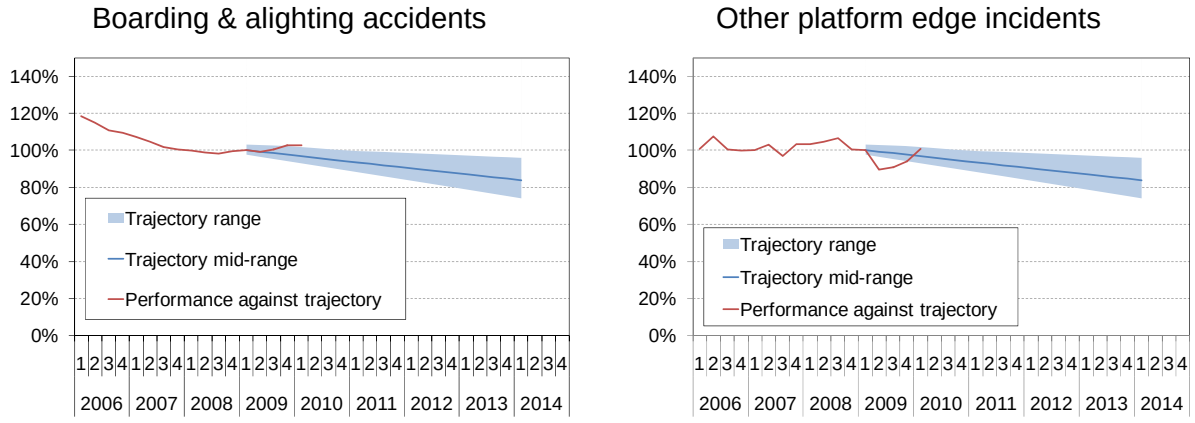


- A best estimate improvement of around 16% is projected by the end of March 2014.
- Based on the number and type of slips, trips and falls that have occurred, performance at the end of 2009/10 satisfies the SSP trajectory.

3.1.3 Risk to passenger at the platform-train interface

Passenger accidents at the platform-train interface comprise accidents during boarding & alighting, and other types, such as falls from the platform edge. Combined, they account for 11.0 FWI per year, which is 8% of the total system risk.

Chart 9. Progress against trajectory related to passenger accidents at the platform-train interface

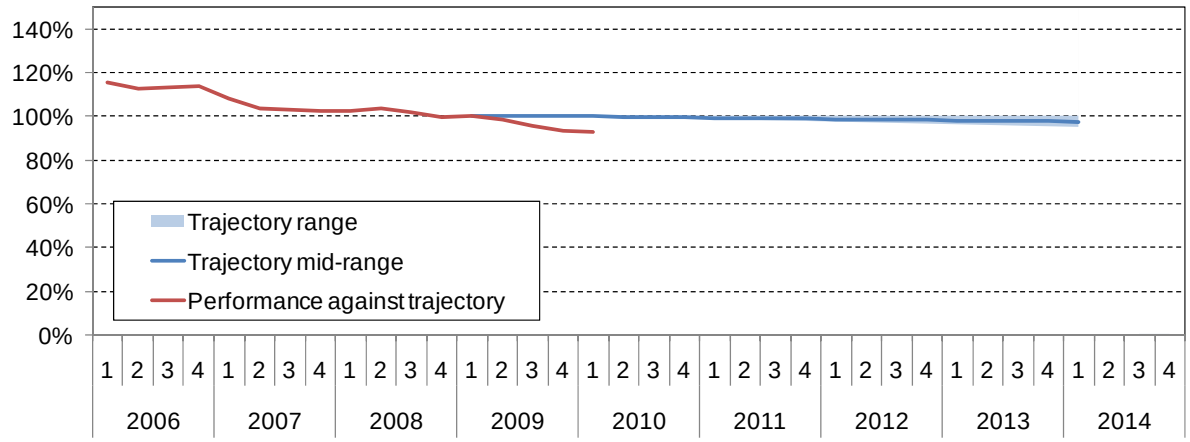


- A best estimate improvement of around 16% is projected by the end of March 2014.
- Based on the number and type of boarding & alighting accidents that have occurred, performance at the end of 2009/10 is slightly above the SSP trajectory. Based on the number and type of other platform edge accidents, performance at the end of 2009/10 satisfies the SSP trajectory.

3.1.4 Risk to passengers from on-board injuries

Passenger injuries on board trains account for 3.8 FWI per year, which is 3% of the total system risk.

Chart 10. Progress against trajectory related to passenger injuries on board trains

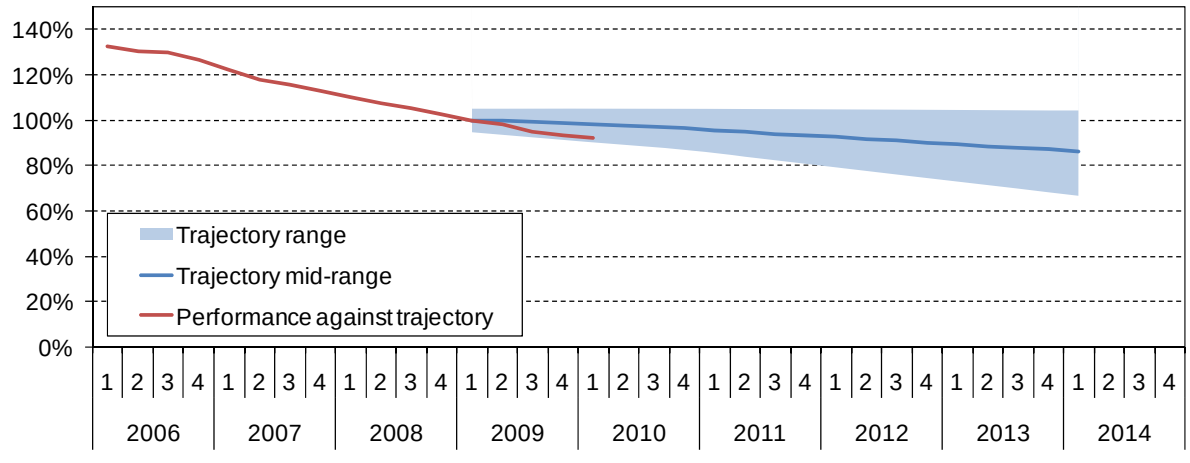


- An improvement of around 3% is projected by the end of March 2014.
- Based on the number and type of on-board injuries that have occurred, performance at the end of 2009/10 satisfies the SSP trajectory.

3.1.5 Risk to train crew from on-board injuries

Train crew injuries on board account for 3.7 FWI per year, which is 3% of the total system risk.

Chart 11. Progress against trajectory related to train crew injuries on board trains

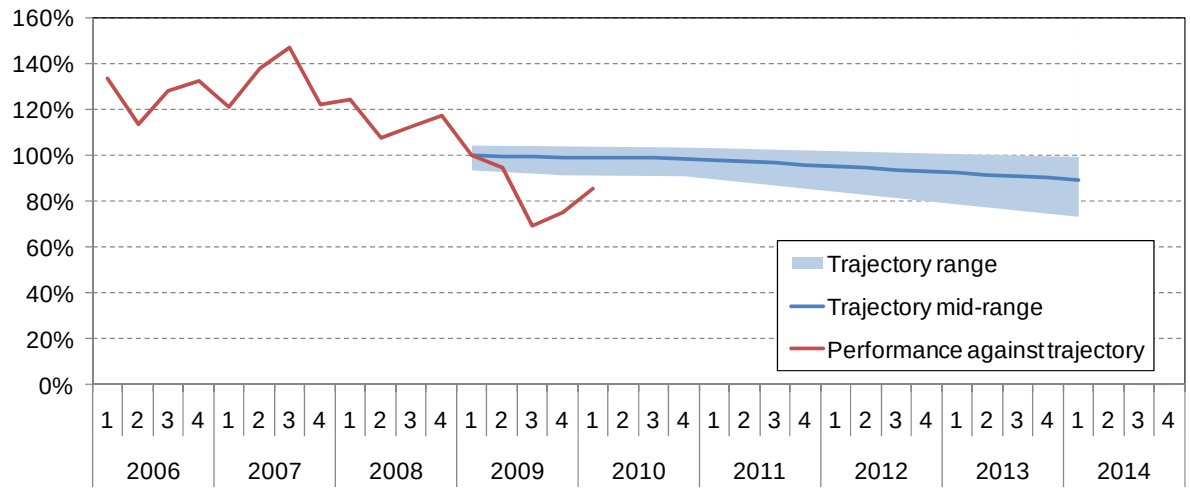


- A best estimate improvement of around 14% is projected by the end of March 2014.
- Based on the number and type of train crew injuries on board trains that have occurred, performance at the end of 2009/10 satisfies the SSP trajectory.

3.1.6 Risk from SPADs

SPADs account for 0.8 FWI per year, which is around 1% of the total system risk. All of this is train accident risk.

Chart 12. Progress against trajectory related to SPADs

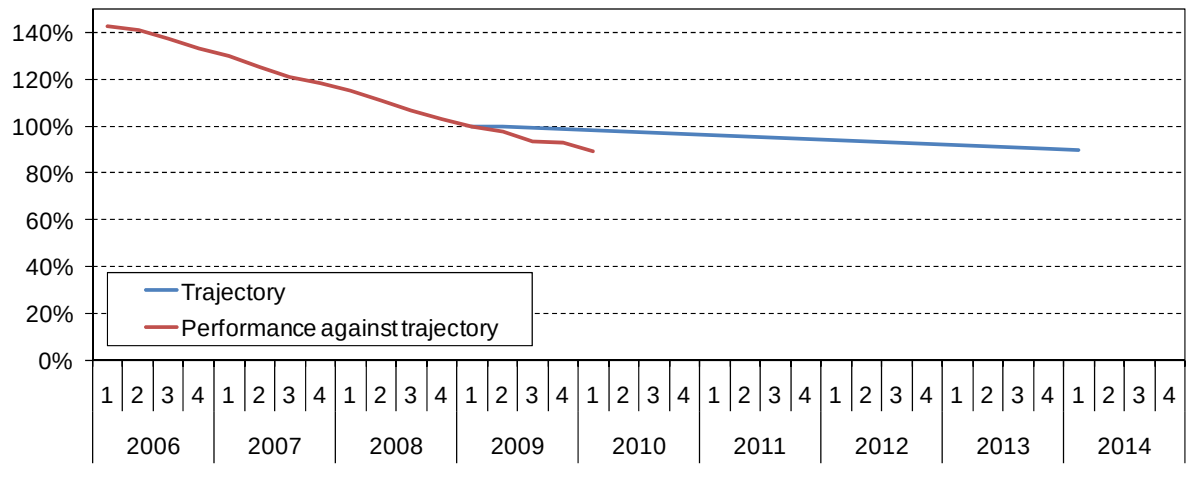


- A best estimate improvement of around 10% is projected by the end of March 2014.
- Based on the number and type of SPADs that have occurred, performance at the end of 2009/10 satisfies the SSP trajectory.

3.1.7 Risk to track workers

Track worker injuries account for 12.1 FWI per year, which is 9% of the total system risk.

Chart 13. Progress against trajectory related to track worker injuries

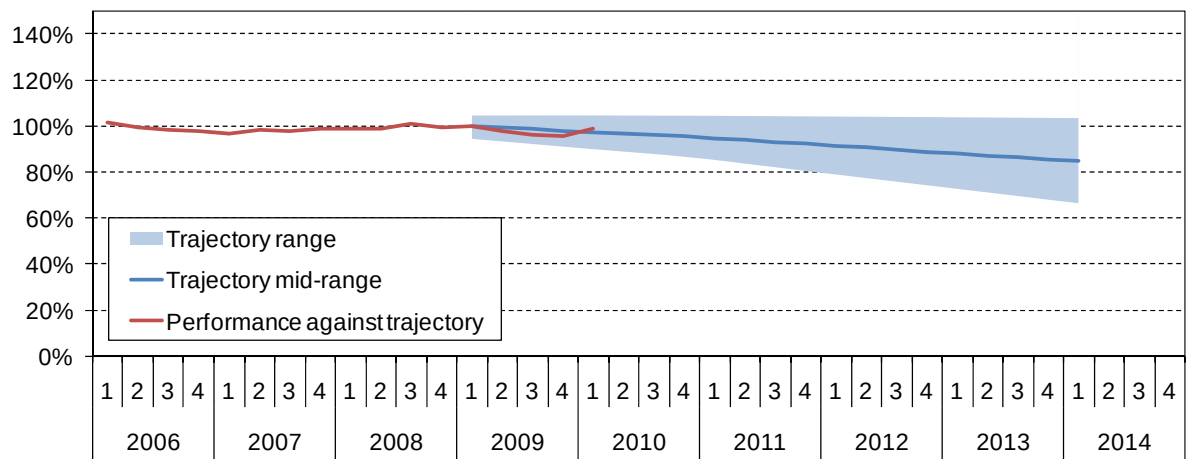


- An improvement of around 10% is projected by the end of March 2014
- Based on the number and type of track worker injuries that have occurred, performance at the end of 2009/10 satisfies the SSP trajectory.

3.1.8 Risk to station staff from slips, trips and falls

Station staff slips, trips and falls at stations account for 1.3 FWI per year, which is 1% of the total system risk.

Chart 14. Progress against trajectory related to station staff slips, trips and falls

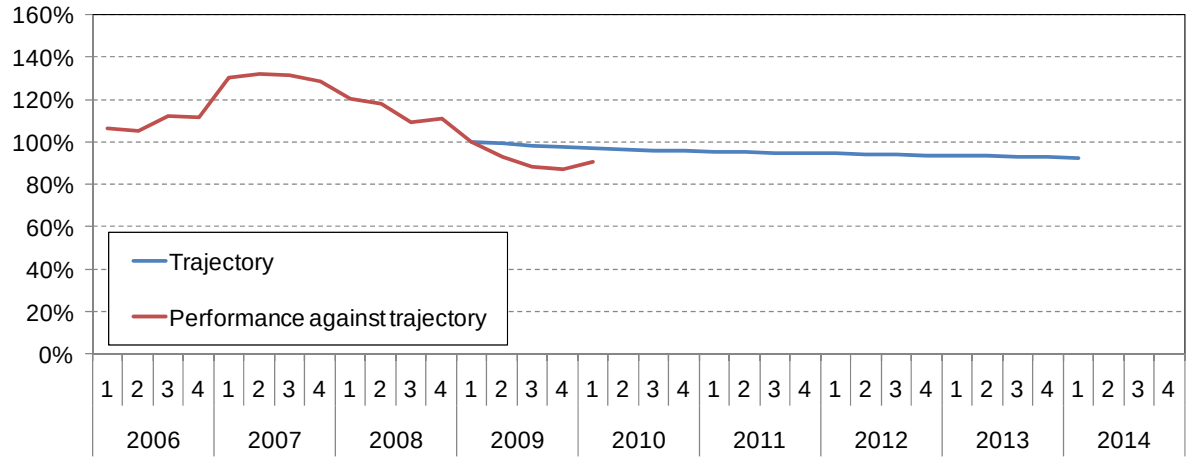


- A best estimate improvement of around 15% is projected by the end of March 2014.
- Based on the number and type of station staff slips, trips and falls that have occurred, performance at the end of 2009/10 satisfies the SSP trajectory.

3.1.9 Risk from train accidents caused by infrastructure failure

Infrastructure failure accounts for 1.6 FWI per year, which is around 1% of the total system risk. Of this, 1.4 FWI is train accident risk, with the remaining 0.2 FWI arising from personal accidents, such as slips, trips and falls on substandard surfaces.

Chart 15. Progress against trajectory related to infrastructure failure

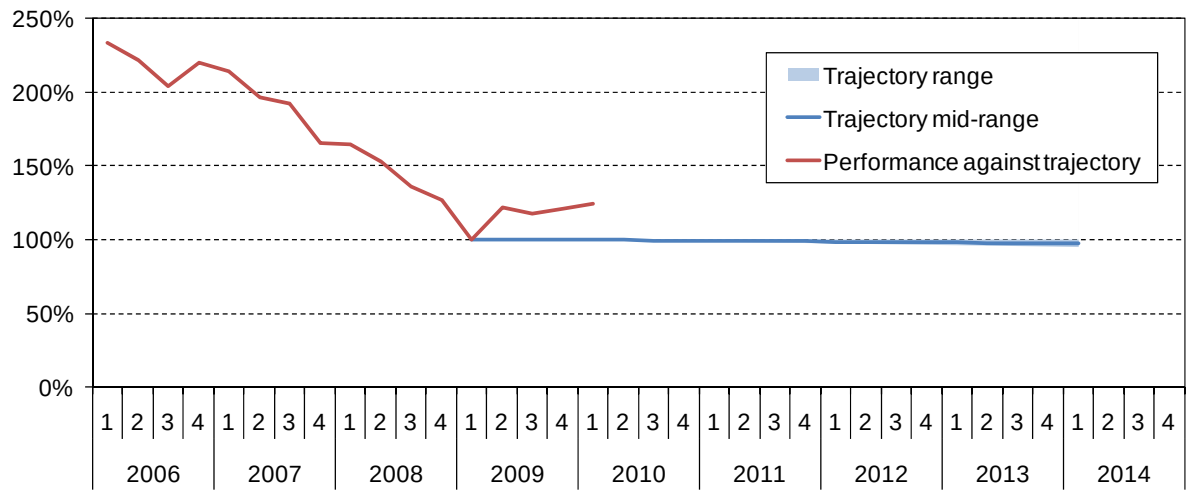


- An improvement of around 7% is projected by the end of March 2014.
- Based on the number and type of infrastructure-related train accident precursors that have occurred, performance at the end of 2009/10 satisfies the SSP trajectory.

3.1.10 Risk from train accidents caused by rolling stock failure

Rolling stock failure accounts for 0.5 FWI per year, which is less than 1% of the total system risk. The majority of this is train accident risk.

Chart 16. Progress against trajectory related to rolling stock failure

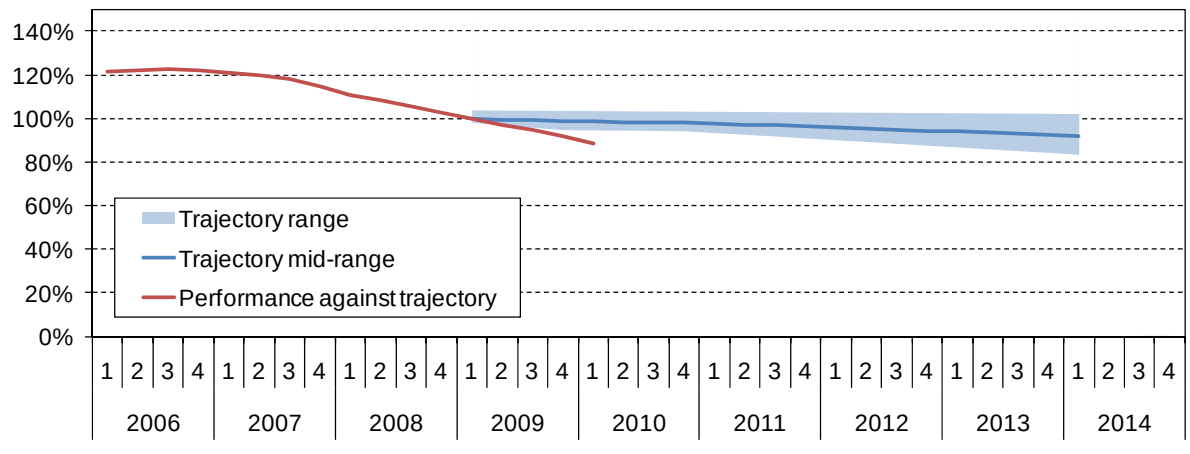


- An improvement of around 3% is projected by the end of March 2014.
- Based on the number and type of rolling stock precursors that have occurred, performance at the end of 2009/10 is above the SSP trajectory. The rolling stock contribution to the PIM is very low, and small changes in absolute value can have large percentage changes. RSSB's data quality project has also resulted in more rolling stock safety-related defects being reported.

3.1.11 Risk to passengers from assault

Assaults on passengers account for 8.0 FWI per year, which is 6% of the total system risk.

Chart 17. Progress against trajectory related to passenger assaults

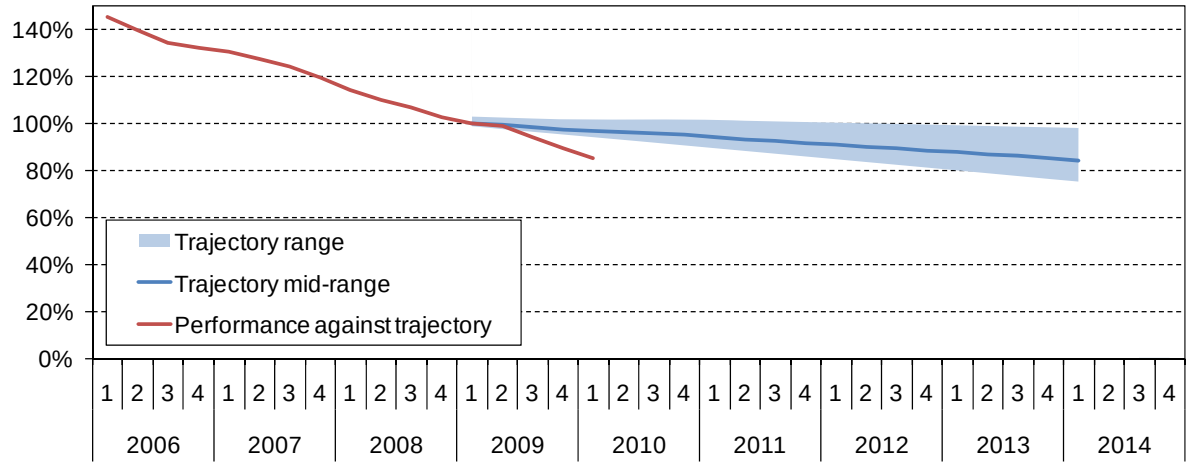


- A best estimate improvement of around 8% is projected by the end of March 2014.
- Based on the number and type of passenger assaults that have occurred, performance at the end of 2009/10 satisfies the SSP trajectory.

3.1.12 Risk to train crew from assault

Assaults on train crew account for 1.7 FWI per year, which is around 1% of the total system risk.

Chart 18. Progress against trajectory related to train crew assaults

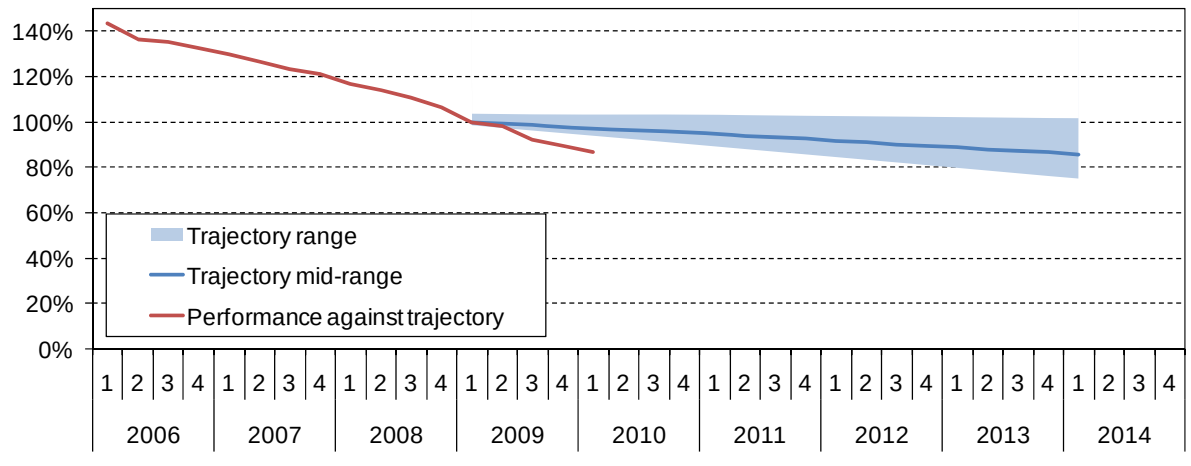


- A best estimate improvement of around 16% is projected by the end of March 2014.
- Based on the number and type of assaults on train crew that have occurred, performance at the end of 2009/10 satisfies the SSP trajectory.

3.1.13 Risk to station staff from assault

Assaults on station staff account for 1.5 FWI per year, which is around 1% of the total system risk.

Chart 19. Progress against trajectory related to station staff assaults

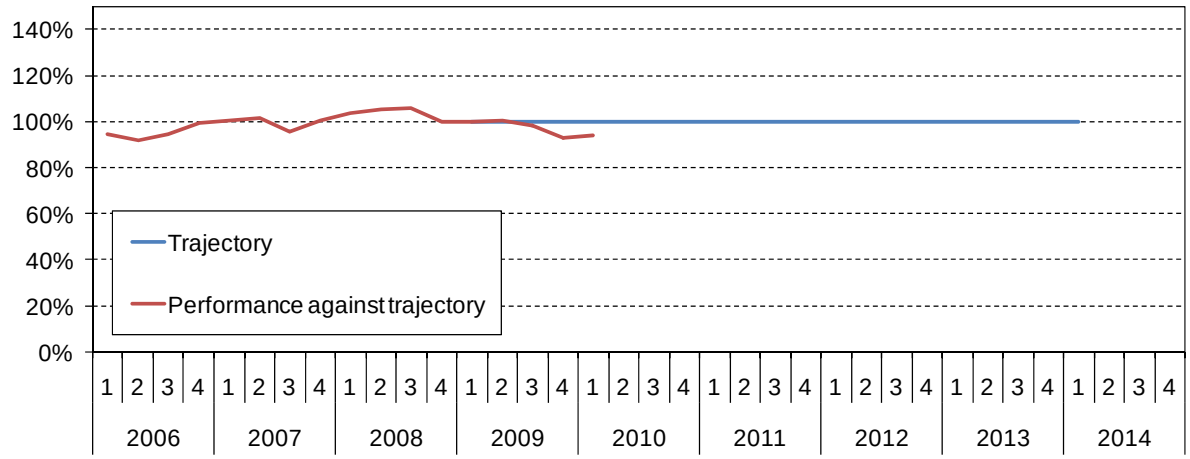


- A best estimate improvement of around 14% is projected by the end of March 2014.
- Based on the number and type of assaults on station staff that have occurred, performance at the end of 2009/10 satisfies the SSP trajectory.

3.1.14 Risk from trespass

Trespass accounts for 40.5 FWI per year, which is 29% of the total system risk.

Chart 20. Progress against trajectory related to trespass

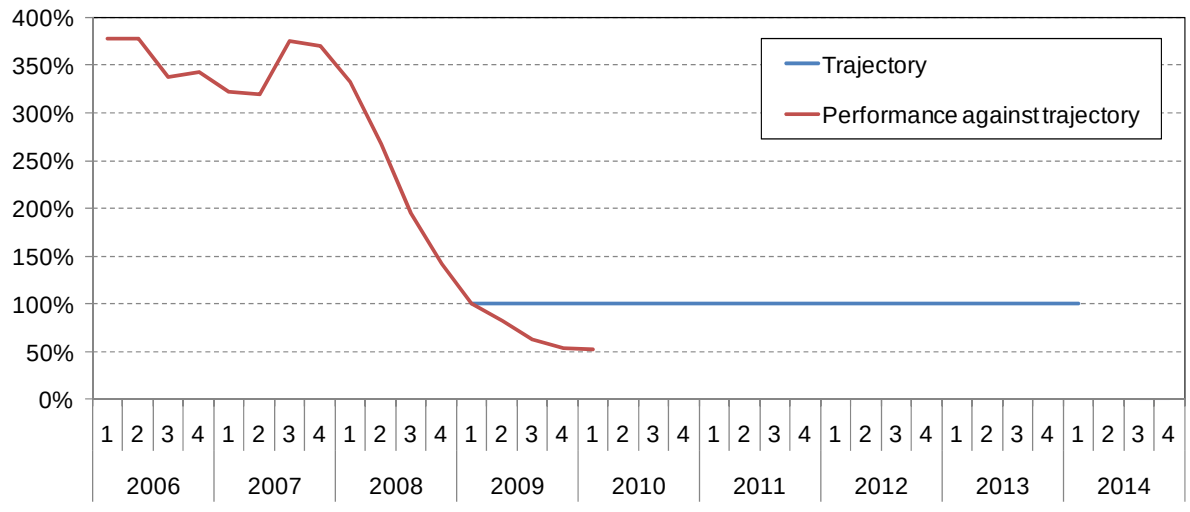


- Risk from trespass is projected to remain level up to the end of March 2014.
- Based on the number and type of trespass injuries that have occurred, performance at the end of 2009/10 satisfies the SSP trajectory.

3.1.15 Risk from vandalism

Vandalism is estimated to account for 0.4 FWI per year, which is less than 1% of the total system risk. This is all train accident risk, and does not include personal accidents arising to those engaged in vandalism, which would usually be categorised as trespass.

Chart 21. Progress against trajectory related to vandalism

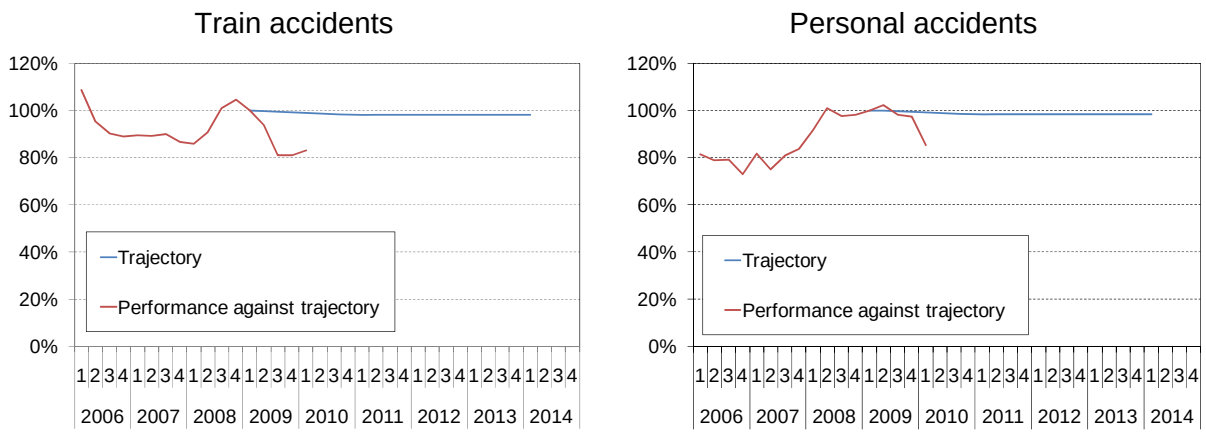


- Risk from vandalism is projected to remain level up to the end of March 2014.
- Based on the number and type of vandalism-related train accident precursors that have occurred, performance at the end of 2009/10 satisfies the SSP trajectory.

3.1.16 Risk from public behaviour at level crossings

Public behaviour at level crossings accounts for 11.3 FWI per year, which is 8% of the total system risk. Of this, 2.5 FWI arises from train accidents (2.1 of which occurs to members of the public) and 8.8 FWI arises from personal accidents.

Chart 22. Progress against trajectory related to public behaviour at level crossings

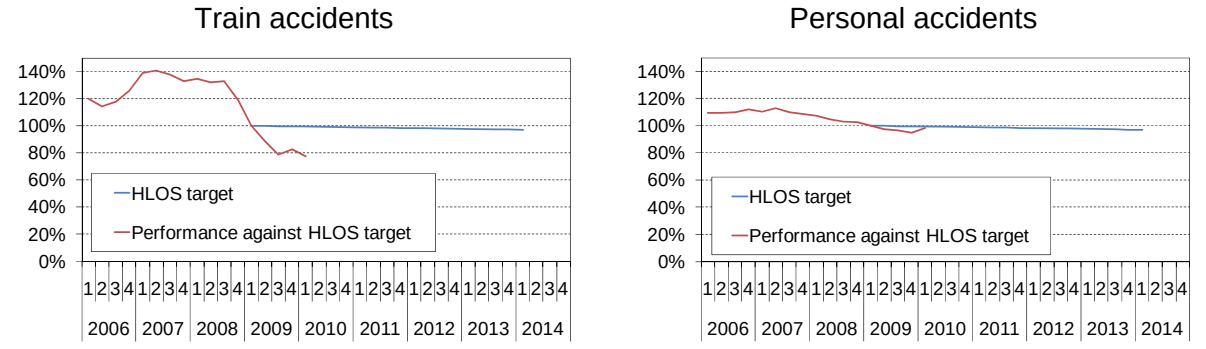


- An improvement of around 2% is projected by the end of March 2014.
- Based on the number and type of train accident precursors that have occurred, performance at the end of 2009/10 satisfies the SSP trajectory. Based on the number and type of personal accidents that have occurred, performance at the end of 2009/10 also satisfies the SSP trajectory.

3.1.17 Trends in performance within categories not covered by an SSP trajectory

Around 17.9 FWI arises from causes that are not covered by an SSP trajectory; this is 13% of the total system risk, excluding suicide. Of this, 2.2 FWI arises from train accidents, and 15.4 FWI arises from personal accidents.

Chart 23. Performance within categories not covered by an SSP trajectory



- By definition, no trajectory exists for these areas of risk. The HLOS target of a 3% reduction by March 2014 has therefore been used to track performance.
- Based on the number and type of train accident precursors that have occurred, performance at the end of 2009/10 satisfies the HLOS target. Based on the number and type of personal accidents that have occurred, performance at the end of 2009/10 also satisfies the HLOS target.

3.2 DfT High Level Output Specification

In the High Level Output Specification (HLOS), the DfT established safety metrics for both passenger risk and workforce risk and specified a requirement for a 3% reduction in both categories over Control Period 4 (CP4), which runs from 1 April 2009 to 31 March 2014.

The HLOS metrics are:

Passenger metric:	Baseline at April 2009:	1.070 FWI per billion passenger km
	Target at March 2014:	1.038 FWI per billion passenger km
Workforce metric:	Baseline at April 2009:	0.134 FWI per million workforce hours
	Target at March 2014:	0.130 FWI per million workforce hours

It has been agreed by the DfT, the Office of Rail Regulation (ORR) and the industry that the safety metrics will be monitored using the SRM. SRMv6 has been used to calculate the HLOS metrics at the beginning of CP4. The model will be updated to version 7 in the middle of CP4 and then again at the end of CP4, to version 8. It has been agreed that between updates, an indication of the trends in both passenger and workforce risk will be provided via an interim monitoring process every six months. While not equivalent to a full update of the SRM, the interim method is designed to show the trend in risk, thereby giving an indication of the likely outcome of the full SRM updates when they are made.

The interim measures for both risk categories are shown as an index starting at 100% at the beginning of CP4, with a target of 97% for March 2014. Both of the measures will comprise two elements: train accident risk and movement/non-movement risk, as defined by the SRM.

The train accident element of each metric is measured by the train accident precursor indicator model (PIM)[9]. Train accident risk contributes a relatively small part of the overall risk to workforce and to passengers, at about 4% and 6% of their respective totals. In the preliminary results, the train accident element is based on the best estimate of the absolute risk at the start of the control period. The movement/non-movement element is based on the number of recorded events that have led to injury (as calculated using a three year rolling period) multiplied by the average consequences per event (as derived from the SRM) for each type of event. This type of risk estimate reduces the variation that would arise if the actual consequences of the events were used (particularly for the rarer type of events with higher consequences) and maintains more consistency with the SRM.

Preliminary results from the first interim review for the passenger and workforce metrics are shown in Chart 24 and Chart 25. It can be seen that the trend in passenger risk, to the end of March 2010, seems consistent with the requirement of the HLOS target. For workforce risk, the initial indication suggests a rate of risk reduction somewhat better than that required by the HLOS target. It must be emphasised, however, that while these results provide some reassurance that the risk reduction is in line with the HLOS requirements, this is only an early indication, and trends will continue to be monitored throughout the period.

[9] RSSB's Precursor Indicator Model measures the underlying risk from train accidents by tracking changes in the occurrence of accident precursors. It is described more fully in section 8.7.1.

Chart 24. Progress against HLOS target for passenger risk (FWI per billion passenger km)

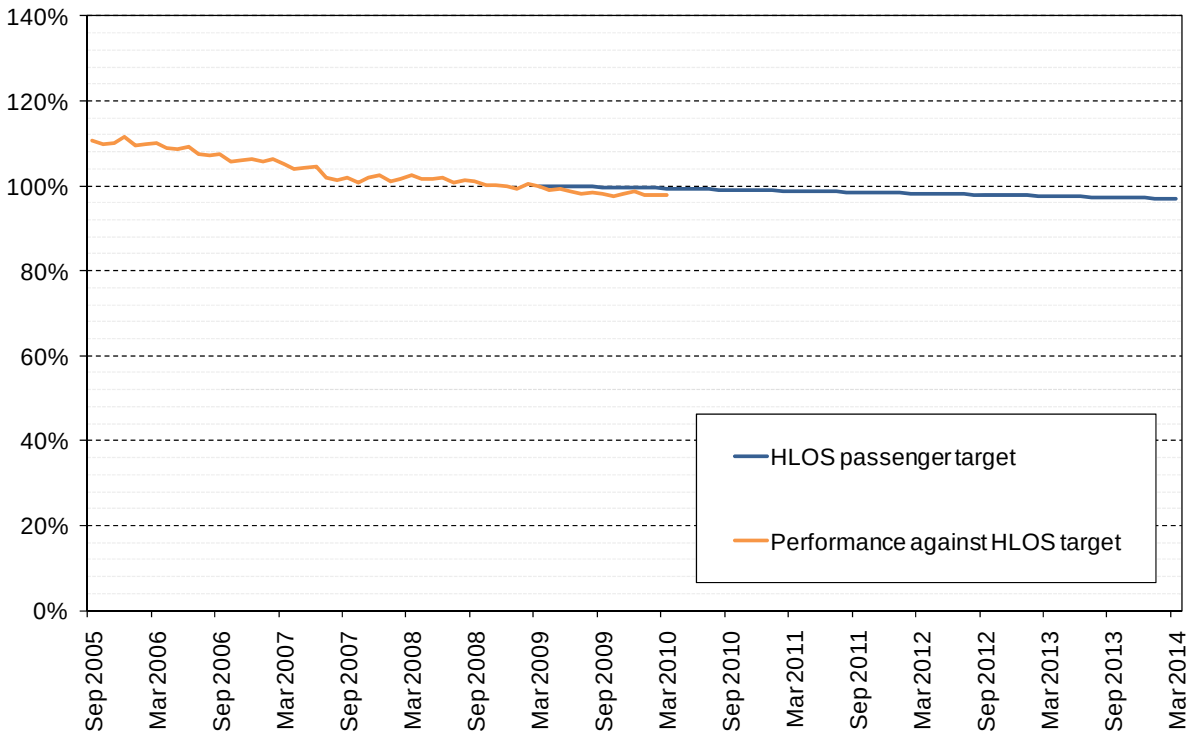
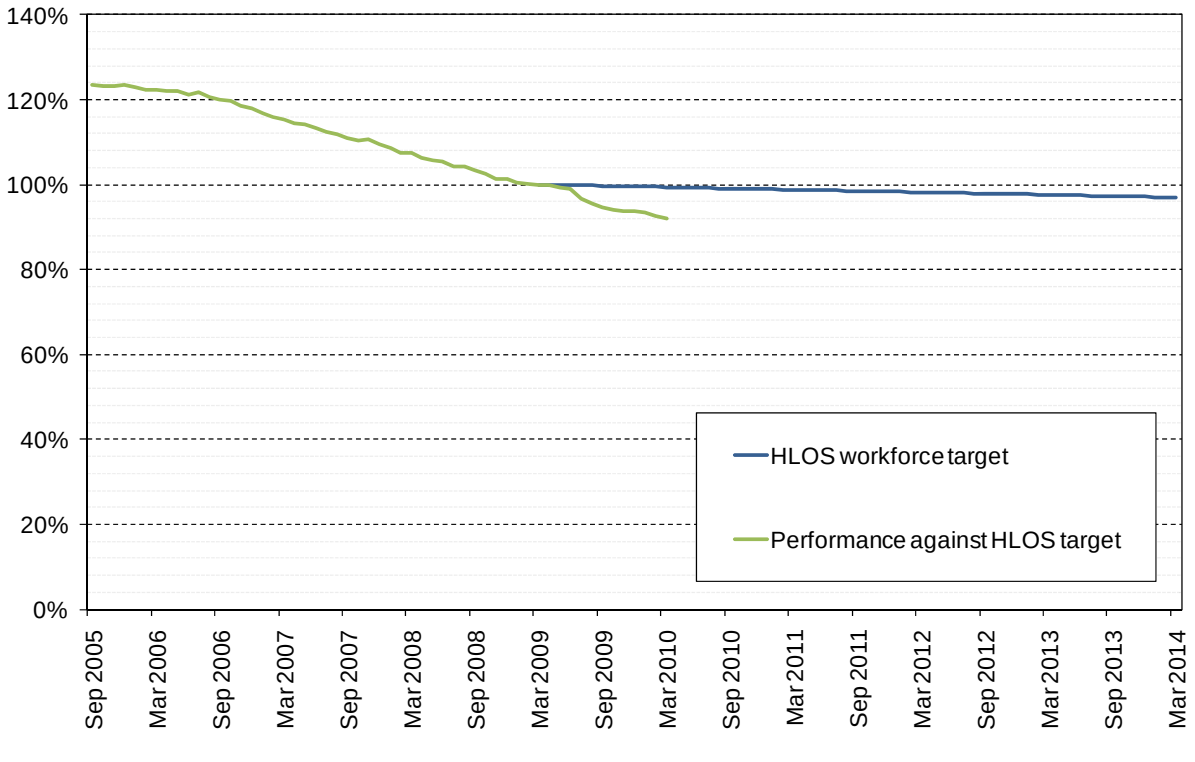


Chart 25. Progress against HLOS target for workforce risk (FWI per million workforce hours)



3.3 Common Safety Targets

The European Railway Safety Directive requires member states to ensure that current levels of safety are maintained and, where reasonably practicable, improved, with a view to gradually harmonising safety performance across member states.

In 2010, the European Commission adopted the first set of Common Safety Targets (CSTs) and the first sets of National Reference Values (NRVs) for the 25 member states with railways. A second set, based on experience gained from implementing the first set, was due to be adopted by the Commission before April 2011. However, this will now be delayed.

NRVs and CSTs are defined in terms of fatalities and weighted serious injuries (FWSI), divided by a suitable normaliser. A serious injury, which occurs if the victim is hospitalised for a period of longer than 24 hours, is given one-tenth the weight of a fatality.

Table 4 shows the first set of NRVs and CSTs, as they apply to the UK. The column *NRV rank* shows where the UK's NRV ranks among the 25 EU countries. For example, the UK has the second lowest NRV for passengers (behind Sweden).

Table 4. NRV and CST definitions and values

NRV Category	NRV number	Definition	UK NRV	NRV rank (in EU25)	CST
Passengers	NRV 1.1	Number of passenger FWSI per billion passenger train km.	6.22	2	250.0
	NRV 1.2	Number of passenger FWSI per billion passenger km.	0.062	2	2.01
Employees	NRV 2	Number of employee FWSI per billion train km	8.33	6	77.91
Level crossing users	NRV 3.1	Number of road vehicle occupant and pedestrian FWSI per billion train km.	23.0	1	743.1
	NRV 3.2[10]	Number of road vehicle occupant and pedestrian FWSI per billion train traverses over a crossing.	n/a	n/a	n/a
Others	NRV 4[11]	Number of other person FWSI per billion train km.	n/a	n/a	n/a
Unauthorised persons on railway premises	NRV 5	Number of unauthorised person FWSI per billion train km. Note: This excludes suicides,	94.7	5	2030.2
Whole society	NRV 6	Total number of passenger, employee, level crossing user, other and unauthorised person FWSI per billion train km.	130.7	1	2507.5

[10] ERA have omitted NRV 3.2 from the first set of NRVs because of concerns about the quality and consistency of normalising data across the member states.
[11] ERA have omitted NRV 4 from the first set of NRVs because of concerns about the quality and consistency of data across the member states

3.3.1 NRVs, CSTs and CSIs

The NRVs were designed to reflect the current levels of safety in each member state. They are based on the four-year period 2004-07, and, recognising the potentially distorting effect of a single multi-fatality event, a form of weighted average was applied to reduce the effect of 'outliers'.[12]

The CSTs apply to all member states. The CST in each category is equal to the lower of (i) the highest NRV value and (ii) ten times the average NRV for all member states. Meeting this first set of CSTs is unlikely to be of concern to countries with relatively strong safety performance, such as the UK. In the longer term, the European Railway Agency (ERA) is likely to set more challenging CSTs that apply to all member states and are targeted to the higher-risk parts of the rail system.

The ERA is monitoring each member state's performance against its NRVs to ensure that levels of safety are at least being maintained in each category. The level of performance is assessed using the Common Safety Indicators (CSIs) that National Safety Authorities submit to the ERA as part of their annual safety reports.

RSSB co-ordinates the collation of UK CSIs by identifying potentially relevant events from SMIS and validating them with the transport operators involved. It provides CSI data to the ORR on behalf of the industry, which satisfies the requirements set out in ROGS Regulation 20(1)(c) for transport operators to produce an annual set of safety data.

The measures are divided into six categories, pertaining to different groups of people. These groups align with categories used by RSSB, with the exception of *passengers*. The ERA defines a person as a passenger only if he or she is on, or in the act of boarding or alighting from, a train, which is more restrictive than the RSSB/RIDDOR definition. The ERA category *others* covers other (RSSB) passengers – such as a person who falls from a platform and is struck by a train – as well as members of the public who are neither trespassing nor using a level crossing.

It is important to note that the NRVs, CSTs and accident-related CSIs only cover significant accidents that involve railway vehicles in motion (collisions, derailments, persons struck by trains etc). The CSIs therefore only represent a subset of the accidents that take place on the railway, and measuring against the NRVs does not provide a complete picture of overall risk.

[12] Because CSIs are available only from 2006, and because of concerns about the quality of the CSI data being provided by some member states, the European Railway Agency based its NRV calculations on data supplied to Eurostat under EC Regulations No 91/2003 and 1192/2003. Prior to 2006, UK data submitted to Eurostat aligns with that published by the ORR (i.e. only confirmed suicides are omitted), whereas from 2006 onwards the data are based on an application of the Ovenstone criteria. This resulted in an inflated number of reported trespasser fatalities for 2004 and 2005, relative to subsequent years. RSSB and ORR work together to ensure the consistency of the annual ERA and Eurostat submissions. The second set of NRVs and CSTs, due to be announced in 2011, will be based explicitly on CSI data.

3.3.2 Assessing performance against the NRVs

The ERA assesses performance against each NRV on the basis of the latest calendar year's performance and the current four-year weighted moving average.[13]

To make allowance for statistical uncertainty, the ERA will only consider flagging up concerns about safety to a member state if its level of performance falls outside the NRV plus a 20% tolerance limit and if this apparent deterioration cannot be attributed to a single high-consequence accident.

In such cases, the ERA will then ask whether the state has been in this position more than once in the last three years, and whether it has experienced a significant increase in the number of CSI-reportable accidents (as opposed to their consequences) that are relevant to the NRV area.

- If the answer to both questions is no, then the ERA will still conclude that safety performance is acceptable, and the member state will not be required to take specific action.
- If the answer to both questions is yes, then the ERA will conclude that there has been a *probable deterioration of safety performance*. The member state will be required to provide a written statement explaining the likely causes and – where needed – submit a safety enhancement plan to the European Commission.
- In the remaining cases, the ERA will conclude that there has been a *possible deterioration of safety performance*, and the member state will be required to provide a written explanatory statement.

The DfT is accountable to the European Commission for the UK's performance. If there were a genuine deterioration in safety then the DfT would initially look to ORR, as the safety regulator, to ensure that the industry was taking remedial action. ORR would aim to work in co-operation with the industry to understand the cause of the poor performance, and to ensure that the appropriate action was taken. However, if enforcement action were needed, the relevant legislative tools would be:

- Health and safety enforcement powers, which might be applicable if safety levels were deteriorating.
- ROGS regulations, which requires each transport operator to have a safety management system that ensures that the mainline railway can achieve its CSTs.

The four-page leaflet *HLOS and Common Safety Targets – What you need to know*, which is available from the RSSB website, provides essential information about these measures, the roles and responsibilities of the parties involved, and the implications for transport operators.

[13] Because of concerns about the quality of CSI data being supplied by some member states, ERA is currently using Eurostat data to assess performance against the NRVs. The classifications used by Eurostat do not differentiate between *level crossing users*, *unauthorised persons* and *others*. ERA analyses are based on the assumption that anyone in this combined category who is injured in an accident at a level crossing is a *level crossing user*, anyone injured in a *rolling stock in motion* accident is an *unauthorised person*, and anyone else is classed as *other*. This results in a small number of casualties being misclassified (for example, people who are struck by trains at, or after falling from, the platform edge will feature as *unauthorised persons* in the ERA statistics and in the charts in this chapter). ERA will begin using CSI data once they have sufficient confidence in its quality. See also the footnote (12) on the previous page.

3.3.3 Current performance against the NRVs

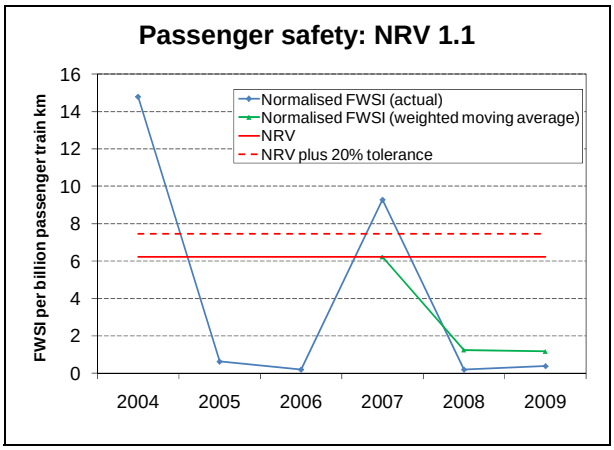
The first assessment of performance against the NRVs – based on data from 2008 – will be published by the ERA in summer 2010.

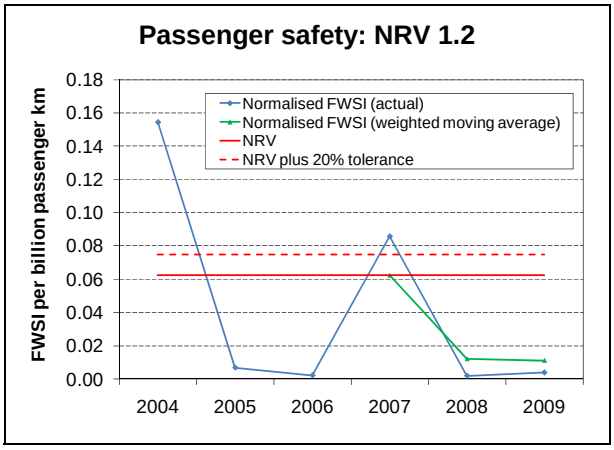
Data for 2009 has not yet been submitted to the ERA and Eurostat, but the charts below present provisional performance estimates based on the data that has been agreed between RSSB and Transport Operators. If the green line (the weighted moving average of normalised FWSI) lies below the dashed red line (the NRV plus a 20% tolerance limit) then safety performance is judged to be at an acceptable level.

The provisional estimates indicate that UK's safety performance is at an acceptable level in all NRV categories that are being measured.

NRVs for passenger safety

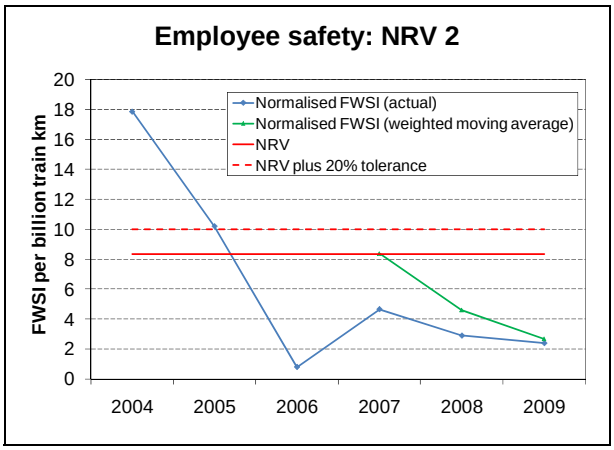
- The NRVs relating to passenger safety cover passenger fatalities and serious injuries from train accidents and from other accidents involving railway vehicles in motion (for example, a fall on board a train caused by sudden braking).
- The highest FWSI values for passengers were recorded in 2004 and 2007. These reflect the fatalities and serious injuries that occurred in the train accidents at Ufton and Grayrigg respectively.
- The NRVs are reasonable estimates of the underlying level of risk to passengers from accidents involving railway vehicles in motion and are broadly consistent with the underlying level of risk predicted by the SRM.
- Performance in 2008 and 2009 was well within the NRV. There were no high-consequence train accidents in those years.





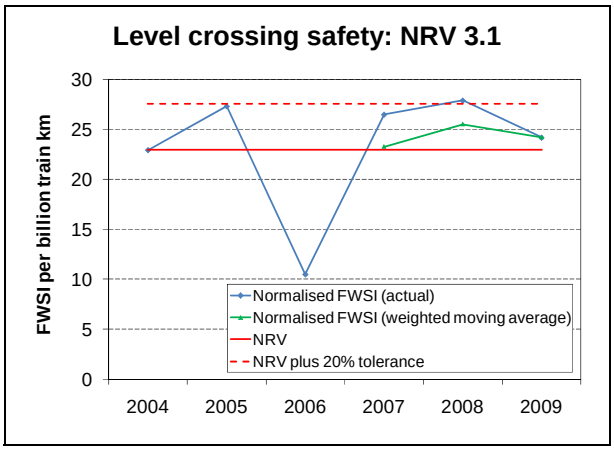
NRV for employee safety

- Most FWSI in this category arises from track workers being struck by trains.
- Performance in 2008 and 2009 was within the NRV.
- In 2004, there were particularly high numbers of both fatalities and serious injuries to track workers. The level of FWSI has reduced since 2004.
- When compared to estimates from SRMv6, the employee NRV is a reasonable estimate of the underlying level of risk to employees.



NRV for level crossing safety

- This NRV covers both pedestrians and road vehicle occupants on level crossings (but not train occupants).
- The UK has the lowest NRV for level crossing safety of all EU states.
- The level of normalised FWSI in 2008 and 2009 exceeded the NRV. However, in both years, the weighted moving average fell within the 20% tolerance limit. Therefore, safety performance is deemed to be acceptable.
- Overall, the level of risk to level crossing users has been fairly static. The exception was 2006, which saw an unusually low number of level crossing fatalities.
- When compared to estimates from SRMv6, the values of the level crossing NRVs are a reasonable estimate of the underlying level of risk to level crossing users.
- ERA has not set values for NRV 3.2 because of concerns about the quality of normalising data. NRV 3.2 will measure FWSI at level crossings normalised by the number of times that trains are estimated to traverse level crossings during the year. There are currently no plans in place to normalise by the volume of road traffic and the number of pedestrians using level crossings.

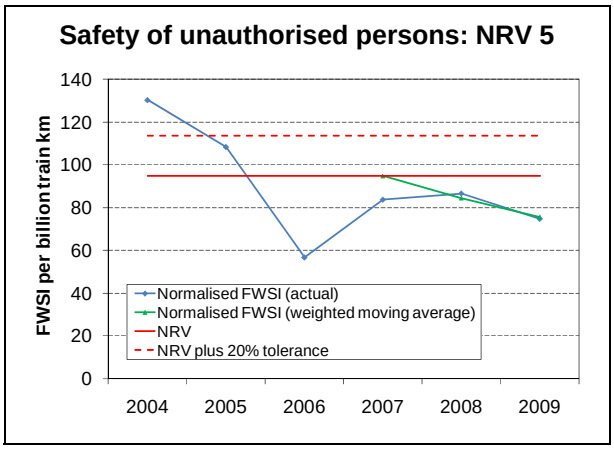


NRV for other persons

- This NRV covers the risk to people who do not fall into any other category. This includes people who are struck by trains in stations (when not trespassing or boarding or alighting from trains) and members of the public who are not trespassing or using level crossings.[14]
- The NRV was not based on UK data because there were too few incidents.
- ERA has decided that it will not present progress against the NRV for others persons in their 2008 report because of poor data quality across the members states.

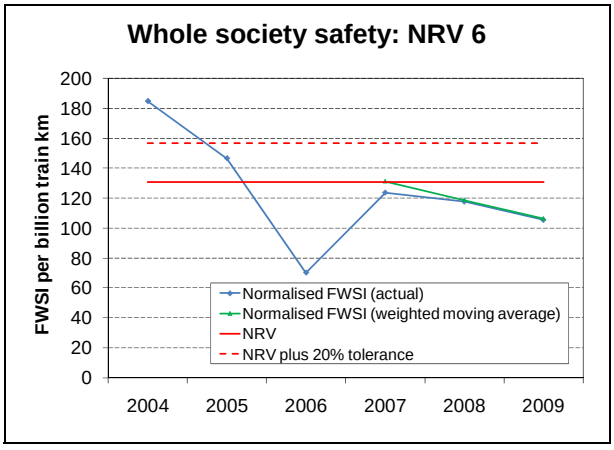
NRV for unauthorised persons

- This NRV covers the risk from trespassers being struck by trains, and from 'train surfers'.
- Performance in 2008 and 2009 was within the NRV.
- The Eurostat data used to set the NRV (2004-07) was based on a different suicide classification than is being applied to CSI data (see footnote 12 in section 3.3.1).



NRV for the whole of society

- This NRV represents the overall impact of the railway on its passengers, staff and members of the public (excluding suicides but including trespassers).
- Performance in 2008 and 2009 was within the NRV.
- Unauthorised persons (that is, trespassers) are the dominant contributor to this risk category. Changes in the risk to passengers, staff, level crossing users and others are likely to have little impact.
- The UK NRV value in this category is the lowest of all member states.



[14] The statistics that ERA is using to assess performance against the NRVs (and which are featured in the charts in this chapter) are based on Eurostat data rather than CSI data. Because *level crossing* users, *unauthorised persons* and *others* are not differentiated in Eurostat data, the casualties classified as *others* in the chart do not necessarily meet the ERA definition of *others* and vice versa. For example, people who fall from the platform and are struck by trains, or are struck by a train when standing too close to the platform edge, do not appear in the chart. See also footnote 13 for more information.

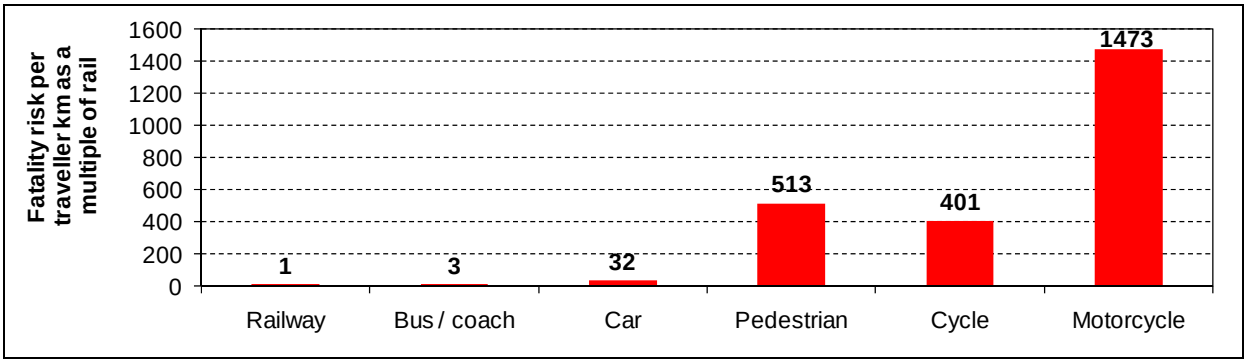
4 Benchmarking railway performance

This chapter looks at railway safety in the wider context. It uses a range of data sources to examine the safety of other transport modes, in other countries and other industries, and compares them with the mainline railway in Britain.

2009/10 Headlines

- Competition between different modes of transport remains intense. The factors that influence transport choices include speed, cost, comfort, convenience, safety and – increasingly – environmental impact. Many regard the relative safety of rail travel compared to other modes as one of its strengths.
  - Public transport is generally safer than private transport.
  - Rail travel is generally safer than road transport.
- International railways differ in terms of infrastructure, rolling stock, working practices and the external hazards they are exposed to. Safety on Britain's railways compares favourably with other EU countries.
- The Health and Safety at Work Act requires employers to ensure, so far as is reasonably practicable, the health, safety and welfare at work of employees. It also places responsibility on all workers to look after their own safety and that of others, including members of the public. Railway work is often regarded as relatively high-risk compared to other occupations.
  - Track worker risk appears to be higher than the risk faced by road construction operatives. Station staff risk appears to be higher than other customer facing occupations. On-board train crew appear to have higher risk of non-fatal injuries than other rail workforce groups.
  - Differences in data quality among comparators groups are likely in industries less well-regulated than the railway.
- RSSB is engaged in a number of workstreams that will enable operators to compare their own performance with the wider industry, and aid safety management.
  - Planned enhancements to SMIS will enable companies to extract safety data and review it via dashboards and drill-down tools.
  - Safety data profiles provided for each train operator allow performance to be seen in the context of overall progress against the SSP trajectories.
  - Work on leading and lagging indicators has the aim of providing information and support in the areas of safety management systems.

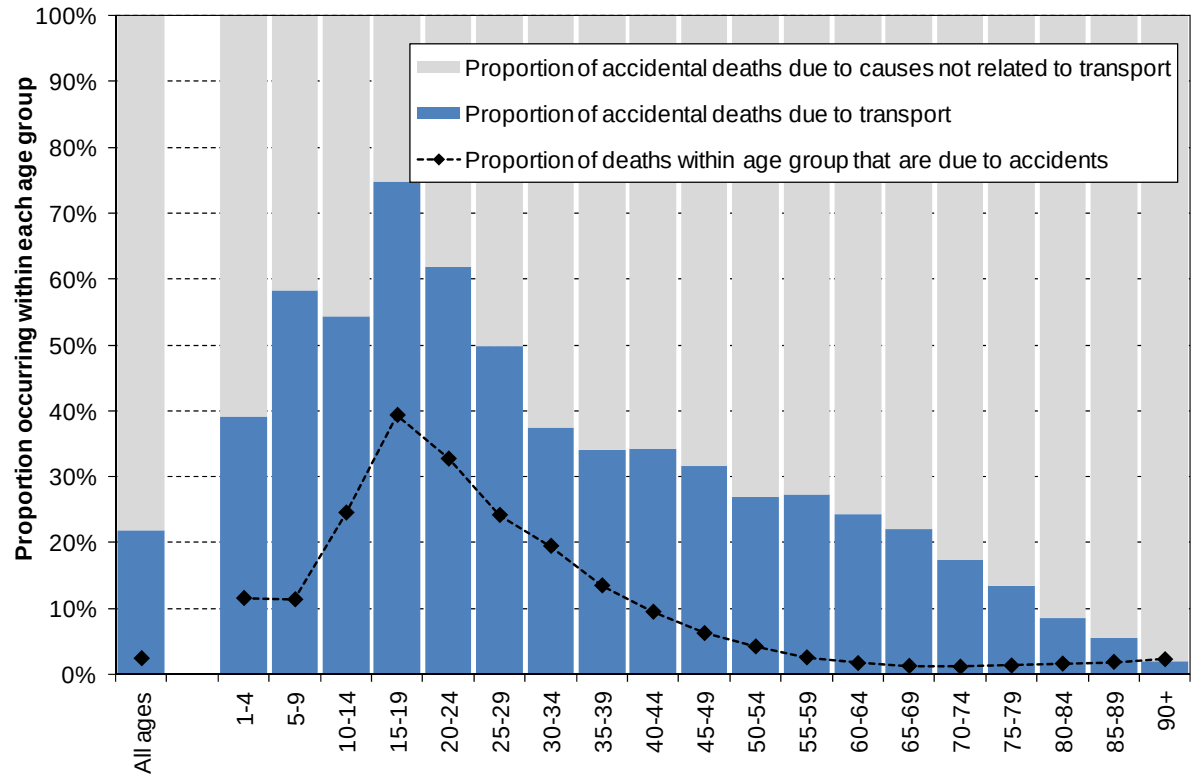
Benchmarking at a glance



4.1 Transport risk in general

Across the British population as a whole, accidental deaths account for just over 2% of the total number of deaths. The average Briton spends just over one hour per day travelling, and in total, transport accidents account for around 20% of all accidental deaths. The vast majority (99% in 2008) of transport deaths result from road traffic accidents, rather than rail, sea or air.

Chart 26. Proportion of deaths due to accidents, by age and cause, 2008[15]



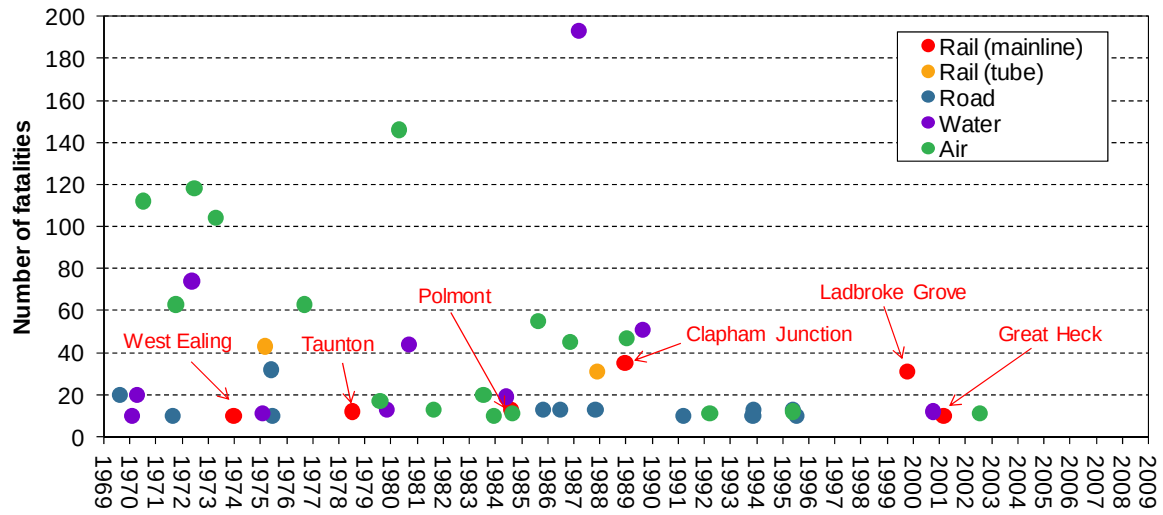
- Taking all ages as a whole, accidents cause 2.4% of the total number of deaths. Other deaths are caused mostly by natural causes, e.g. illness, disease, or existing health conditions, but also include suicide and unlawful killing.
- The rate of accidental death within different age groups varies considerably from the population average of 2.4%. The age group most at risk from accidental death are those aged 15-19: 40% of deaths within this group are due to accidents, of these nearly three quarters are due to some form of transport.
- Nearly 90% of deaths are to those aged 60 or over. Within these older age groups, only a small proportion of deaths are accidental. Of those that are, a decreasing proportion are due to some form of transport; as age increase, there is a tendency to travel less, and an increasing vulnerability to accidents in other locations, such as the home.

[15] Data sources: Office for National Statistics for accident rates by age in (*Mortality statistics – deaths registered in 2008*) and population estimates. Figures in Chart 26 relate to England and Wales only.

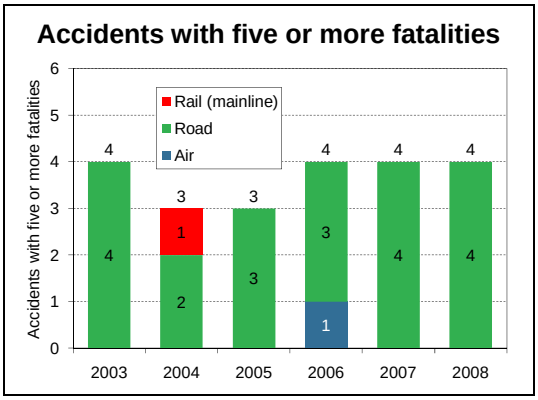
4.1.1 Transport accidents with multiple fatalities

A single accident with a large number of casualties can have a profound effect on the public mood. Fewer than 1,000 passengers have died in train accidents since 1945. A similar number of people are killed in road accidents every five months, yet there is no comparison between the media coverage that these statistics have generated. One reason is that a single train accident has the potential to result in many casualties. Over the past 40 years, roughly two-thirds of British accidents with ten or more fatalities have been transport-related.

Chart 27. Transport accidents with ten or more fatalities since 1969



- Since 1969, there have been six accidents on the mainline railway that have resulted in ten or more fatalities. These represent around 13% of all such transport accidents, and roughly 7% of the resulting casualties.
- The accidents with the highest consequences have involved air and water transport.
- In recent years, high-consequence accidents in all modes have become less frequent. There have been three transport accidents in the past decade with 10 or more fatalities, one of which (at Great Heck) was on the railway.
- Most accidents with five or more fatalities occur on the roads; since 2003, there have been between two and four each year.



- Since the Potters Bar accident in 2002, there have been two train accidents with passenger fatalities: Ufton Nervet in November 2004, where five passengers and the train driver died, and Grayrigg in February 2007, where one passenger died. The train accident at Ufton Nervet, was due to a car deliberately parked on a level crossing by a driver intent on committing suicide.

Data sources: A W Evans (HSE Research Report 073) *Transport fatal accidents and FN-curves 1967-2001* for historical data; Marine Accident Investigation Branch annual reports, DfT (*Road Casualties Great Britain*, various years) and Civil Aviation Authority (*Aviation Safety Review 2008 CAP 780*) for more recent data. Land transport statistics are for accidents in Great Britain. Aviation and shipping accidents are to British-registered craft involved in accidents anywhere in the world. Acts of terrorism have been excluded. The single worst transport accident over the period was the capsizing of the *Herald of Free Enterprise* in 1987, in which 193 people perished.

4.2 Comparing the railway with other modes of transport

4.2.1 Making meaningful comparisons between modes

It can be difficult to compare different modes of transport on a like-for-like basis.

Rail

The risk estimate for rail travellers presented on the previous page covers train accidents and individual accidents that occur on board trains, while boarding or alighting from trains, or in falls from trains. To allow a like-for-like comparison with other modes, other elements of individual risk, such as falls in stations, are excluded. The SRM provides a more robust estimate of the underlying risk than the events that have occurred over a fixed period, as it takes account of the expected frequency and consequence of rare multiple fatality accidents. At current usage levels, the SRM-estimated risk of 0.1 fatalities per billion traveller kilometres[16] corresponds to fewer than five fatalities per year.

Road

More than 2,000 people are killed in road traffic accidents each year. This reflects the widespread usage of road transport (which accounts for more than 90% of the total distance covered by journeys within Britain) as well as its safety. The volume of data means that fairly robust estimates of risk can be obtained from observed events.

The risk estimates apply to the 'average' person making the 'average' journey by each mode. Car drivers, cyclists and pedestrians typically have more control over their destinies than travellers on trains and aeroplanes. Differences in risk levels can be seen in differences in the accident statistics for different demographic groups. Per head of population, around five times as many 18 and 19-year-olds are killed in car accidents as those in the 40-59 age group. Likewise, some environments are inherently safer than others. Driving on motorways is around six times safer than driving on urban roads on a per kilometre basis.

Air

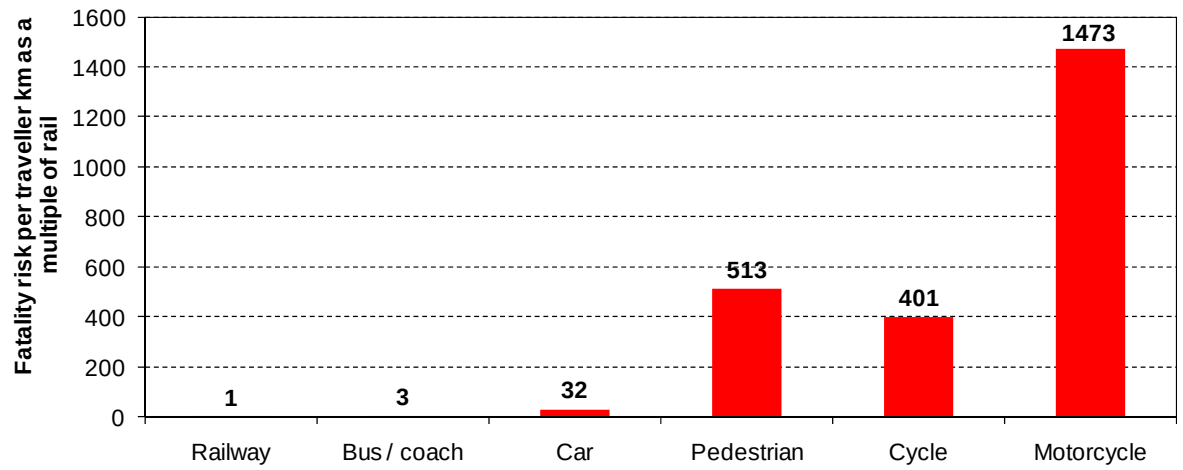
It is very difficult to obtain a robust estimate for the safety of air travel on British carriers. Civil aviation in Britain has had a very good safety record in recent years. The risk from commercial air travel is dominated by accidents that are very rare but of potentially very high consequence. Safety cannot be satisfactorily estimated from historical data alone, so a modelling approach is required. The 2007 ASPR attempted to quantify the risk from air travel on British-registered airlines by considering worldwide accident rates and making adjustments to account for the superior safety records of 'first world' carriers. However, the uncertainty in such models is very large, particularly as they take no explicit account of factors such as the relatively clement British weather, the widespread use of English in aviation, the lack of high ground near airports, and the greater use of landing aids. For this reason, no estimate of aviation safety has been provided in this report. Most existing estimates put air safety either on a par with or somewhat safer than (but of the same order of magnitude as) rail travel on a per kilometre basis.

[16] For comparison, *Transport Statistics Great Britain 2009* estimates for rail travel that there are 0.3 fatalities per billion passenger kilometres, based on the average rate of fatalities associated with train accidents and other accidents involving the movement of trains over the period 1998-2007. A ten-year average will include an influence from multi-fatality events, but is likely to lag behind improvements in safety. The average fatality rate for the period 2006-2008 is 0.07, which is below the SRM estimate.

4.2.2 Relative safety of travel on different transport modes: fatality risk

From the user's perspective, the risk from using a mode of transport can be assessed on the basis of fatalities per traveller kilometre. In theory, this allows him or her to compare the risk from undertaking the same journey using different modes.

Chart 28. Traveller fatality risk for different transport modes (relative to rail) [17]



- The motorcycle is by far the most dangerous mode of popular transport, with a fatality risk per kilometre three orders of magnitude greater than rail.
- Car travel is around 30 times more dangerous, on average, than making a rail journey of the same length.
- Bus and coach travel is around ten times safer than making the same journey by car, but less safe than rail.
- Rail transport has the lowest traveller fatality risk per kilometre. While a measure such as fatalities per kilometre is the best metric for comparing the risk from making the same journey using different modes, fatalities per hour is useful for comparing travel with other activities.
- When a per hour or per trip metric is used, rail loses some of its advantage over other forms of land transport. However, it occupies first or second place, whichever measure is used.
- If a journey has to be made to a given destination, comparing safety using the risk per hour metric penalises the fastest mode of transport.

Traveller fatality risk – other metrics

	Fatality risk per bn traveller…		
	km	hours	trips
Railway	0.1	3	3
Bus / coach	0.2	4	2
Car	1.9	74	26
Cycle	24.0	280	94
Pedestrian	31.0	120	35
Motorcycle	89.0	3,600	1,600

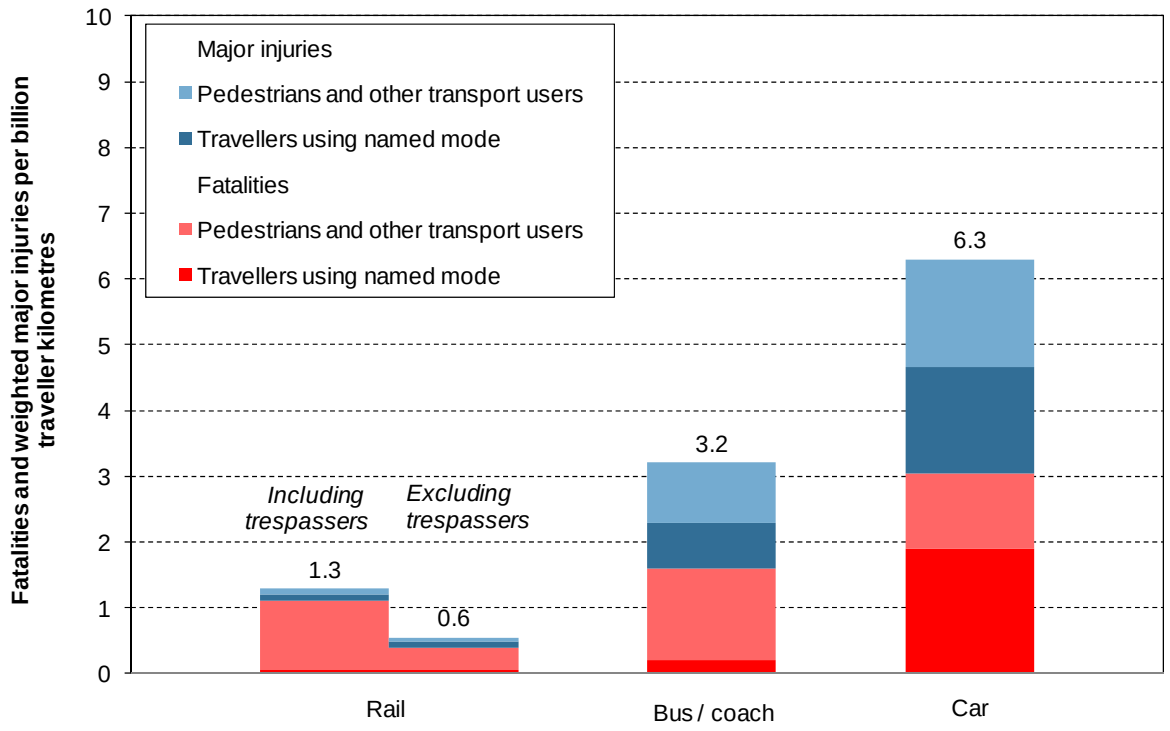
Data source: SRMv6 for rail (based on data to September 2008), DfT for other modes (*Transport Trends 2009* for headline rates and *Reported Road Casualties Great Britain 2008* for casualties to other road users). A three-year average (2006-2008) was used to estimate casualty rates for bus and coach occupants, a single year (2008) for other forms of road transport. In 2008, there were 2,538 road accident fatalities: 572 pedestrians, 115 pedal cyclists, 493 motorcyclists (including 20 passengers), 1,257 car occupants (including 396 passengers), 6 bus and coach passengers (but no drivers), and 95 other road users (mostly occupants of goods vehicles).

[17] Aviation risk is omitted, due to difficulties in obtaining robust estimates (see next page).

4.2.3 Relative safety of travel on different transport modes: total risk

If the risk to users of other modes of transport is considered, for example pedestrians struck by road vehicles, rail's safety advantage increases (if trespass fatalities are excluded).

Chart 29. Traveller total risk for different transport modes (relative to rail)

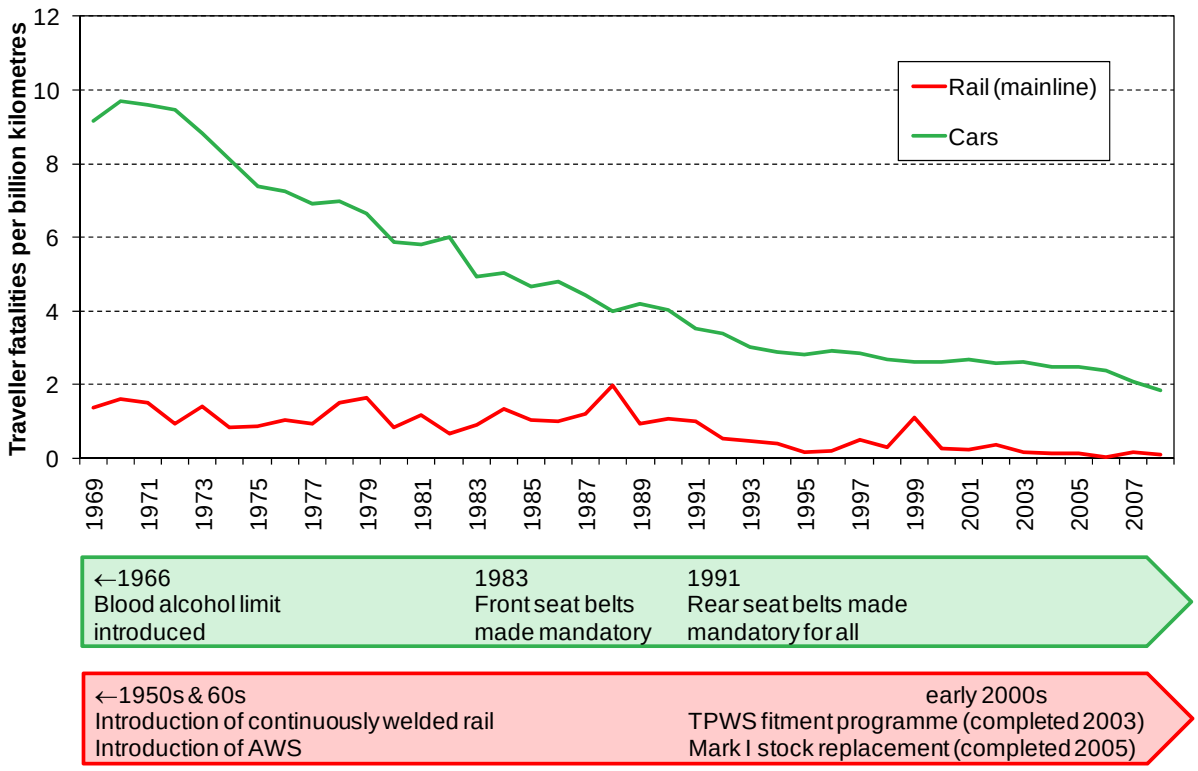


- If the risk to users of other modes of transport is considered, for example pedestrians struck by road vehicles, rail's safety advantage increases (if trespass fatalities are excluded).
- Buses and coaches present a relatively high risk to pedestrians and other transport users. They are heavy vehicles that often operate on busy streets.
- Bus and coach travellers also have a higher rate of major injury than those on trains.
- Cars kill and injure more pedestrians and other road users than trains, even when normalised by usage. Interactions between people and trains (other than for those travelling on them) tend to be limited to level crossings and stations.

4.2.4 Safety trends in car and train travel

Safety has improved on most modes of transport – and in many other areas of life – over recent decades. There are many reasons for this, including technological developments, an improved understanding of human behaviour, changing attitudes towards risk, increasing wealth and medical advances.

Chart 30. Safety trends in rail and car travel since 1969



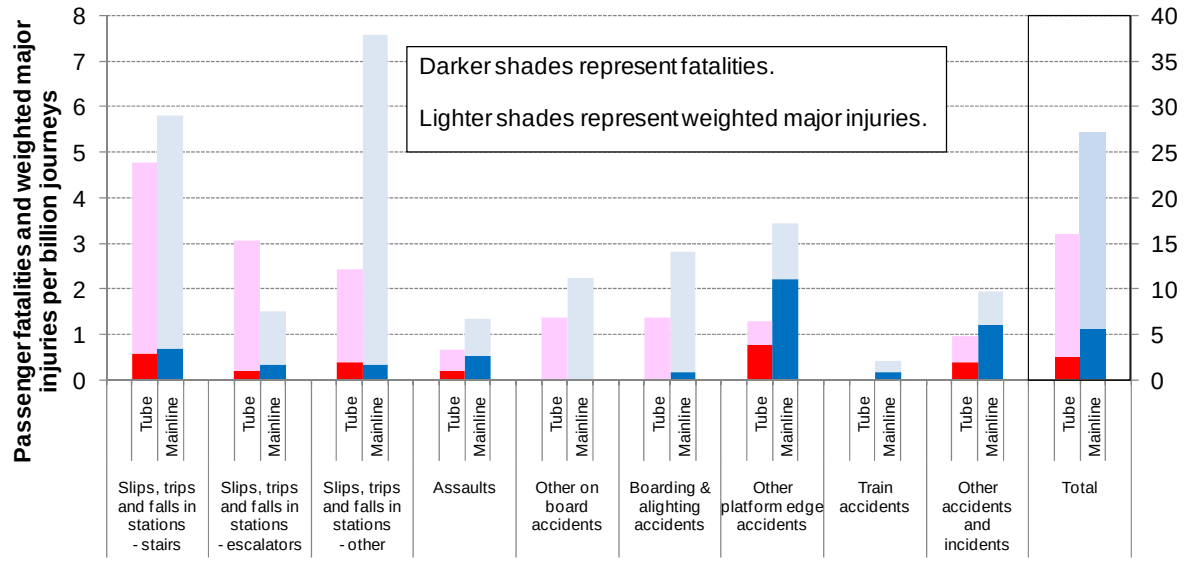
- There have been substantial improvements in the safety of both road and rail transport over the past four decades, although car travel today is still less safe than rail travel was 40 years ago.
- Improvement has generally been via gradual trends rather than step changes. Although it is possible to identify significant safety developments, their effects tend to be spread over a number of years and many other factors have also played a part.
- The safety of car travel improved at a faster rate than rail safety between the early 1970s and the early 1990s.
- From the early 1990s to the mid 2000s, the gap widened again (in relative terms). There were major safety improvements on the railway, while the safety of car occupants improved at a much slower rate (around 1% per year).
- Car safety has improved significantly in 2007 and 2008. There were reductions in a number of areas, including deaths involving young drivers of cars and drivers of larger engine motorcycles.

Data sources: DfT for historical car safety data. Like car safety, rail safety is based on actual fatalities per year (using ORR data for historical rates and RSSB data for recent years). This differs from Chart 28, in which rail safety is based on data from SRMv6. For rail, a single event can have a substantial effect on that year's fatality rate. For example, the chart shows peaks in 1988 and 1999, reflecting the major train accidents at Clapham Junction and Ladbroke Grove.

4.2.5 Comparing the mainline railway and London Underground

Users of tram and metro systems are exposed to hazards similar to those found on the mainline railway. The number of journeys made each year on London Underground is broadly similar to the number made on the national rail network. Each was used for more than one billion journeys in 2009.

Chart 31. Fatality/weighted injury profile for the mainline railway and London Underground



- Measured by FWI per passenger journey, London Underground is safer than the mainline railway. This may be due to different passenger profiles and the frequency and regularity of services (people tend to spend less time waiting for trains in tube stations and trains calling at a platform tend to serve the same, or a smaller set of, destinations). Tube journeys tend to be shorter, and station areas smaller, with fewer retail outlets.
- The only accident type more prevalent on the tube is slips, trips and falls on escalators. There are more than 400 escalators on the network's 270 stations.
- Over the past five years, both the mainline and tube network have seen improvements in safety. There have been no train accidents with passenger fatalities on the Underground (excluding the terrorist attacks in July 2005). The mainline experienced Grayrigg (February 2007).

Data sources: Accident data for the London Underground supplied by Transport for London. Data for both the mainline railway and London Underground is based on the five-year period 2005-2009. Normalising data are from ORR (*National Rail Trends*) and DfT (*Transport Statistics Great Britain 2009*). Major injuries are given a weight of one-tenth (of a fatality). Deaths and injuries resulting from natural causes, trespass, suicide and terrorism have been omitted. Assaults on passengers are under-represented in SMIS data so the chart may underestimate this component of mainline risk.

4.2.6 Freight transport: comparison of fatality rates by road and rail[18]

Both road and rail are used to transport freight goods. They offer different benefits and risks. Due to its 'door-to-door' nature, transport by road may appeal from a convenience point of view, but has a greater environmental impact, and results in different levels of safety risk.

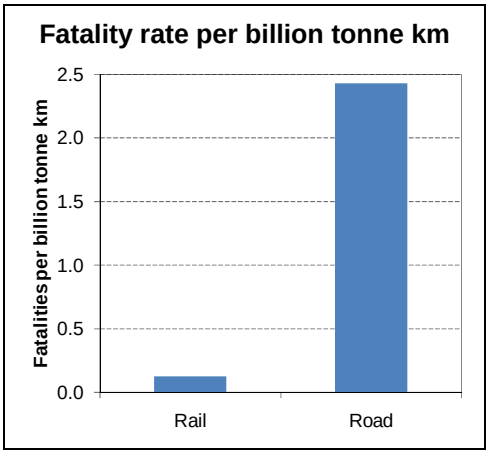
The safety risk from freight transport by road comprises risk to freight vehicle drivers, occupants of other vehicles involved in accidents with freight vehicles, and pedestrians hit by freight vehicles. The safety risk from freight transport by rail comprises risk to freight train drivers, occupants of other trains involved in accidents with freight trains, and trespassers or level crossing users hit by freight trains. Suicide is excluded because the absence of freight traffic is not likely to affect number of fatalities from this cause. Deaths by other causes, which are not related to train movement (eg electrocution, slips, trips and falls, assault) are similarly excluded.

Table 5. Freight fatality and usage statistics 2006 to 2008

Road	2006	2007	2008	Total
Freight carried (billion tonne km)	167	173	163	503
Freight km (billion)	29.1	29.4	28.7	87.2
Fatalities involving HGVs	419	435	368	1222

Rail	2006	2007	2008	Total
Freight carried (billion tonne km)	22	21	21	64
Freight km (million)	45.6	41.8	39.5	126.9
Trespass/LX fatalities involving freight trains	8	9	9	29.6
Train accident risk involving freight (SRMv6)	1.2	1.2	1.2	

- Over the period shown, the amount of freight carried by road was 503 billion tonne km. There were 87.2 billion road freight vehicle km and 1222 fatalities involving road freight transport.
- Over the same period, the amount of freight carried by rail was 64 billion tonne km. There were 126.9 million rail freight km and 26 fatalities. There were no fatalities caused by train accidents involving freight trains over the period, but to take account of the possibility of this, the actual number of fatalities is adjusted by the SRMv6 estimated contribution from this source. This brings the expected total to 29.6 fatalities.
- The statistics indicate a rate of 2.43 fatalities per billion tonne km for road freight, compared with 0.46 fatalities per billion tonne km for rail freight. On this basis, rail compares favourably with road. However, the situation is reversed if the comparison is made on a per vehicle km basis. This is because per km travelled, rail carries more than 80 times the tonnage of road. This is partly due to the different types of freight carried by each, as well as the larger vehicle volume. For example, nearly 40% of rail freight is coal, while for road freight the proportion is 1%.



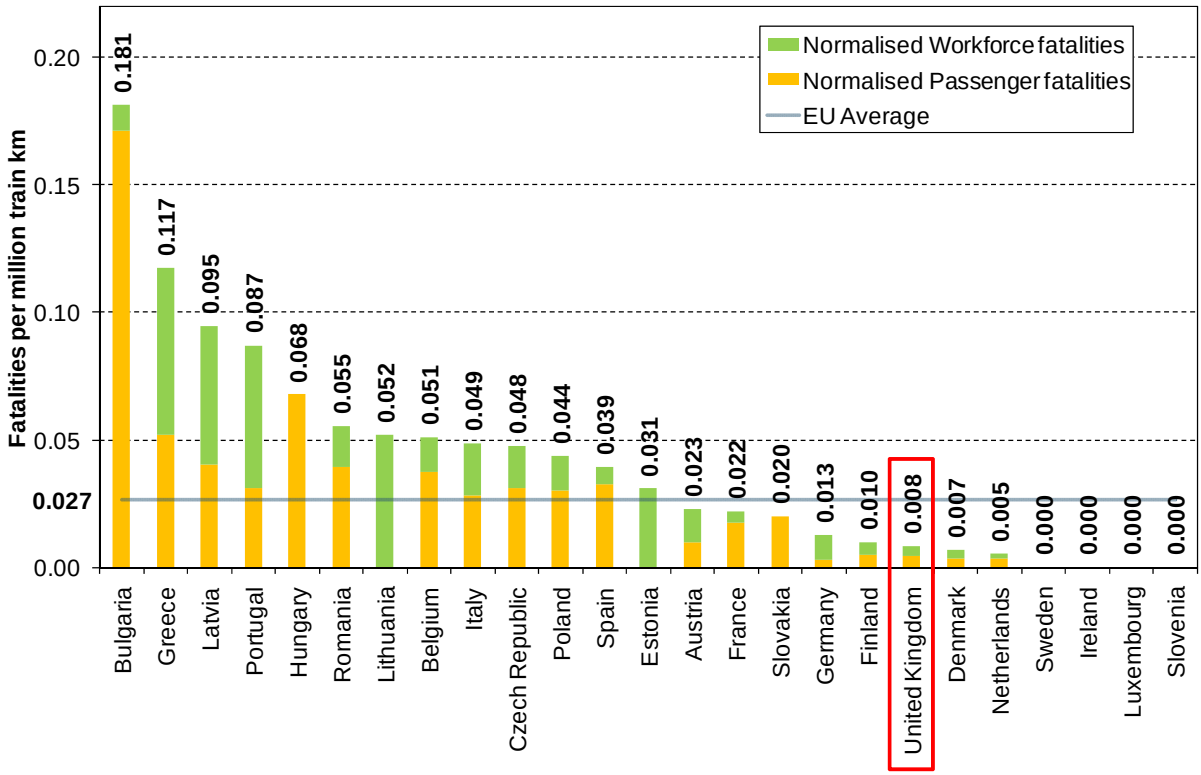
[18] Data sources: Road: Transport Statistics Great Britain 2009; Road Casualties Great Britain, 2006 and 2007; Reported Road Casualties Great Britain 2008. Rail: SMIS, Network Rail.

4.3 International comparisons

4.3.1 Comparing rail safety within the EU

Countries across Europe submitted their second set of Common Safety Indicators to the European Rail Agency in 2008. Once this process is established, the availability of safety statistics based on a consistent set of definitions will make it easier to compare the safety performance of different railway networks.

Chart 32. Passenger and workforce fatality rates on European Union railways 2005-2008



- Passenger and workforce fatality rates in Great Britain were well below the EU average over the four-period 2005-2008. (This is the same period as the one used by ERA for assessing 2008 performance against the National Reference Values.)
- The countries with similar rates to Britain include Germany, the Netherlands and Scandinavian countries.
- In general, countries in northern and western parts of Europe have safer railways than those further south and east. Slovenia (with no fatalities in the period) is an exception.
- A single multiple fatality accident can have a significant effect on the accident rate, especially for smaller countries.

Data source: Eurostat. The data cover the four-year period 2005-2008. Figures are normalised by train kilometres. Only accidents relating to railway vehicles in motion are included, and the ERA definition of a passenger differs from that used in Great Britain (see section 3.3.1), so the UK figures do not match those presented elsewhere in this report. There are issues with data quality for some states, for example as a result of the different member states' interpretations of scope and definitions. ERA is currently working with member states to ensure that the data they submit is as complete as possible. The chart covers the 27 members of the EU except Malta and Cyprus, which no longer have railways.

4.3.2 Railway safety worldwide

Railways differ in terms of infrastructure, rolling stock, working practices, and the external hazards they are exposed to, but lessons can be learnt from international events. They can reveal accident scenarios that are rare in Britain, identify possible vulnerabilities and show the potential for harm if effective controls are not maintained.

The table lists all identified train accidents in which five or more passengers and workforce were killed. It covers the 15-month period January 2009 to March 2010, due to the shift from calendar year to fiscal year coverage of the ASPR. There were 18 such accidents.

The two worst incidents (27/11/09 and 29/03/10, 39 deaths each) were both due to terrorist action in Russia. The third worst, and the worst in the EU, was on 29/6/09 when 32 people died after an explosion caused by a derailment in Italy.

The table excludes most collisions between trains and road vehicles at level crossings, as most casualties in such accidents tend to be road users.

Table 6. Worldwide train accidents with five or more fatalities

Date	Place, country	Fatalities	Accident type	Key issues
13/02/09	Bhubaneswar, **India**	15+	Passenger train derailment.	Train speed; infrastructure maintenance.
29/03/09	Gulwe, **Tanzania**	12+	Rear-end collision between passenger train and freight train.	Freight train driver stopped train without informing signaller (led to legal action).
22/06/09	Washington DC, **USA**	9	Rear-end collision between two passenger trains.	Wrongside signal failure. See RSSB's Operational Feedback Update on Opsweb.
29/06/09	Viareggio, **Italy**	32	Freight train (LPG) derailment; tank rupture and explosion.	Axle integrity.
24/07/09	Rudine, **Croatia**	6	Passenger train derailment.	Local temperature; flange lubricant left on line.
30/08/09	Yaounde, **Cameroon**	5	Passenger train derailment.	Possible infrastructure management issues.
05/10/09	Hua Hin, **Thailand**	7	Passenger train derailment.	SPAD; fatigue/drug issues.
21/10/09	Agra, **India**	21	Rear-end collision between two passenger trains.	SPAD.
24/10/09	Al-Ayaat, **Egypt**	25	Rear-end collision between two passenger trains.	Lack of signal protection.
02/11/09	Uttar Pradesh, **India**	14	Level crossing collision.	Crossing user behaviour led to multiple passenger fatalities on a crowded passenger train.
03/11/09	Karachi, **Pakistan**	17	Collision between passenger train and freight train.	SPAD.
14/11/09	Banshkov, **India**	9+	Passenger train derailment.	Broken rail; possible train speed issues.
27/11/09	Bologoye, **Russia**	39	Passenger train derailment.	Terrorist action (bomb).
02/01/10	Panki, **India**	10	Rear-end collision between two passenger trains.	SPAD.

Note: Excludes train accidents with solely public fatalities.

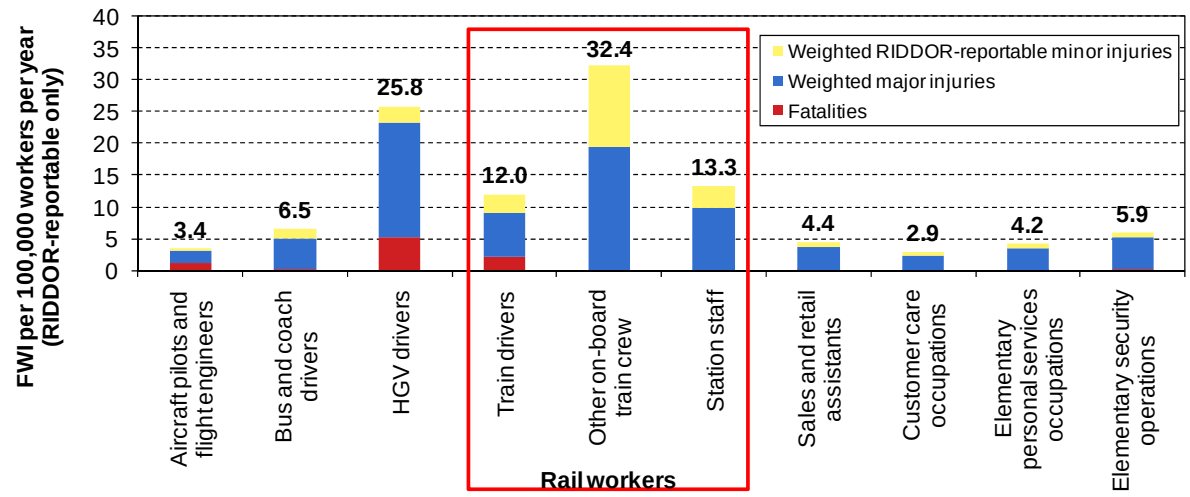
4.4 Occupational risk: comparisons with other industries

The Health and Safety at Work Act requires employers to ensure, so far as is reasonably practicable, the health, safety and welfare at work of employees.[19]

4.4.1 Safety at work: train drivers and station staff

Although no other jobs are exactly comparable to railway occupations, bus and lorry drivers face hazards similar to those of train drivers. Train crew and station staff experience some of the same hazards as others in customer-facing roles, plus other hazards specific to the railway environment.

Chart 33. Train crew and station staff risk compared with other occupations 2006/7-2008/9



- Train drivers have a lower level of risk than the drivers of heavy goods vehicles (HGVs). Road accidents account for most HGV driver fatalities, but a minority of major injuries, which can occur while loading and unloading or moving around depots and loading bays. Train drivers have a higher level of risk than drivers of buses and coaches.
- Other on-board crew appear to have a high level of risk compared with other groups, though this may be due at least partly to better reporting of minor accidents. Around 70% of crew are guards/conductors; most of the rest are hosts/catering staff. The risk mostly arises from 'everyday accidents' – high frequency but typically low consequence; see Chapter 6*: Workforce safety*. Main causes of injury include:
- Physical assault and verbal abuse (these account for almost one-third of risk)
  - Slips, trips and falls: on trains and in stations
  - Boarding and alighting
  - Scalds and burns
  - Train movement: losing balance & dislodged objects
  - Contact with train interior
- Station staff have a higher level of risk than some other customer-facing jobs. While injuries may be under-reported for some of the other occupations, distorting the comparison, station staff also face railway-specific hazards.

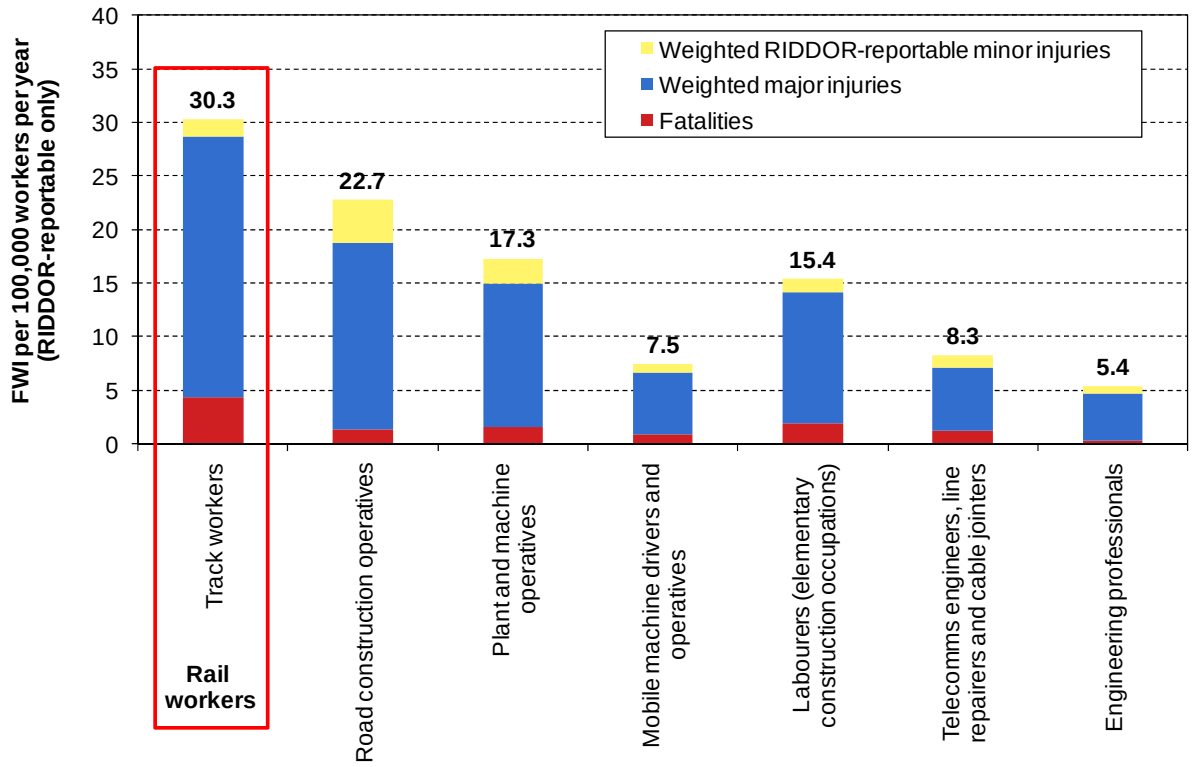
Data sources: see next page.

[19] The Act also requires workers to look after the safety of themselves and colleagues, passengers and the public.

4.4.2 Safety at work: track workers

Track workers are exposed to many of the hazards associated with general construction work, as well as railway-specific hazards, such as proximity to moving trains and unguarded electricity supplies.

Chart 34. Track worker risk compared with other occupations 2006/7-2008/9



- Track work is relatively high risk. Track workers appear to be exposed to a higher risk than road construction operatives; however, there is a substantial element of uncertainty in both estimates. They also appear to have a higher level of risk than plant operatives, mobile machine drivers and labourers, although it is possible that reporting rates are lower among these groups.
- Other groups of workers, such as shunters in the freight sector, may be exposed to a higher level of risk than track workers. An RSSB special topic report published in 2008 estimated that freight shunters have a RIDDOR-reportable injury rate that is more than twice that of track workers.

Data sources: Health and Safety Executive for non-rail occupations, with bus, coach and HGV driver rates amended to include fatalities and serious injuries in road traffic accidents (using DfT's *Reported Road Casualties Great Britain 2008*). Other injuries in road traffic accidents are excluded because the statistics contain no equivalent to RIDDOR-reportable injuries. Injury data for railway staff relates to the three-year period April 2006-March 2009. The categories correspond to occupations and occupation groups defined under the Standard Occupational Classification (SOC) 2000. Safety comparisons must be viewed with caution because (i) some groups (especially the rail occupations) cover a relatively small number of workers so there is a large element of statistical variation, especially for fatality risk, and (ii) there are known problems with the under-reporting of injuries, which may disproportionately affect the statistics for those working in less well-regulated industries. HSE estimates that, across the board, roughly 50% of RIDDOR-reportable non-fatal injuries are not reported to them. As in the rest of the report, in the combined measure of FWI, major injuries are given a weighting of one-tenth and other RIDDOR-reportable injuries are given a weighting of one-two-hundredth. These weights differ from those that DfT usually applies to fatalities and serious injuries when considering road accidents.

4.5 Benchmarking within the industry

It is useful for railway companies to be able to benchmark their own safety performance against that of similar organisations. This may help to identify areas in which they are industry leaders, and areas to focus on improving. Making meaningful comparisons between organisations is difficult, as results can be influenced by factors such as reporting rates and statistical variation as well as reflecting different operating environments. RSSB continues to work with the industry to improve the provision of safety intelligence at the local as well as the national level. Three recent or ongoing developments are listed below.

SMIS Vision

SMIS 9, the latest phase of the SMIS vision project, went live in April 2010. The enhancements to the system are aimed at making it easier for rail companies to extract safety management information. The two main additions to reporting capability are:

- Dashboards that will provide senior managers with the ability to view current benchmarking data on how their organisation is performing.
- Ad hoc reporting software to allow industry safety analysts to query data, produce reports and charts, and 'drill down' to event details.

SMIS dashboard

Safety data profiles

RSSB produces an annual safety data profile for each passenger train operator. This provides each organisation with information on how its recent safety performance compares with the rest of the industry, and with the overall improvement projected in the 2009-14 Strategic Safety Plan (SSP).

RSSB will be working with the Association of Train Operating Companies (ATOC), which produces regular key performance indicators for train operators, to determine how to best meet the needs of its members in 2010/11.

Research into safety performance indicators (SPIs)

RSSB is currently undertaking research project *T852: Investigation into the application of leading and lagging indicators in the rail industry*. The objectives of the project are:

- To develop guidance representing good practice in the development and use of leading and lagging indicators of safety risk within the railway industry.
- To propose developments to RSSB's supporting services, tools and processes to aid in the implementation of this guidance and ongoing safety monitoring and management activities.

The guidance will cover the generic principles and application of SPIs, and be aimed at the industry as a whole. Detailed examples will focus primarily on passenger train operating companies, although future extensions to cover other parts of the industry are being considered. The project is due to be completed in late 2010.

5 Risk to passengers

For the purposes of RSSB data, a passenger is any person on railway infrastructure who intends to travel, is in the process of travelling, or has travelled. This is regardless of whether he or she has a valid ticket. The exceptions are travellers who trespass or who commit, or attempt to commit, suicide. People who are injured in this way are classified and analysed as members of the public (see Chapter 7 - *Risk to members of the public*).

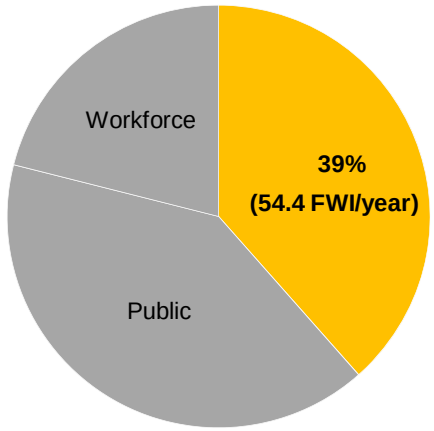
A detailed breakdown of passenger fatalities and injuries is presented in the key safety facts table at the end of this chapter.

2009/10 Headlines

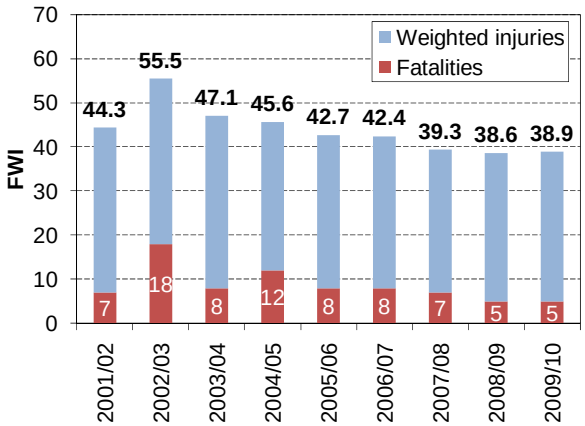
- There were no passenger fatalities in train accidents. This is the third year running with no such fatalities.
- There were five passenger fatalities, 238 major injuries, 5,266 minor injuries and 197 cases of shock/trauma reported.
- The five passenger fatalities occurred in separate incidents at stations. This is equal to the lowest passenger fatality total ever recorded. In one of the events, alcohol was recorded as a factor.
- The total level of passenger harm in 2009/10 was 38.9 FWI, compared with 38.6 FWI that was recorded in 2008/09. However, when normalised by passenger journeys, 2009/10 shows a 5% increase in rate on 2008/09. This is because of the downturn in passenger journeys that has occurred in the current economic climate.
- BTP data shows that both the absolute number and normalised rate of assaults on passengers continue to reduce; the average rate of recorded assault is currently around one per 400,000 journeys. National Passenger Survey data shows that passengers' perceptions of their personal security continue to improve.
- Passenger risk profiles differ with age and gender, with elderly people and females being more susceptible to slips, trips and falls. A greater proportion of passenger harm occurs during the autumn and winter periods.

Passenger safety at a glance

Passenger risk in context (SRMv6)



Trend in passenger harm

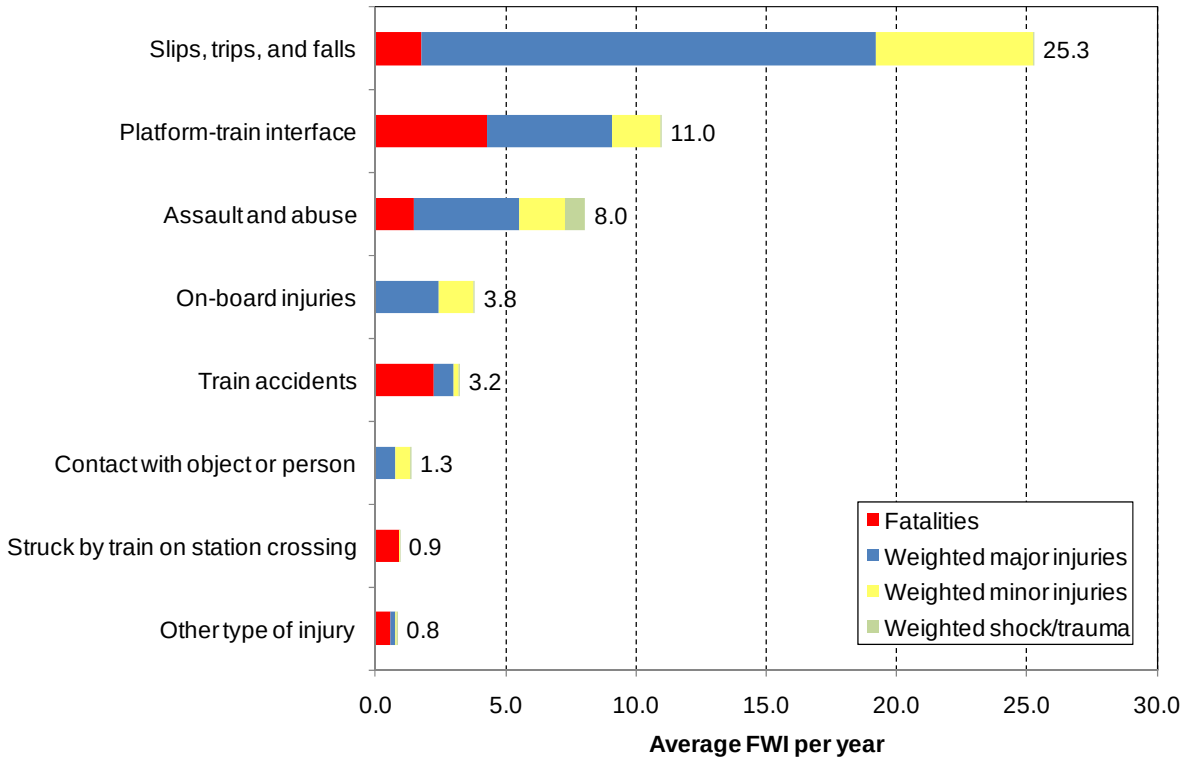


5.1 Passenger risk profile by accident type

Although risk to passengers and the risk from train accidents are strongly linked in the public mind, passengers are more likely to be injured as a result of other hazardous events. Some of these, such as slips, trips and falls, or assaults, are not particular to the railway environment.

Descriptions of the types of events that are included in each accident type grouping are shown in Appendix 5.

Chart 35. Passenger risk by accident type: 54.4 FWI per year



Source: SRMv6

- Slips, trips and falls account for 47% of passenger FWI risk. Most of this risk arises from major injuries.
- Passenger accidents at the platform-train interface account for the largest proportion of passenger fatality risk, at 38%. This category of accidents includes injuries during boarding and alighting, but also injuries when no train is present, such as falls from the platform edge.
- Train accidents account for 6% of passenger FWI risk and 20% of passenger fatality risk – the next highest contributor to passenger fatality risk after accidents at the platform-train interface.
- Assault on passengers is estimated to contribute 8.0 FWI per year, which is 15% of the passenger FWI risk. Passenger assaults are not regularly reported into SMIS, and the SRM estimate is therefore based on BTP data.
- The category *other type of injury* includes events such as falls from height, exposure to hazardous substances, manual handling injuries and station fires.

5.2 Passenger fatalities and injuries in 2009/10

More than a billion passenger journeys took place during the year. The following injuries were recorded.

Fatalities

- There were no passenger fatalities in train accidents during 2009/10.
- There were five passenger fatalities in other, separate, incidents. All fatalities occurred during the autumn/winter months; an analysis of passenger safety by season is presented in section 5.6.6.

Table 7. Passenger fatalties in 2009/10

Date	Location	Accident type	Territory	Description of incident
11/11/09	West Ealing	Platform-train interface	Western	A man walking close to the platform edge was killed after he stumbled and was struck by a train arriving at the platform.
21/11/09	Angmering	Platform-train interface	South East	A young woman, who was running alongside a train as it was departing the station, came into contact with the train and fell from the platform.
03/01/10	Carshalton Beeches	Platform-train interface	South East	A man fell from the platform onto the track, and was struck by a through train after being unable to climb back up to the platform. Alcohol was reported as a factor.
30/01/10	Streatham	Platform-train interface	South East	A man, sitting on a platform bench, stood up, stumbled and fell from the platform onto the live rail and was electrocuted.
04/02/10	Liverpool Central	Slip, trip or fall.	London North Western	An elderly woman lost her balance on an escalator, falling and hitting her head.

Major injuries

- There were 238 passenger major injuries in 2009/10.
- 83% occurred at stations, and around three-quarters of these were slips, trips and falls.
- There were three major injuries in train accidents[20].

Minor injuries

- There were 5,266 recorded minor injuries, 1,162 (22%) of which were RIDDOR-reportable (ie the injured party went straight to hospital).
- Of the reportable minor injuries, 91% occurred at stations, with around three-quarters again being due to slips, trips and falls.

Shock and trauma

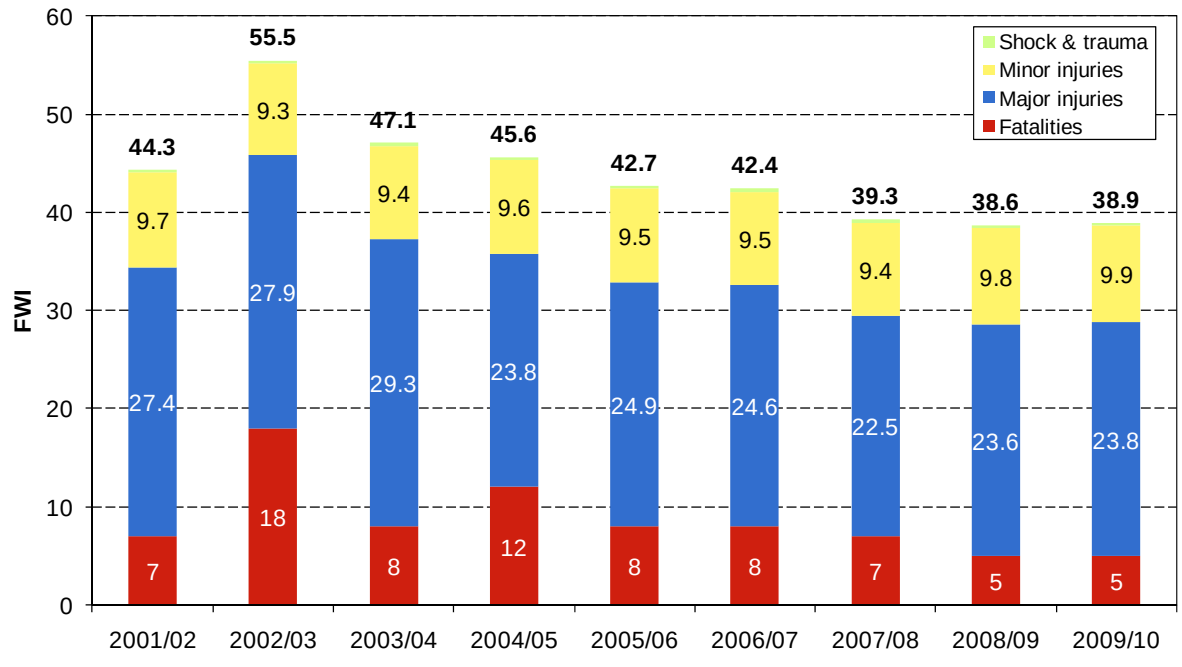
- There were 197 recorded cases of passenger shock or trauma, three of which were Class 1. Of the Class 1 incidents, two were the result of train accidents and one was the result of witnessing a trespasser fatality.

[20] Details of these can be found in Chapter 8 - *Risk from train accidents*.

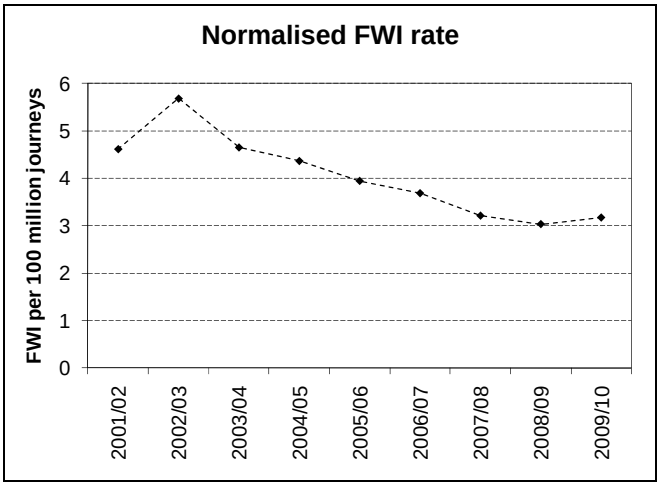
5.3 Trends in passenger harm by injury degree

Based on SRMv6, the average level of risk to passengers is 54.4 FWI per year, of which 11.3 (21%) is fatalities. The SRM figure includes the risk from low frequency, high consequence events, so the actual level of harm in any particular year may be lower (or higher) than the SRM estimate. SMIS data does not contain complete information on passenger assault, which is another reason for differences in passenger FWI levels compared with the SRM value. Passenger harm from assault is analysed using BTP data: see section 5.5 for details.

Chart 36. Passenger FWI by injury degree



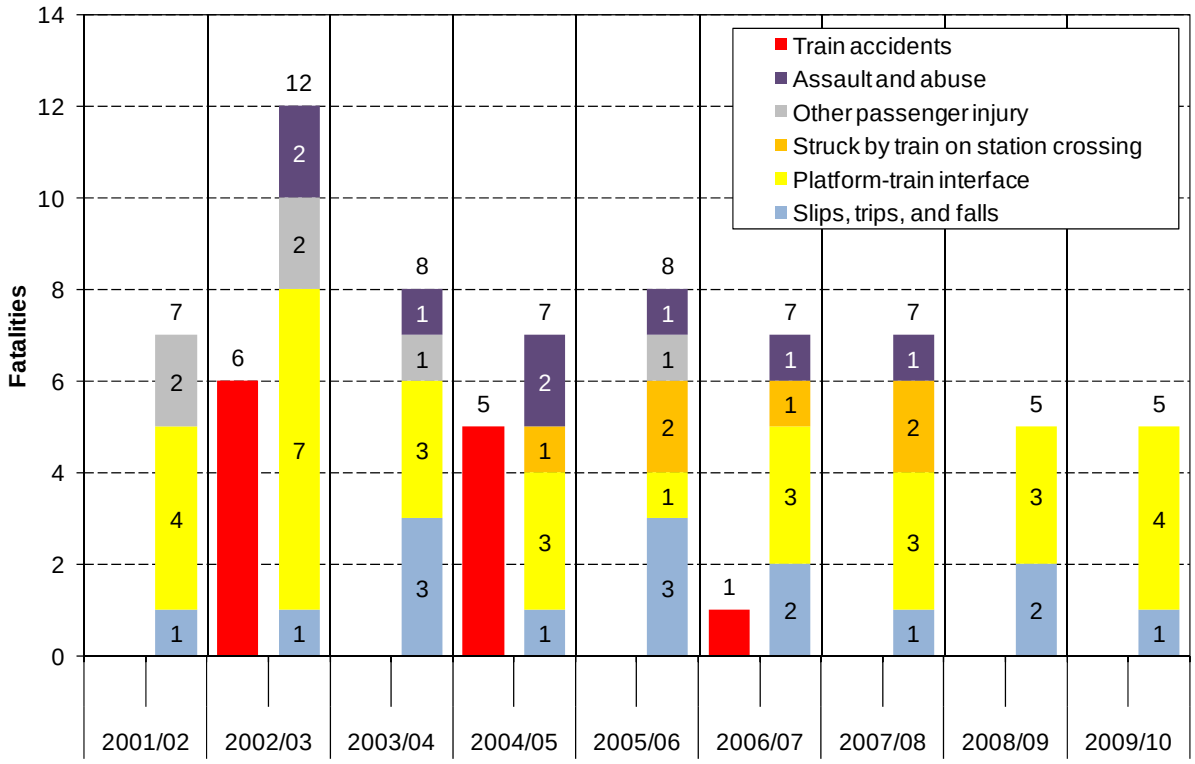
- The level of passenger FWI recorded for 2009/10 was 38.9. Performance over the past three years has been very similar; 2009/10 is virtually unchanged from 2008/09.
- At five, the number of fatalities recorded for 2009/10 was equal to the previous year, which was the lowest number recorded.
- Weighted major injuries dominate total passenger harm over the period shown. The number of major injuries for 2009/10 was commensurate with recent years.
- When performance is normalised by passenger journeys, 2009/10 shows an increase of 5% compared with the previous year. Although there has been little change in FWI since last year, there has been a reduction of 4% in passenger journeys as a result of the economic situation. The normalised rate therefore shows a rise.



5.3.1 Passenger fatalities

Of the 11.3 fatalities per year estimated by SRMv6, 2.3 (20%) are estimated to occur in train accidents, while the risk from other accidents is estimated to be 9.0 fatalities per year (80%). However, as train accidents are low-frequency but potentially high-consequence events, the actual number of train accident fatalities in any given year can differ greatly from this.

Chart 37. Passenger fatalities by accident type



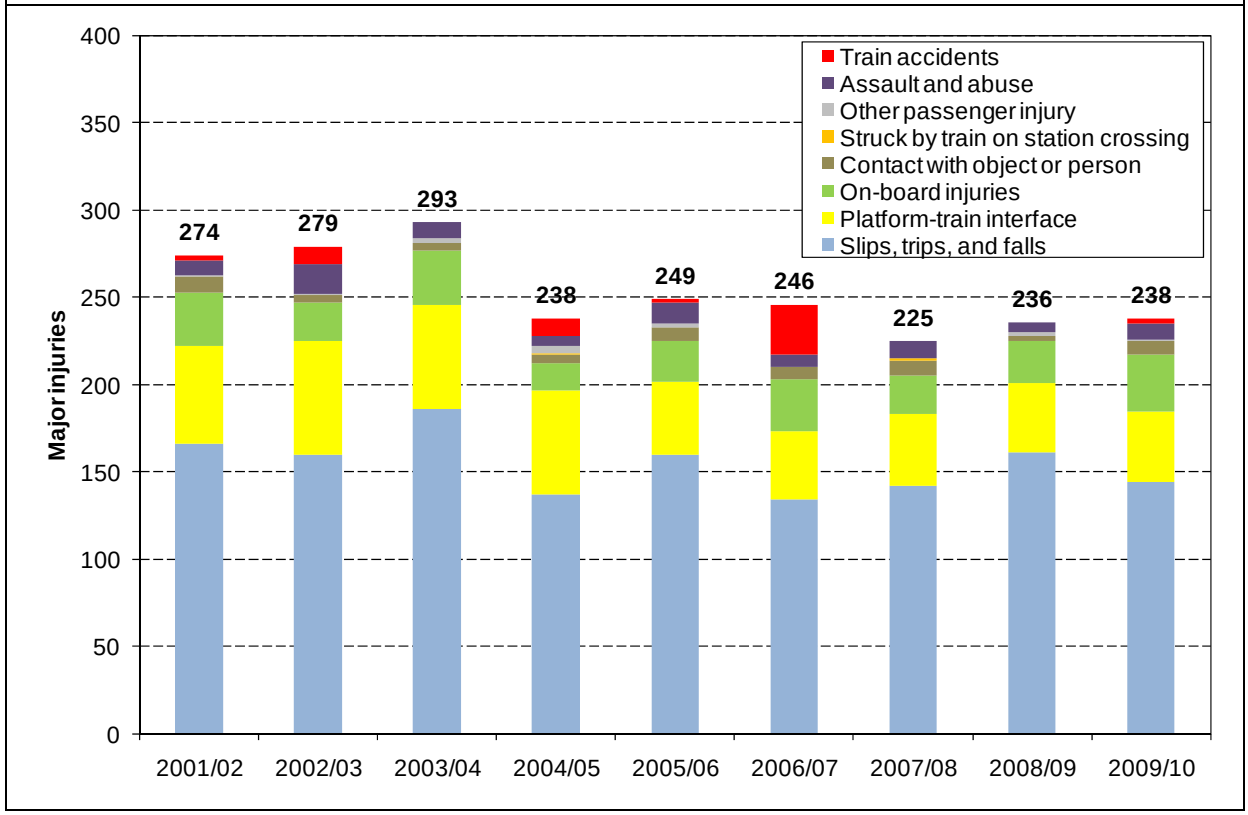
- The five passenger fatalities in 2009/10 all occurred in separate accidents at stations. Four occurred at the platform-train interface, none of which were during boarding or alighting. The fifth was the result of a fall on an escalator.
- It is possible for a single train accident to result in many fatalities; conversely, there have been a number of years with no fatalities due to this cause. The last three years have seen no passenger fatalities in train accidents.
- Since 2003/04, there have been no passenger fatalities as a result of falling from moving trains[21]. The risk associated with falls from moving trains has reduced since the early part of the decade, largely due to the removal of Mark 1 (slam door) rolling stock.

[21] In 2007, there were two incidents of people deliberately jumping from High Speed Trains (HSTs), which utilise Mark III coaching stock. The doors on this stock are centrally locked, but have sprung droplight windows out of which it is possible to climb. Passengers who deliberately decide to exit a train in running are classed as engaging in trespass; these events are therefore covered under Chapter 7 - *Risk to members of the public*.

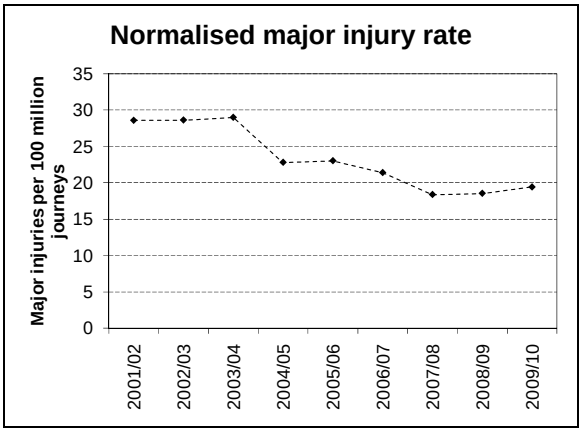
5.3.2 Passenger major injuries

A passenger injury is classed as major where it satisfies RIDDOR 1995 Schedule 1[22]. SRMv6 estimates passenger major injuries to account for 30.4 FWI per year, which is 56% of the total passenger risk. Most major injuries to passengers occur when people are moving around the station – predominantly as a result of slips, trips and falls.

Chart 38. Passenger major injuries by accident type



- The total number of major injuries in 2009/10 was near level with 2008/09. Since 2004/05, yearly numbers of major injuries have been consistently lower.
- Three passengers received major injuries in two train accidents in 2009/10. Both accidents were low-speed collisions in stations: poor adhesion due to prevailing weather conditions was a factor in each incident.
- The majority of major injuries are due to slips, trips and falls. The number of such events during 2009/10 was lower than the previous year; this was countered by a rise in the number of on-board injuries.
- After a period of reduction, the normalised passenger major injury rate is now showing a slight upward trend. Passenger journeys have fallen in 2009/10.

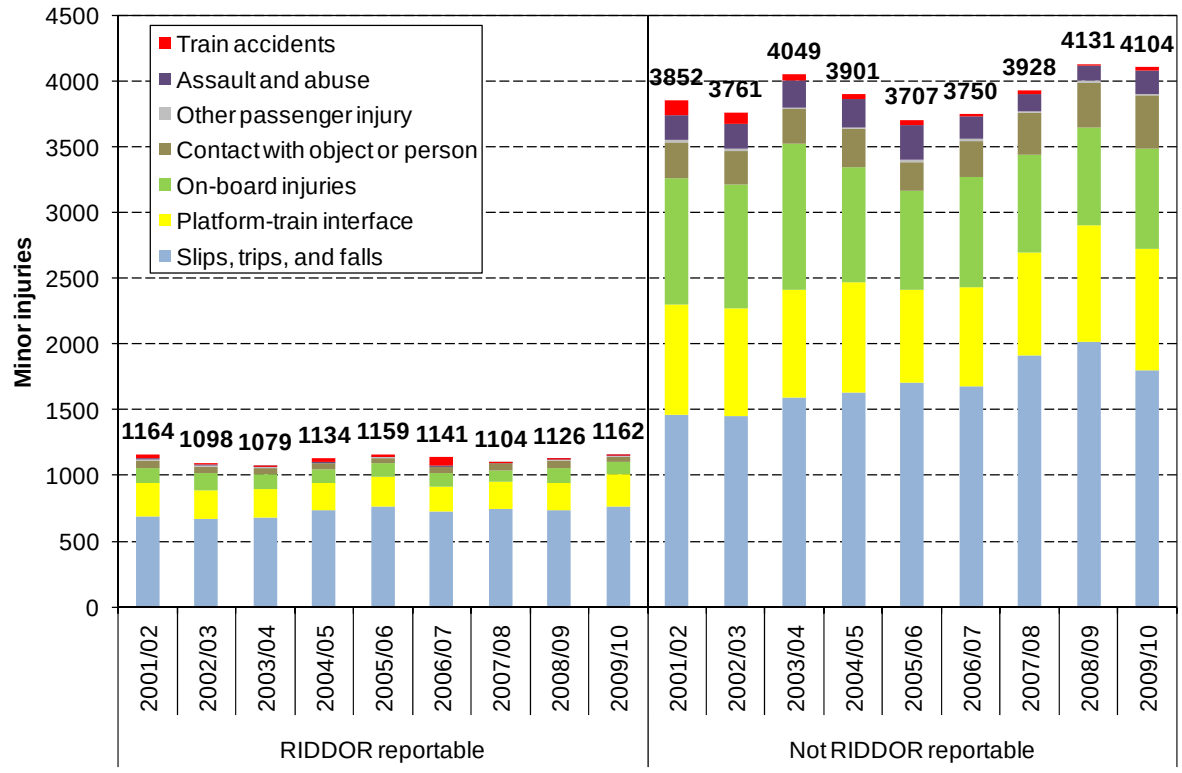


[22] See Appendix 6 for definition.

5.3.3 Passenger minor injuries

Passenger minor injuries are classed as RIDDOR-reportable if they are not major injuries, but the person is taken to hospital from the scene of the accident. Non-RIDDOR-reportable minor injuries are generally of a less serious nature than reportable ones, and are consequently given a lesser weighting when calculating weighted injuries. SRMv6 estimates reportable passenger minor injuries to account for 6.9 FWI per year, which is 13% of the total passenger risk, and non-reportable minor injuries to account for 4.9 FWI per year (9%).

Chart 39. Passenger minor injuries by accident type

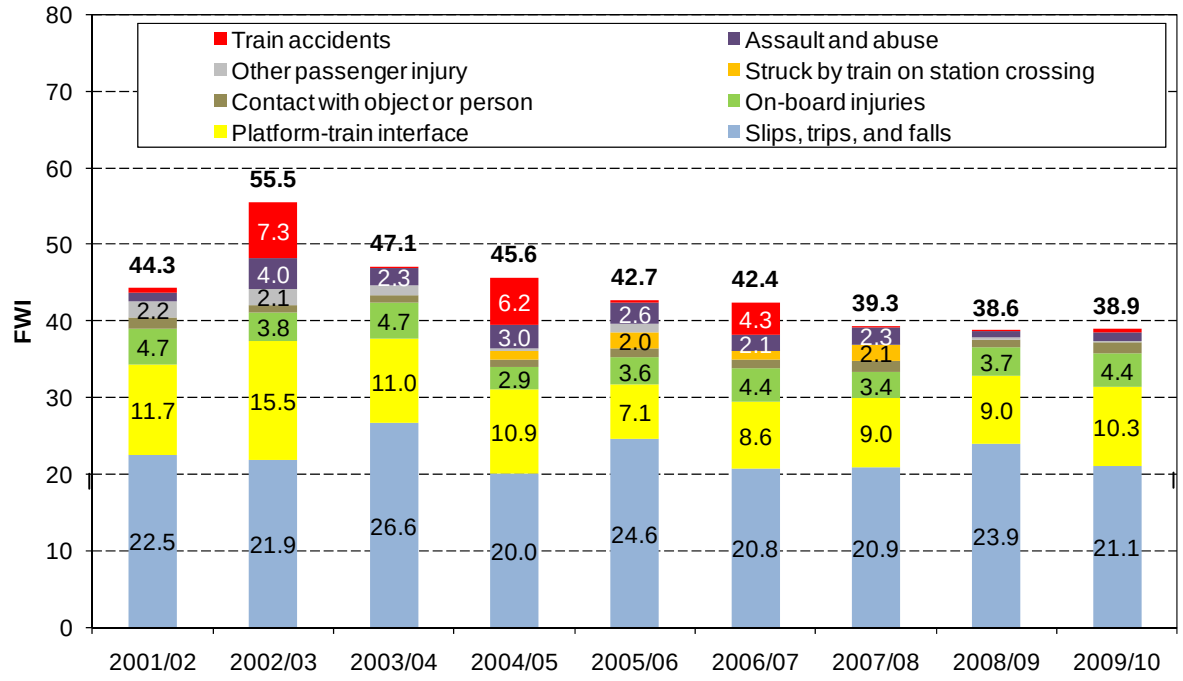


- The number of RIDDOR-reportable minor injuries for 2009/10 is an increase of 3% compared with 2008/09.
- Non-reportable minor injuries are lower than for the previous year, but represent the second highest total over the period.
- From discussions with train operators during RSSB visits as part of the data quality 'health checks' project (see Chapter 10 for details), it is believed that improved reporting is a factor in the rising numbers.
- For different types of accident, the proportion of reportable and non-reportable injuries varies. For some types of accident there appears to be a greater propensity for minor injuries to be more severe. However, there may also be difference in the propensity for reporting of different types of accident affecting the observed ratios. Examples of differences are on-board injuries, where 11% of minor injuries are RIDDOR-reportable, and slips, trips and falls, where 30% are RIDDOR-reportable.

5.4 Trends in passenger harm by accident type

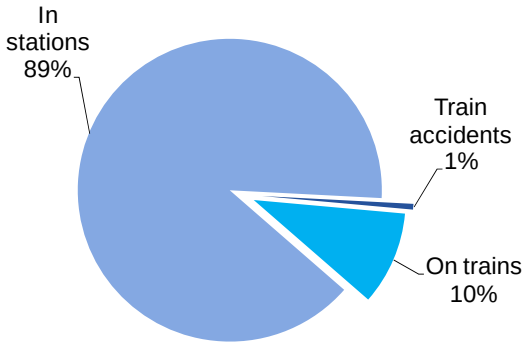
Analysis of passenger harm by accident type enables the causes of changing trends to be identified and considered further.

Chart 40. Passenger FWI by accident type



- The largest contributor to FWI is slips, trips and falls. There has been no discernible trend in the level of harm from this source over the period shown. The current year shows an improvement on the previous year.
- The next largest contribution is from accidents at the platform-train interface. The current year shows an increase on the previous year.
- The contribution from train accidents is variable, reflecting their low-frequency high-consequence nature.
- Recorded levels of FWI from assault differ noticeably from the SRM estimate of 8.0 FWI. As noted previously, SMIS is not the main means of recording these events, which are more usually recorded by BTP[23].
- The majority of passenger harm occurs in stations – around 90% over the period shown in the chart.

FWI by location since 2001/02

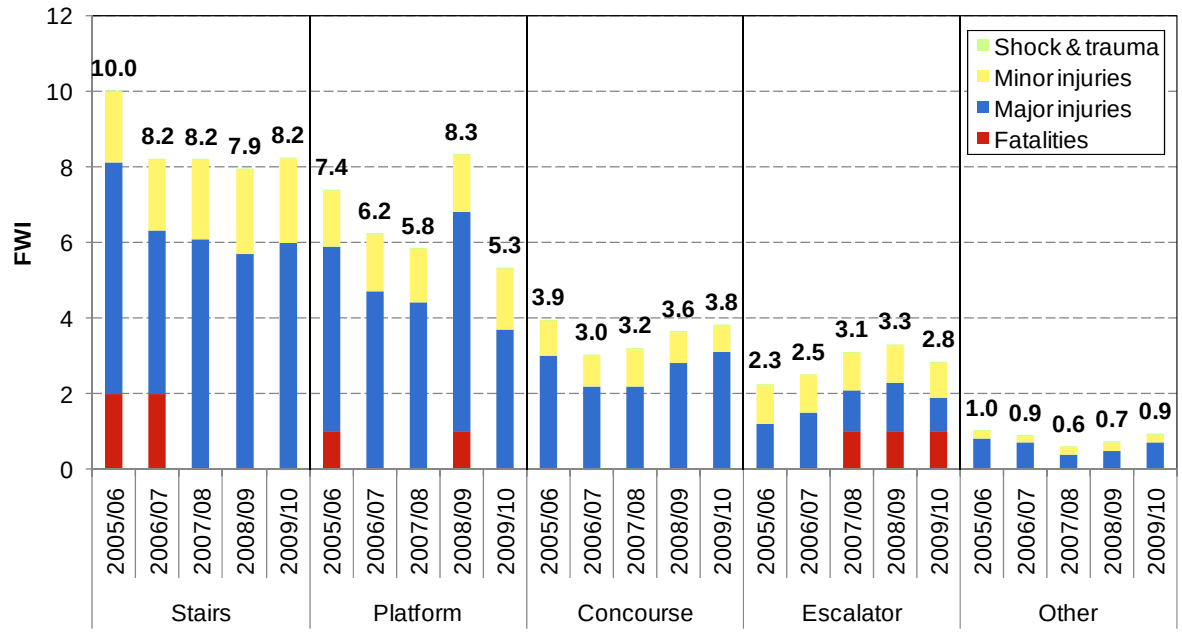


[23] See research project T723: *Making the most of data associated with railway crime*. This project considered the identification and analysis of various sources of railway crime intelligence, including BTP's CRIME and RSSB's SMIS systems, to help establish how the industry can improve its use of crime data.

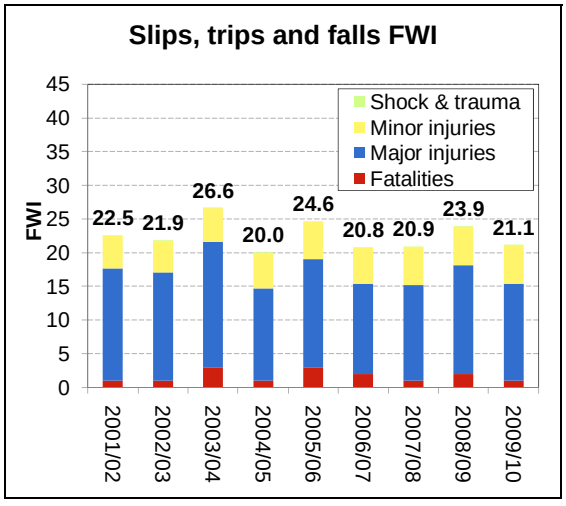
5.4.1 Slips, trips and falls in stations

From SRMv6, slips, trips and falls in stations are estimated to account for 47% (25.3 FWI) of passenger FWI risk and 16% (1.8 FWI) of passenger fatality risk. Of the SRM FWI risk from slips, trips and falls, around 41% occurs on stairs. The platform accounts for a further 28% of the SRM risk, with the concourse and escalators accounting for 17% and 11% respectively. Other areas of the station make up the remainder.

Chart 41. Passenger harm from slips, trips and falls



- The decrease in harm from slip, trip and fall injuries in 2009/10 was due mainly to a fall in the harm on platforms, compared with 2008/09. However, 2008/09 was an above average year for slips, trips and falls on platforms.
- In the past five years, the greatest proportion of harm from slips, trips and falls in stations occurred on stairs, with platforms being the next most common location.
- Escalators typically contribute a lower level of harm, although this is not normalised by usage; there are fewer escalators than stairs on the rail system. In each of the past three years, falls on escalators led to the death of a passenger. In all cases, the person was elderly.
- The location *other* covers ramps, benches, and station crossings.



5.4.2 Accidents at the platform-train interface

The platform-train interface presents a number of potential hazards for station users, which can be exacerbated by their own behaviour, such as trying to alight or board trains in a hurry, or standing too close to the platform edge while under the influence of alcohol.

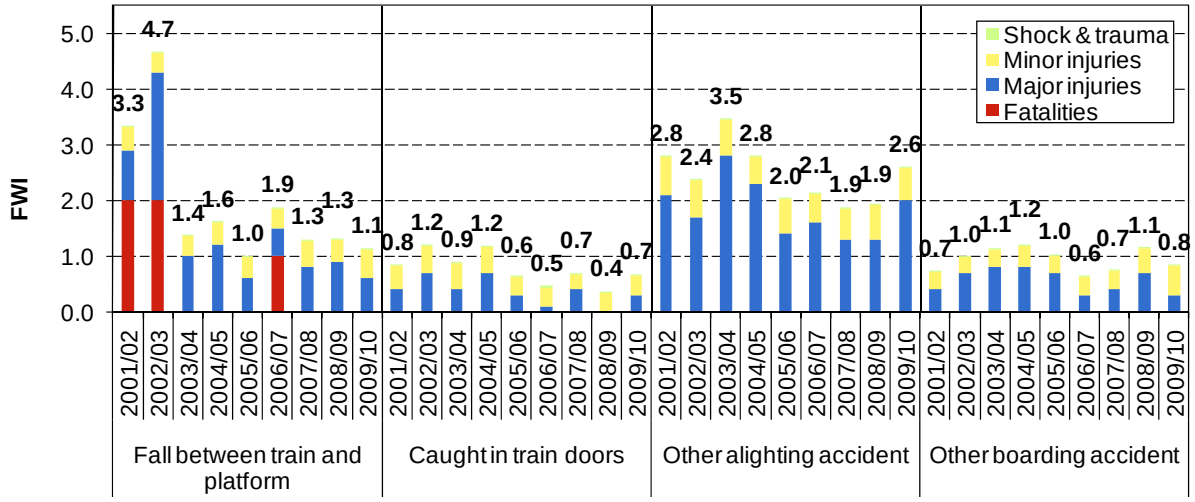
Table 8. Passenger FWI at the platform train interface

Year	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
FWI	11.7	15.5	11.0	10.9	7.1	8.6	9.0	9.0	10.3

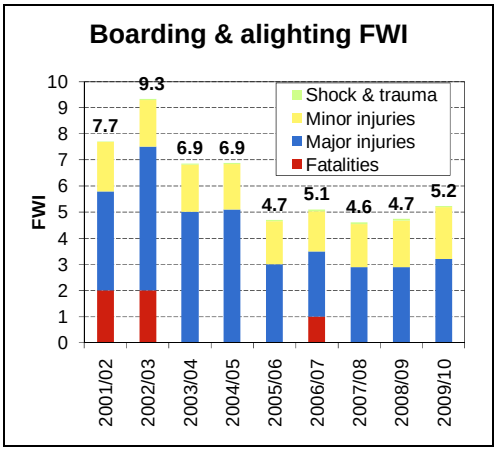
Accidents during boarding and alighting

SRMv6 estimates that 12% (6.4 FWI) of passenger FWI risk and 9% (1.1 FWI) of passenger fatality risk occurs during boarding and alighting.

Chart 42. Passenger FWI from boarding and alighting accidents



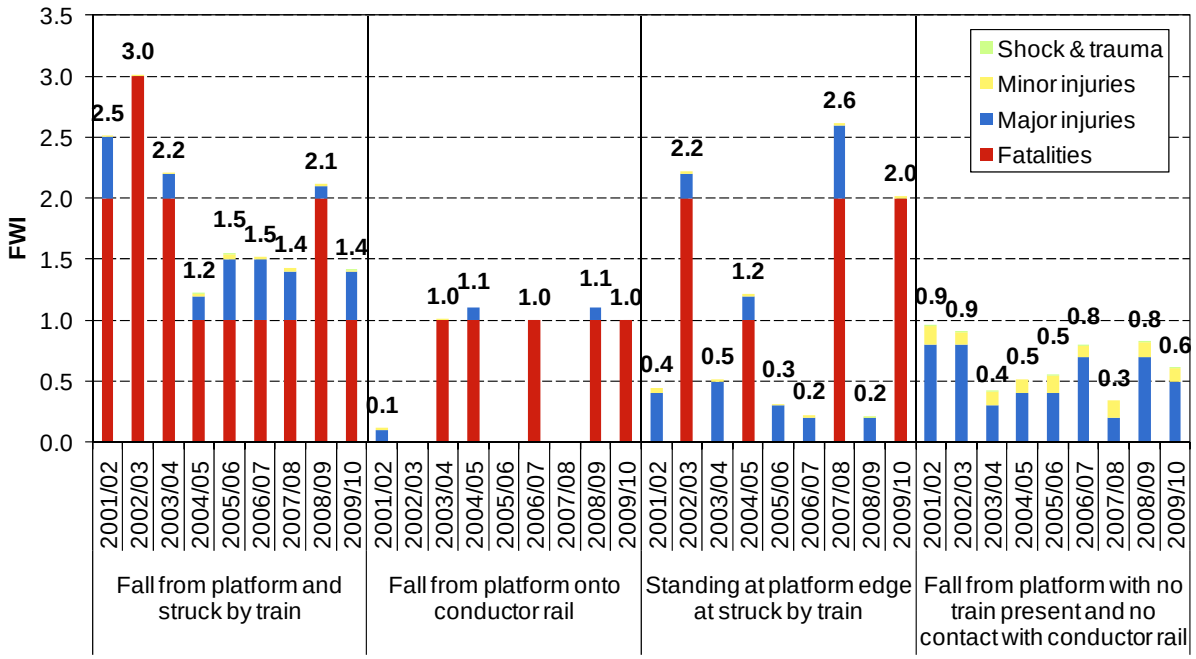
- Harm from boarding and alighting increased in 2009/10, but remains at a level notably lower than before 2005/06.
- The categories *fall between train and platform* and *caught in train doors* include both boarding and alighting injuries. In addition, the *fall between train and platform* category is likely to include some falls that are not due to boarding or alighting; it is currently difficult to identify separately those that do not occur while getting on or off trains due to RSSB data coding methodology; work to resolve this is underway.
- The largest category covers events termed *other alighting accidents*. However, although it contributes the greatest amount of harm, fatalities arising from accidents in this group are rare. The type of events within the *other alighting accident* and *other boarding accident* categories are largely falls from the train onto the platform, or trips from the platform onto the train.



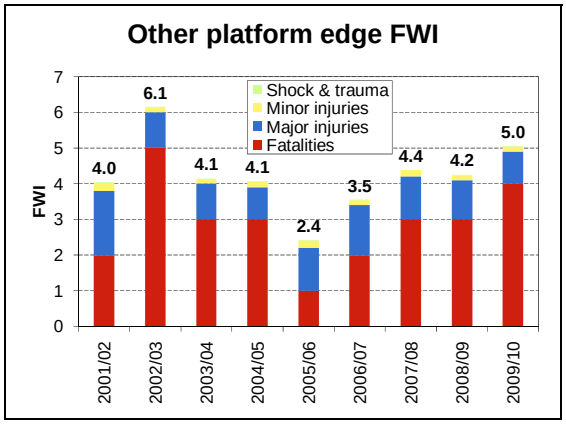
Other accidents at the platform edge

Other accidents at the platform edge are estimated by SRMv6 to account for 8% (4.6 FWI) of the total passenger FWI risk. However, they account for 29% (3.2 FWI) of the passenger fatality risk: by far the greatest contributor of any accident type.

Chart 43. Other passenger accidents at the platform edge



- The level of FWI from other platform edge accidents is the highest since 2002/03; four of the five passenger fatalities this year were due to this cause.
- Each year since 2001/02, there has been at least one fatality involving a passenger falling from the platform and being struck by a train.
- Falling from the platform and coming into contact with the conductor rail is a relatively rare event, but with a comparatively high likelihood of fatality occurring. Over the period shown, there have been 13 such incidents, five of which were fatal.
- A number of fatalities result from standing too close to the edge[24] of the platform such that contact with a train entering the station occurs. On occasions where the contact is sufficiently serious, or the person subsequently loses balance and falls in between the train and platform, the likelihood of fatality is again comparatively high.
- Over the period shown, there have been no fatalities occurring to people who have fallen from the platform edge, unless they have subsequently been struck by a train, or come into contact with the conductor rail.

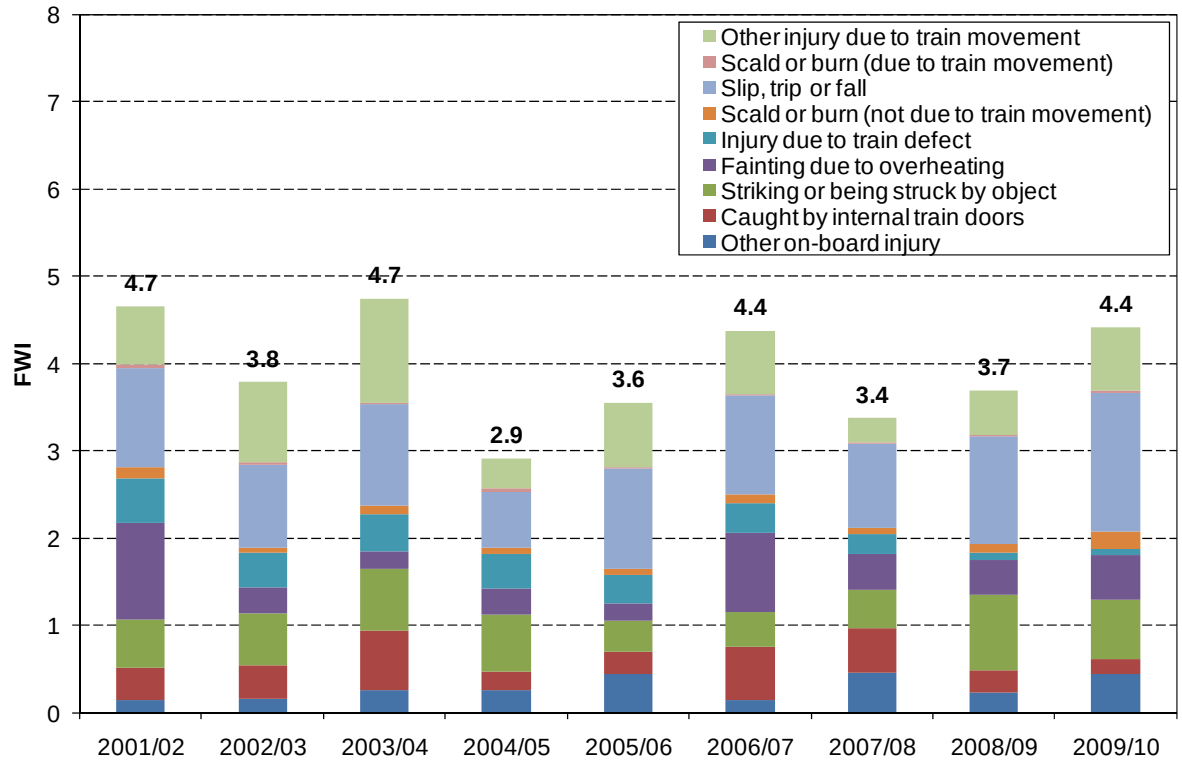


[24] This category also includes people walking, running, or otherwise being too close to the platform edge.

5.4.3 Passenger harm from accidents on board trains

The category of on-board injuries does not include train accidents or assaults, which are considered under separate categories. It accounts for 7% (3.8 FWI) of the total passenger risk profile, based on SRMv6. Passenger fatality risk from on-board accidents is estimated to be negligible.

Chart 44. Trends in on-board passenger FWI (excludes train accidents and assaults)

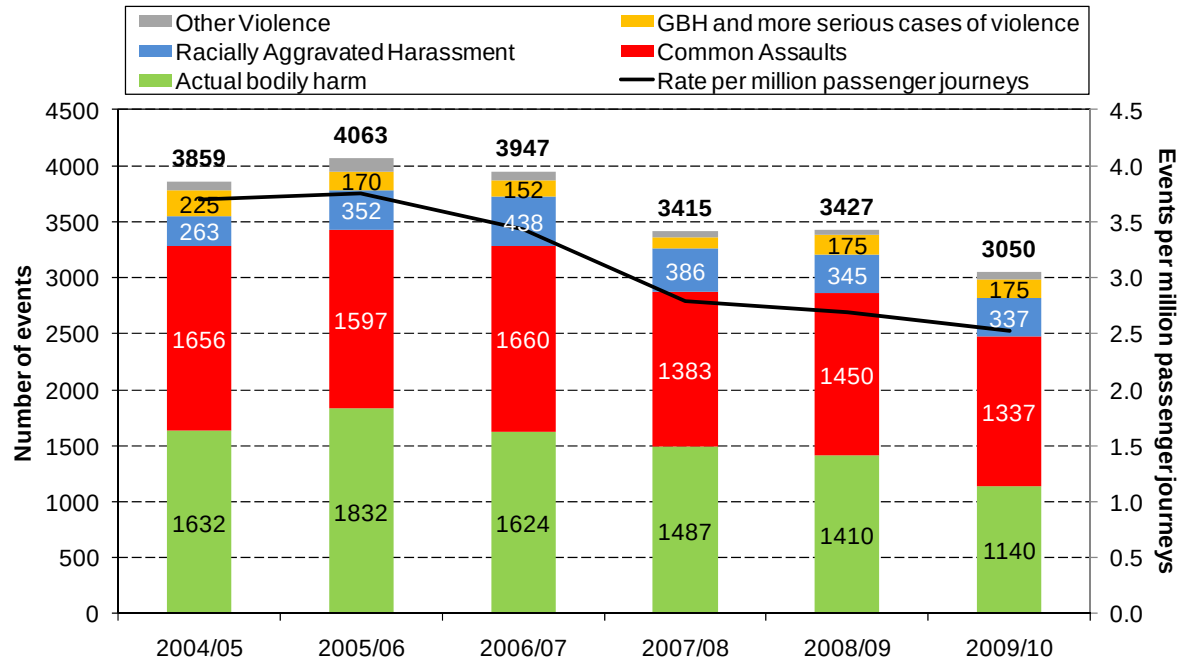


- On average over the past nine years, slips, trips and falls have accounted for 28% of injuries on board trains (excluding injuries from train accidents, falls from trains and assault). In 2009/10, the proportion was slightly higher, at 36%.
- Injuries directly attributable to the train itself (train defect, movement due to lurching or braking, and overheating) have accounted for 38% of on-board harm since 2001/02. In 2009/10, the proportion was smaller, at 30%. However, it is not always straightforward to determine whether train movement was a causal factor in an accident. Therefore, some accidents categorised as, for example, slips, trips and falls or being struck by objects may also be a result of train movement.
- Although harm has increased over the past two years, it can be seen from the chart that levels of harm are variable, and there is no trend over the period shown.

5.5 Passenger personal security[25]

As with other public-facing industries, fatalities and serious injuries resulting from crime occur on the railway from time to time. SRMv6 estimates that assaults contribute 15% (8.0 FWI) of the FWI risk, and 13% (1.5 FWI) of the fatality risk, for passengers. While SMIS is a good source of information on workforce assaults, only a small proportion of passenger or public assaults are entered into the system. The BTP CRIME database is therefore used to analyse non-workforce assaults. However, it is not possible in CRIME to completely separate passengers from members of the public, nor is it possible to categorise the seriousness of the non-fatal injuries reliably.

Chart 45. Assaults on passengers and public



Source: BTP CRIME data

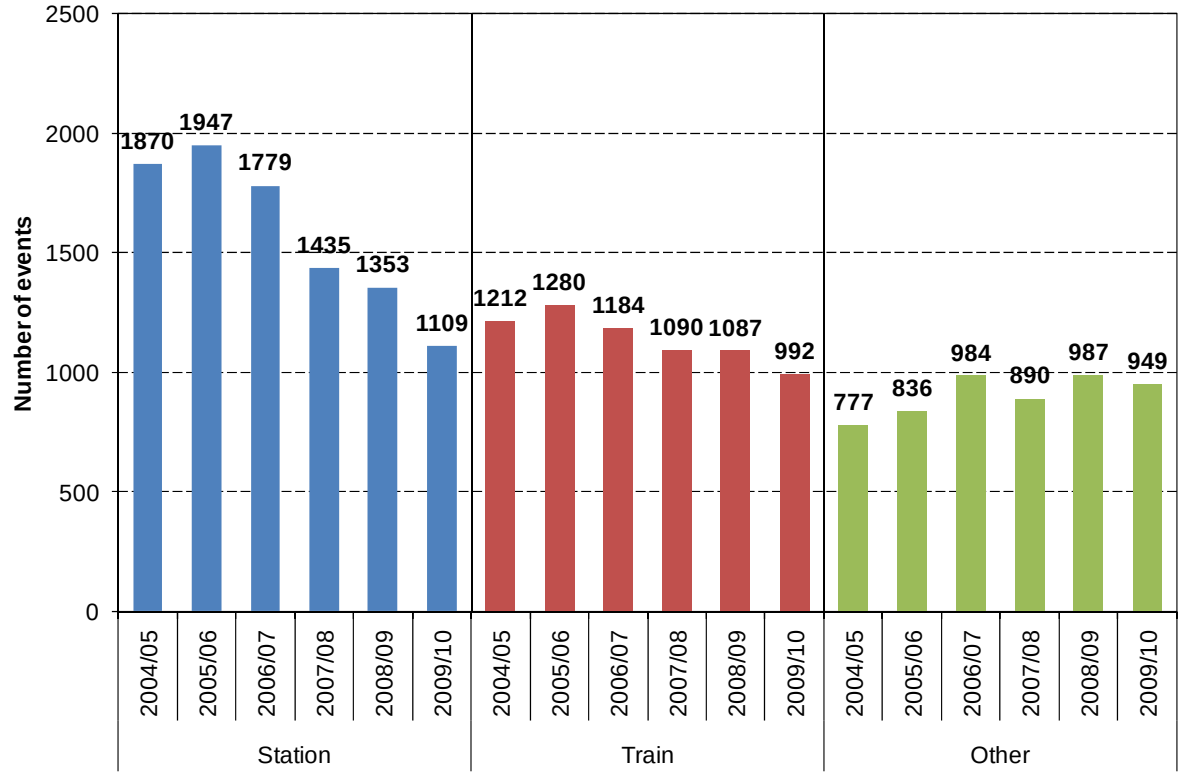
- The current year shows a decrease of 11% in the total number of passenger and public assaults, compared with 2008/09.
- The decrease is due to a reduction in the category of actual bodily harm, which fell by 19%, and common assault, which fell by 8%. More serious cases of violence, such as grievous bodily harm (GBH), remained stable. Since 2001/02, the classes of actual bodily harm and common assault have each accounted for around 42% of the total number of assaults
- Year on year, the normalised assault rate has decreased steadily, and is currently around one per 400,000 passenger journeys.
- It is difficult to separate changes in recording from changes in actual underlying levels of assault. The overall peak in 2005/06 is believed to be due to improvements in recording following the introduction of the National Crime Recording Standard in 2002. Changes in recorded levels of racial harassment may also be due to a greater willingness to report incidents; BTP has encouraged a zero-tolerance approach to culturally motivated crime.

[25] Because of the way BTP records person type, the analysis in this section will also include assaults to non-travelling members of the public.

5.5.1 Passenger and public assaults by location

Within the CRIME database, BTP record the location of assaults. In the following chart, the category of 'Other' includes assaults outside the station, or inside the station but at locations operated by third parties, such as shops.

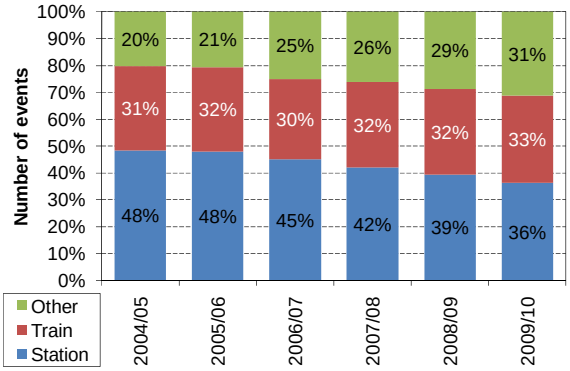
Chart 46. Passenger and public assaults by location



Source: BTP CRIME data

- Over the period shown, the majority of assaults have been recorded as occurring in stations. There has been a strong trend of reduction in this category over time, with the current level being an improvement of 18% over the previous year.
- The second most common location recorded is on trains. Again, there has been a decreasing trend, with the current year being 9% lower than 2008/09. It is possible that the introduction of new rolling stock with on-board CCTV has contributed to the trend.
- The 'third party' locations that comprise the category *other* are generally outside the scope of the ASPR and are not covered in analyses based on SMIS data. In contrast to station and train assaults, there has been no decreasing trend in this category. Consequently, the proportion of the total number of assaults occurring in these locations has been increasing.

Proportion of assaults by location



5.5.2 Perceived security

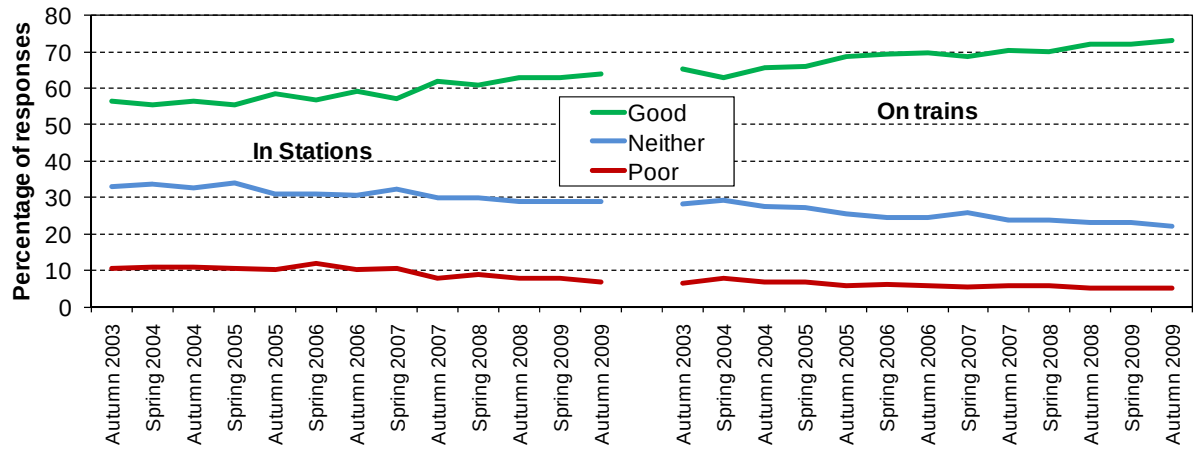
BTP data indicates that the probability of falling victim to violent crime is relatively low, at around 1 in 400,000 per journey. Media coverage of events can affect public perceptions of personal security, and feeling vulnerable to such offences may still deter people from travelling by train. Passenger Focus, the independent national rail consumer watchdog, carries out the National Passenger Survey (NPS) twice per year (autumn and spring) to provide a network-wide picture of passengers' views on rail travel. One of the areas covered is perception of personal security. The latest perceptions of personal security for the different NPS operator groupings are shown below.

Table 9. Passenger perceptions of personal security (NPS autumn 2009)

	In the station			On the train		
	Good	Neither	Poor	Good	Neither	Poor
Long distance	72%	25%	3%	83%	15%	2%
London & South East	62%	31%	7%	71%	24%	5%
Regional	69%	25%	6%	78%	18%	4%
National Total	64%	29%	7%	73%	22%	5%

- Overall, 64% of passengers perceive their personal security at the station to be good, and 73% perceive their safety on the train to be good. Passengers' perception of their personal security both in stations and on trains is best on Long Distance routes. Passenger perceptions of personal security on Regional services are better than on London & South East services.

Chart 47. Trends in perceived personal security at stations and on trains



Source : National Passenger Survey

- The proportion of passengers that feel they have a good level of personal security in stations and on trains is at its highest level over the analysis period. Passengers appear to be more satisfied with their level of personal security on trains than in stations.
- There has been an overall improvement in perception of personal security at stations and on trains over the analysis period. The reasons for this may be the various improvements made and initiatives instigated by operating companies, which may include: better lighting, installation of CCTV cameras, more staff on duty, cleaner stations/trains and better information for customers. It is likely that some of these factors have a positive effect on actual security, as well as perceived security.

5.5.3 Identified causes of concern – anti-social behaviour

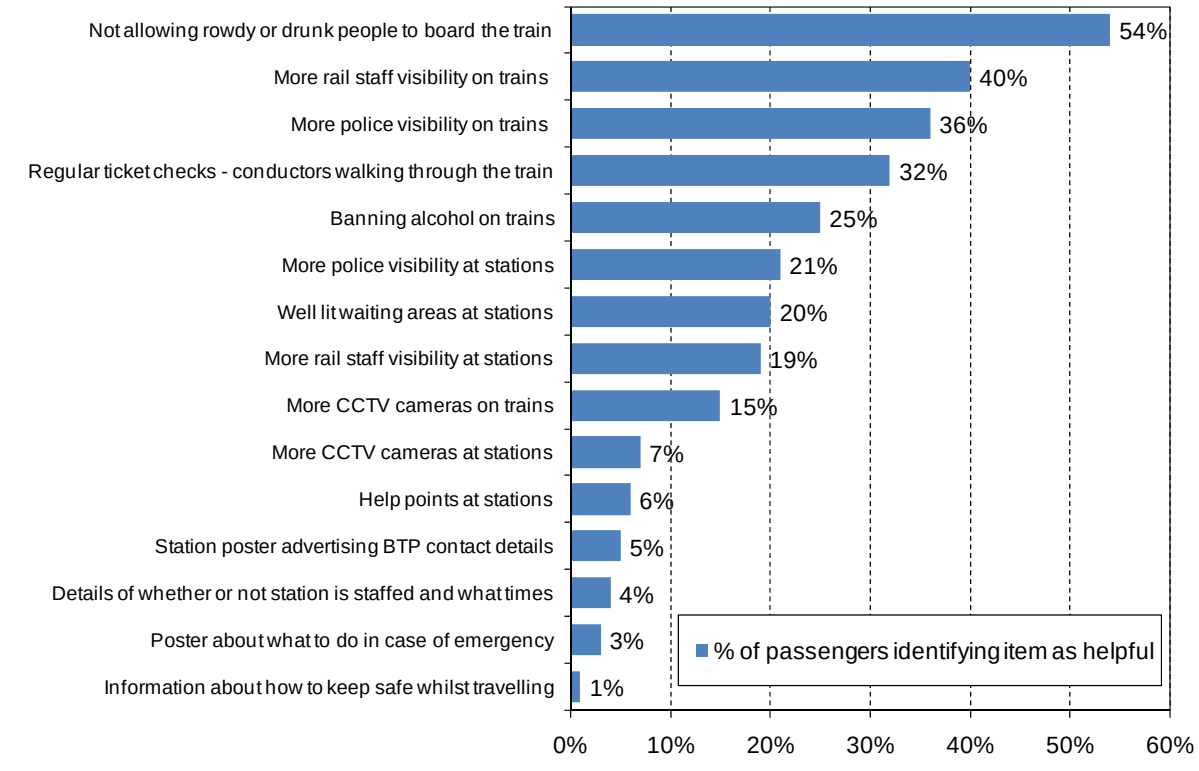
In March 2009, Passenger Focus published a more detailed report looking at passengers' main concerns related to personal security perceptions. The most commonly identified concern was anti-social behaviour. Of those expressing concern in the station, 66% highlighted this issue. Of those expressing concern on the train, 76% identified this as an issue.

Following on from the March 2009 report, in February 2010, Passenger Focus published a second report[26] specifically looking at rail passenger views of anti-social behaviour, based on a survey of passengers travelling in September 2009. The survey, which had 1146 respondents, posed a number of questions, including asking what people found most annoying and most worrying in terms of anti-social behaviour, and explored what things would help passengers feel safer.

Table 10. Type of behaviour identified as most annoying or worrying

Behaviour most annoying	Behaviour most worrying
1. Playing music or DVDs loudly (66%)	1. Abusive or threatening behaviour (61%)
2. Fare evasion (56%)	2. People under the influence of alcohol or drugs (37%)
3. Graffiti or vandalism (50%)	3. Theft of belongings (36%)

Chart 48. Reponses to 'what things would make you feel safer?'



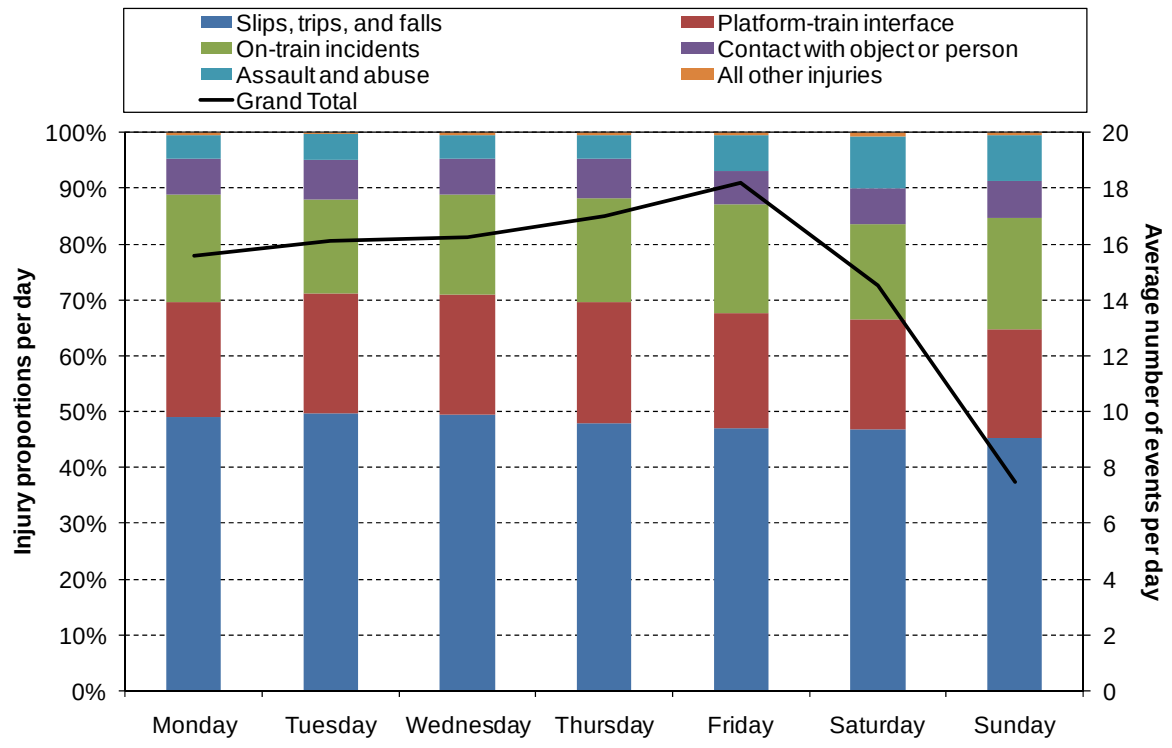
[26] *Anti-social behaviour report: Rail passenger views*. Passenger Focus, February 2010.

5.6 Further analysis of passenger safety

5.6.1 Passenger safety by day of week

Passenger accident rates vary according to the day of the week. Passenger accidents of all levels of consequence are included in the analysis.

Chart 49. Passenger accident profiles by day of week 2001/02 to 2009/10

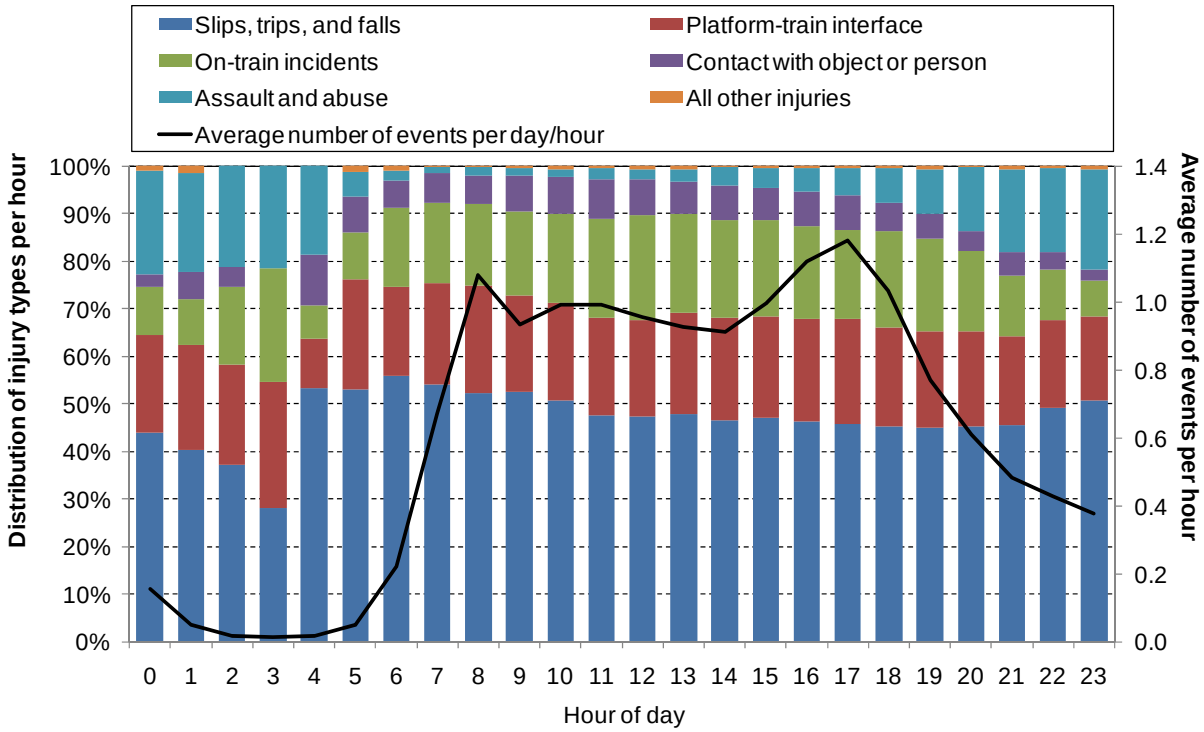


- The number of injuries occurring is higher during the working week, gradually increasing in number each day from Monday to Friday.
- Sunday has the smallest number of passenger accidents of any day of the week, with Saturday having, on average, the next fewest. However, weekends see fewer passenger journeys on average, so this is not unexpected.
- The types of injuries occurring generally remain similar in proportion from day to day. Slips, trips and falls account for the most injuries to passengers, averaging around 50%.
- There is a higher proportion of passenger assaults from Friday to Sunday. This is generally believed to be due to these times being popular for social activities and alcohol consumption, which is believed to be a catalyst to assaults taking place. However, it is reminded that this analysis is based on SMIS data, which is more limited than BTP data in relation to assaults on passengers.

5.6.2 Passenger safety by time of day

Passenger accident rates and profiles vary according to the time of day. Again, passenger accidents of all levels of consequence are included in the analysis.

Chart 50. Passenger accident profiles by time of day 2001/02 to 2009/10

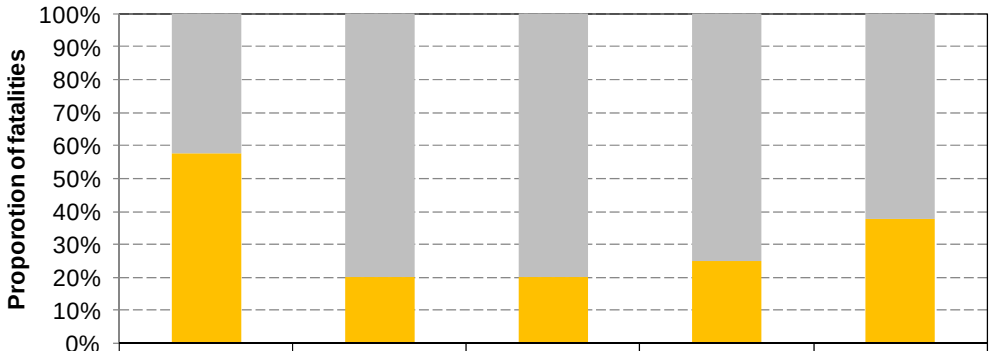


- During the day, peak hours see more accidents, which again, is not unexpected. However, the peaks in accidents appear smaller than the likely peaks in usage. This suggests that off-peak passengers report a higher number of accidents per journey. People travelling off peak may – on average – be under less time pressure and more likely to make a minor accident known to a member of staff. Alternatively, it may be that those travelling off-peak are less frequent commuters who are at higher risk because they are less familiar with the hazards of rail travel.
- Passenger assaults contribute an increasing proportion of the total injuries over the evening hours, reaching a peak between 23:00 and 01:00. Alcohol is a likely factor in this trend.

5.6.3 Passenger safety and intoxication

A number of passenger accidents occur where intoxication is recorded as a factor. This is particularly the case for fatalities. The analysis in this section excludes injuries in train accidents, as these are not directly affected by intoxication, and injuries due to assault, as information on passenger assault in SMIS is limited.

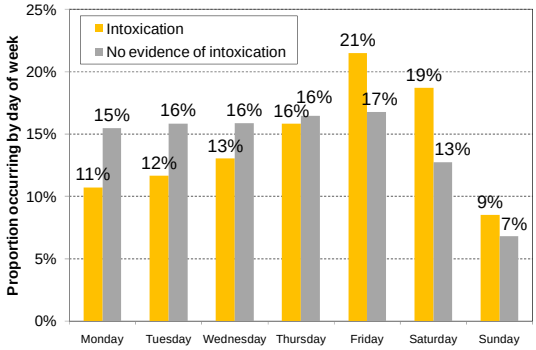
Chart 51. Intoxication and passenger fatalities 2001/02 to 2009/10



	Platform-train interface (not boarding / alighting)	Platform-train interface (boarding / alighting)	Slips, trips, and falls	Other (excluding assaults and train accidents)	Total
No evidence of intoxication	11	4	12	9	36
Intoxication	15	1	3	3	22

- Since 2001/02, there have been 58 fatal accidents (excluding assaults and train accidents), 22 of which have had intoxication recorded as a factor.
- The most common type of fatality, and the one which shows alcohol to be most significant, relates to passenger accidents at the platform edge, not due to boarding or alighting (such as falls from the platform onto the track).
- The mini-chart shows how those injuries (both fatal and non-fatal) involving intoxication are distributed throughout the week. Friday and Saturdays account for 40% of events; weekend socialising is a likely factor. In contrast, the distribution of injuries where intoxication is not recorded as a factor is more even throughout the weekdays, with few occurring at the weekend; this reflects the lower passenger numbers at weekends.

Injuries involving intoxication by day of week since 2001/02

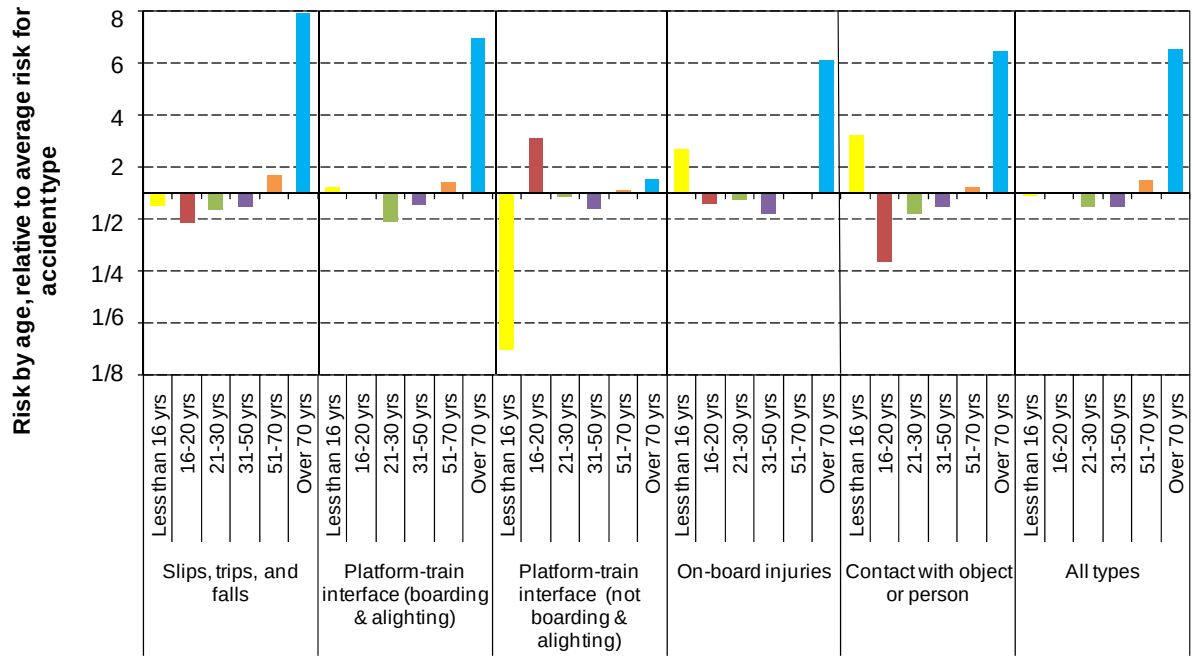


- In March 2010, RSSB launched an industry Good Practice Guide - *Managing alcohol risks to personal security on the railway*. The good practice guide was a result of a research project T704 - *The contribution of alcohol to personal safety and security risk on the railways*, which helped industry to gain a better understanding of the extent to which alcohol is a contributory factor in the areas of personal safety and security of frontline staff and rail users.

5.6.4 Passenger safety and age

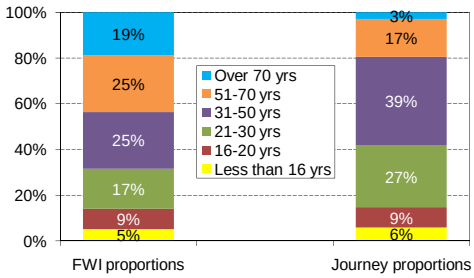
Passenger risk profiles vary by age group, with differences being most notable for older people. The ageing population and consequent issues related to reduced mobility present a challenge to the railway. The industry is already taking steps to address this, for example by improving the station environment and providing step-free access. The analysis in this section excludes injuries in train accidents, as these are not directly affected by age, and injuries due to assault, as information on passenger assault in SMIS is subject to limitations.

Chart 52. Passenger harm by age group 2001/02 to 2009/10



- The chart shows the relative difference in levels of FWI for different age groups, for different types of accident. Elderly passengers are over-represented in many of the categories, most notably slips, trips and falls, and boarding & alighting accidents. When normalised by journeys, they show six times higher levels of FWI for the types of accident shown on the chart.
- Those in the age group 16 to 20 years have levels of harm from platform-train interface accidents (not due to boarding/alighting) that are around three time higher than for the average passenger.
- Passengers aged less than 16 years are over-represented for on-board injuries and injuries due to contact with objects or persons.
- It is possible that reporting rates differ for different age groups. It is also possible that leisure passengers are more likely to report injuries than time-pressed commuters and business passengers, and that parents or older companions of younger travellers are more likely to report injury if it occurs to those in their care.

FWI and journey proportions by age, since 2001/02

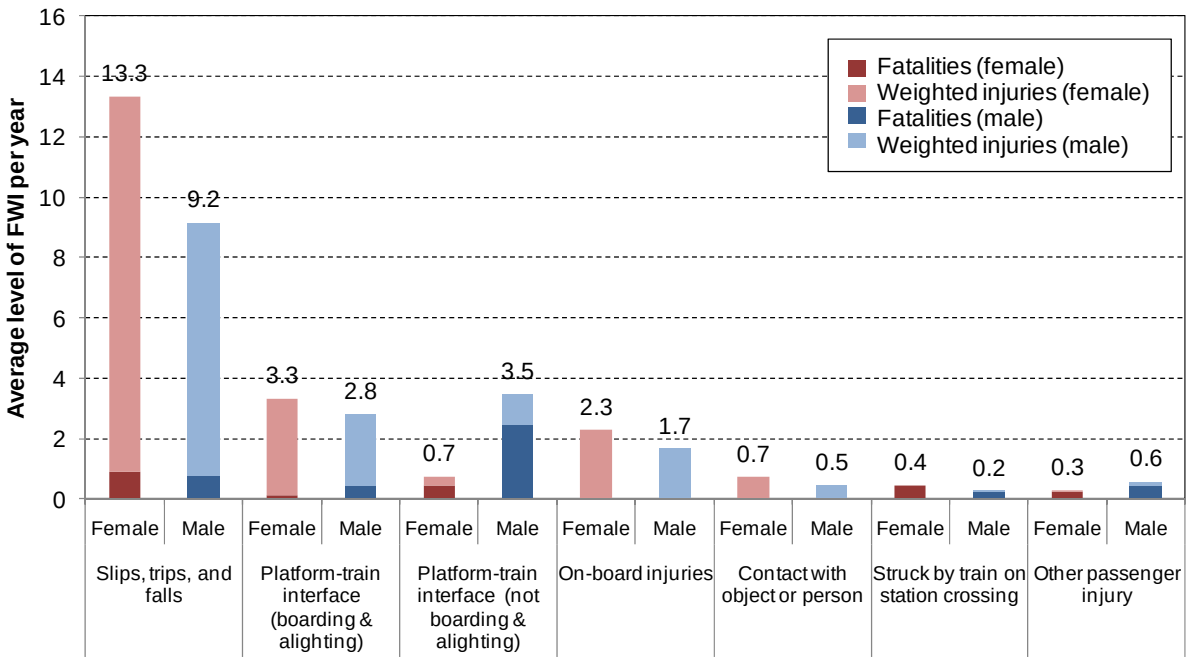


Data source: SMIS data from 2001/02 to 2009/10 where victim's age was recorded. The data has been normalised using data from the DfT *National Travel Survey*, 2007 and 2008.

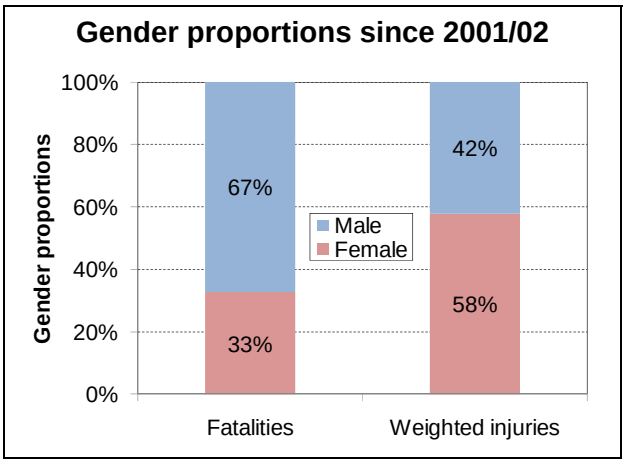
5.6.5 Passenger safety and gender

The proportions of male and female travellers are fairly equal; in recent years, men have made up around 54% of the journeys, and women around 46%[27]. However, there are some notable differences in the types of accident that tend to occur to each. For the same reason as for the two previous sections, the analysis does not include data on train accidents or data on assaults.

Chart 53. Passenger harm by gender 2001/02 to 2009/10 (excluding train accidents and assaults)



- Female passengers are most notably more susceptible to harm from slips, trips and falls in stations. It is possible that differences in footwear between the sexes may have an influence.
- While the difference in harm occurring to each gender from boarding and alighting accidents is not great, the difference in harm from other accidents at the platform-train interface is notable. The average level of FWI per year for male passengers from this type of accident is around five times that of female passengers.
- Based on data since 2001/02, males have been over-represented in fatalities, but females have been over-represented in non-fatal injuries. As well as reflecting accident risk, the chart may also reflect differences in reporting practices between the genders.

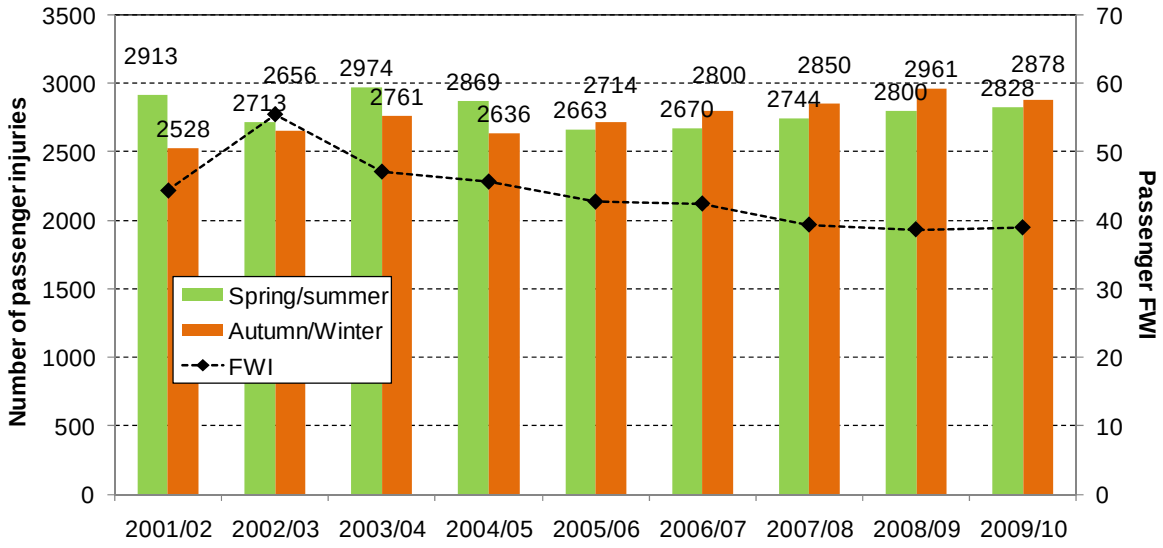


[27] National Rail Travel Survey 2008, DfT.

5.6.6 Passenger safety by season

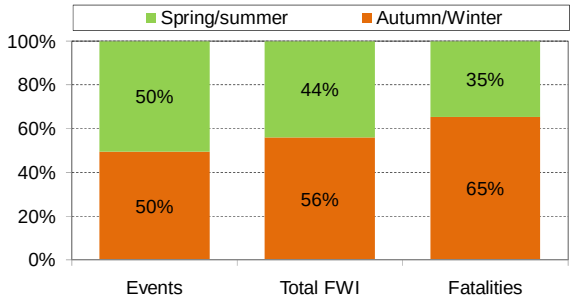
Seasonal weather can have an adverse effect on passenger safety by increasing the propensity for certain hazardous events. Where surfaces are contaminated by snow or ice, there is an increased risk from slips, trips or falls. Train operations may also be affected; icy or contaminated rails can cause traction difficulties, while low temperature can affect other infrastructure, such as points or rolling stock.

Chart 54. Number of passenger injuries by season

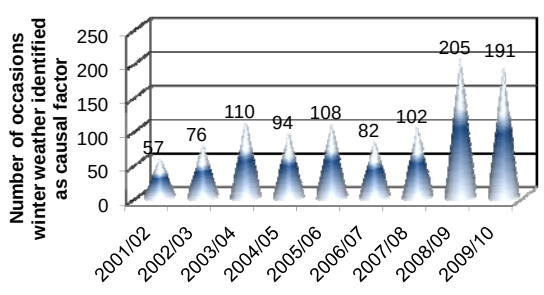


- In recent years, a greater number of passenger injuries have occurred during the autumn/winter months, compared with the spring/summer months. This reverses the trend of the earlier years on the chart, when the opposite was true.
- The first mini-chart indicates that although since 2001/02, the autumn/winter period has accounted for similar numbers of injuries as the spring/summer period, it has accounted for a higher proportion of FWI, and a yet higher proportion of fatalities. This would imply that, on average, more severe injuries occur during the colder season.
- The second mini-chart identifies the number of occasions where wintry weather is identified as a cause of injury. Both 2008/09 and 2009/10 show higher than average numbers. Both had periods of very severe weather. The details of accident causes are not always well-recorded, especially for lesser injuries, so the numbers are likely to be an underestimate.

Proportions of events and harm occurring during autumn/winter



Number of events identifying wintry weather as a cause



5.7 Passenger key safety facts

Incidents of passenger trespass, suicide and suspected suicide are counted within the key safety facts table in Chapter 7 - Risk to members of the public.

Passengers	2005/06	2006/07	2007/08	2008/09	2009/10
Fatalities	**8**	**8**	**7**	**5**	**5**
Train accidents	0	1	0	0	0
Slips, trips, and falls	3	2	1	2	1
Platform-train interface	1	3	3	3	4
Assault and abuse	1	1	1	0	0
On-board injuries	0	0	0	0	0
Contact with object or person	0	0	0	0	0
Struck by train on station crossing	2	1	2	0	0
Other type of passenger injury	1	0	0	0	0
Major injuries	**249**	**246**	**225**	**236**	**238**
Train accidents	2	29	0	0	3
Slips, trips, and falls	160	134	142	161	144
Platform-train interface	42	39	41	40	41
Assault and abuse	12	7	10	6	9
On-board injuries	23	30	22	24	32
Contact with object or person	8	7	9	3	8
Struck by train on station crossing	0	0	1	0	0
Other type of passenger injury	2	0	0	2	1
Minor injuries	**4866**	**4891**	**5032**	**5257**	**5266**
RIDDOR reportable	1159	1141	1104	1126	1163
Non-RIDDOR reportable	3707	3750	3928	4131	4103
Incidents of shock	**254**	**325**	**330**	**263**	**197**
Class 1	10	10	13	5	3
Class 2	244	315	317	258	194
Fatalities and Weighted injuries	**42.70**	**42.42**	**39.33**	**38.64**	**38.93**
Train accidents	0.38	4.28	0.12	0.03	0.40
Slips, trips, and falls	24.58	20.78	20.90	23.88	21.08
Platform-train interface	7.10	8.63	8.99	8.99	10.27
Assault and abuse	2.62	2.08	2.29	0.84	1.18
On-board injuries	3.55	4.38	3.38	3.69	4.43
Contact with object or person	1.23	1.22	1.51	0.95	1.45
Struck by train on station crossing	2.00	1.00	2.10	0.00	0.00
Other type of passenger injury	1.24	0.04	0.04	0.26	0.13
Passenger kms (billions)	**43.2**	**46.2**	**49.0**	**50.7**	**51.0**
Passenger journeys (millions)	**1082**	**1151**	**1225**	**1274**	**1227**

BTP Passenger & Public Assaults	2005/06	2006/07	2007/08	2008/09	2009/10
Total	**4063**	**3947**	**3415**	**3427**	**3050**
Actual bodily harm	**1832**	**1624**	**1487**	**1410**	**1140**
Common assaults	**1597**	**1660**	**1383**	**1450**	**1337**
GBH and more serious cases of violence	**170**	**152**	**108**	**175**	**175**
Other violence	**112**	**73**	**51**	**47**	**61**
Racially aggravated harassment	**352**	**438**	**386**	**345**	**337**

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6 Risk to the workforce

A person is classed as a member of the workforce if he or she is working for the industry on railway activities, either as a direct employee or under contract. Accident and injury data is collected in SMIS on all events occurring at stations or elsewhere on NRMI. Fatalities occurring off NRMI but during working time (for example, while in depots, yards or sidings, or as a result of road traffic accidents) are also included. However, non-fatal injuries occurring off NRMI are not included. This chapter investigates the range of accidents that occurs to the wide variety of railway occupations, from track workers to station staff.

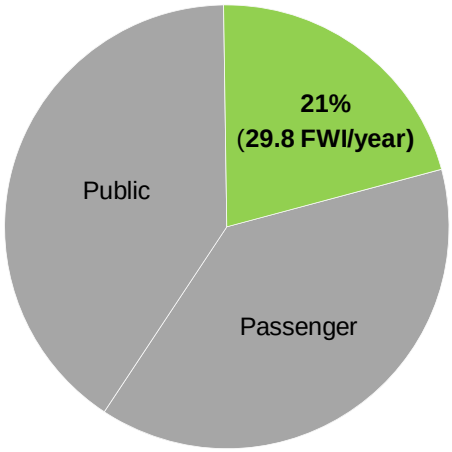
A detailed breakdown of the workforce fatalities and injuries is presented in the key safety facts table at the end of this chapter.

2009/10 Headlines

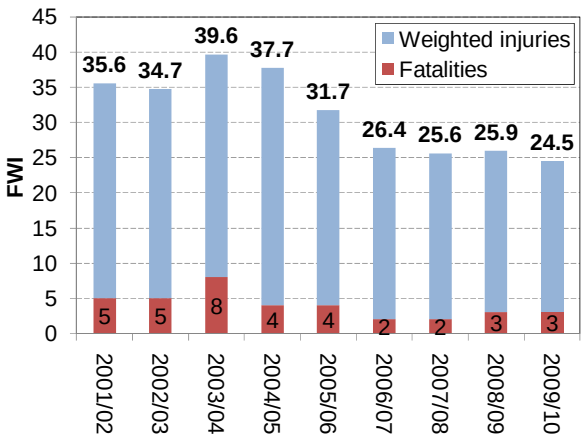
- There were no workforce fatalities in train accidents.
- There were three workforce fatalities, 118 major injuries, 5305 minor injuries and 1143 cases of shock/trauma reported. This equates to 24.5 FWI, which is a decrease of 6% compared with 2008/09.
- The three workforce fatalities all occurred to track workers. In one event, a lookout was struck by a train. The other two events occurred to people working on rail bridges. One involved a fall from height, and in the other event, the worker was overcome by fumes.
- Although track workers remain the workforce group with the highest level of FWI, recent trends in track worker major injuries and RIDDOR–reportable minor injuries have been reducing.
- Since 2006/07, levels of workforce harm have been consistently lower than before that time.

Workforce safety at a glance

Workforce risk in context (SRMv6)



Trend in workforce harm

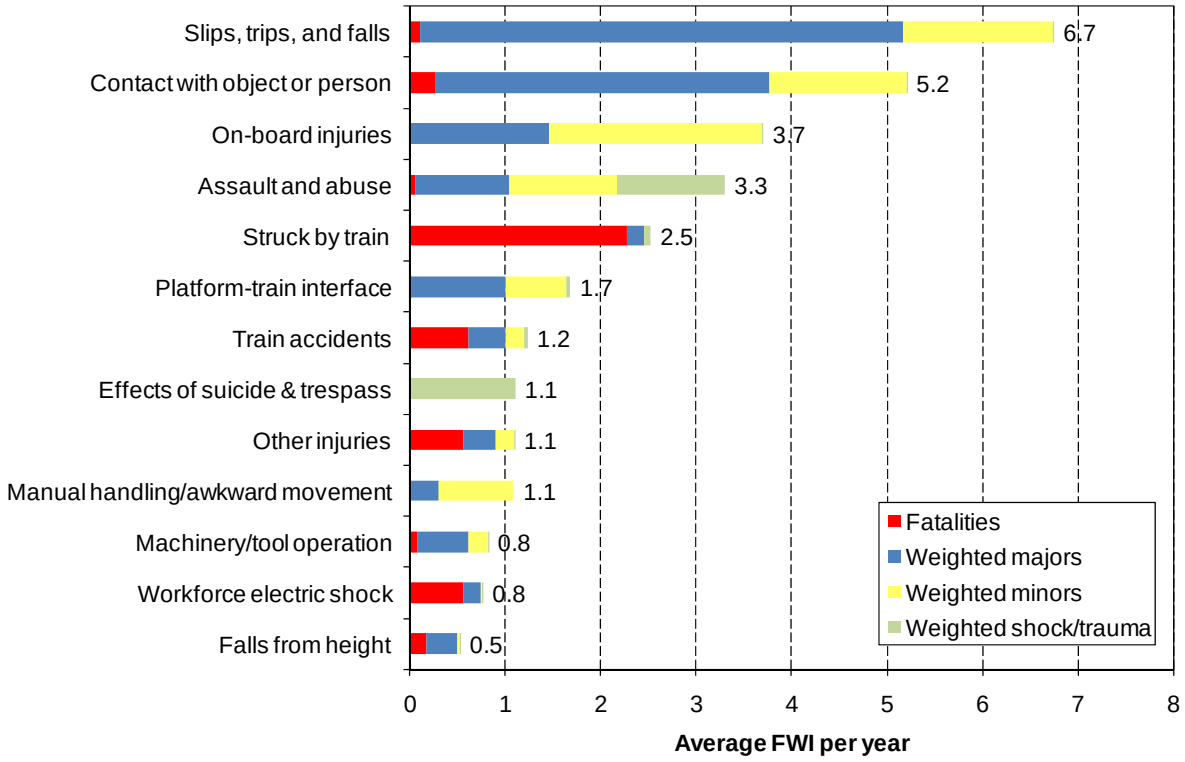


6.1 Workforce risk profile – accident types

Working on the railway covers a wide range of occupations and activities that involve a variety of hazards, some of which are particular to the rail industry, some of which are not.

Descriptions of the types of events that are included in each accident type grouping are shown in Appendix 5.

Chart 55. Workforce risk by accident type: 29.8 FWI per year



Source: SRMv6

- Slips, trips and falls pose the greatest risk to the workforce as a whole. Around 23% of the total FWI risk is from this source, although the contribution to the fatality risk is relatively low, at around 2%.
- The greatest source of fatality risk is being struck by a train, which accounts for 8% of the workforce risk profile, but 49% of the fatality risk profile. Injuries from this cause have a relatively high likelihood of being fatal.
- Train accidents account for 4% of the FWI risk profile and 13% of the fatality risk profile.
- The greatest causes of workforce shock and trauma are assault and abuse, and suicide and trespass fatalities, each of which account for around 1.1 FWI per year.

6.2 Workforce fatalities and injuries in 2009/10

More than 200 million hours of work were performed throughout the railway during the year. The following injuries were recorded.

Fatalities

There were three workforce fatalities, all occurring to track workers.

Table 11. Workforce fatalities in 2009/10

Date	Location	Accident type	Region	Description of incident
2 December 2009	Leeds	Struck by train	London North East	A track worker acting as lookout was struck by a train. He was taken to hospital but later died.
27 January 2010	Forth Bridge, Edinburgh	Fall from height	Scotland	A civil maintenance contractor fell from scaffolding on bridge and landed on a scaffold platform below.
28 January 2010	Tay Bridge, Dundee	Exposure to hazardous fumes	Scotland	A civil maintenance contractor working on a bridge was affected by fumes, while grit-blasting.

Major injuries

- There were 118 major injuries in 2009/10, of which 68 (58%) involved track workers; the most common causes were slips, trips and falls and contact with objects. This latter category covers a variety of events, such being struck by rails or sleepers while engaged on track work, or bumping into equipment around stations.

Minor injuries

- There were 5305 recorded minor injuries, 529 (10%) of which were RIDDOR-reportable. These affected the full range of railway employees and had a wide variety of causes.

Shock and trauma

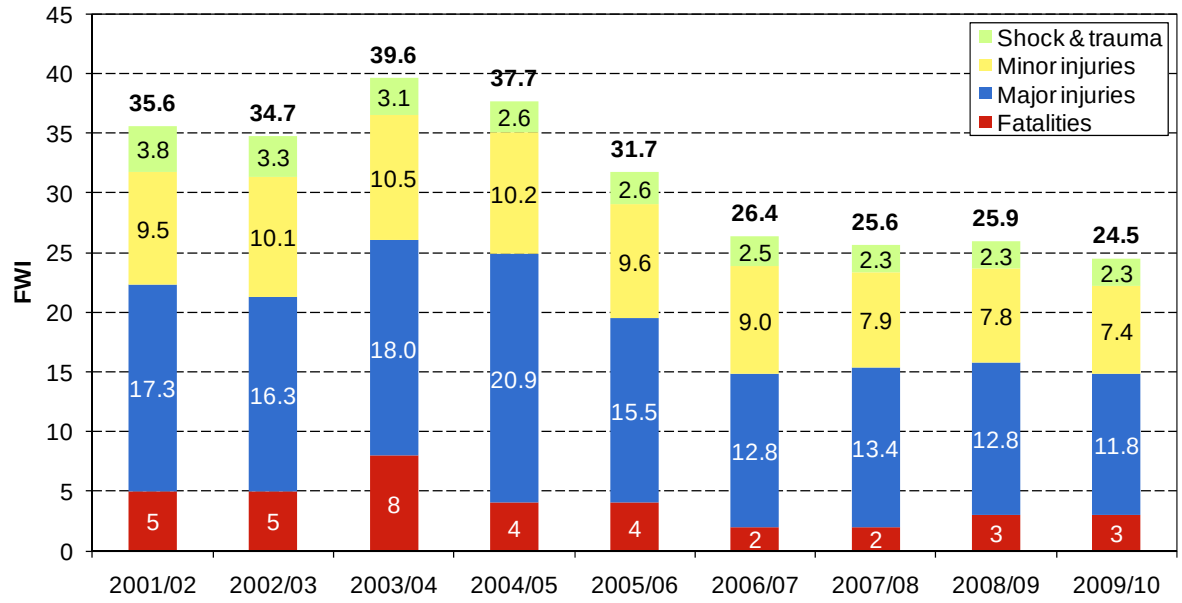
- There were 1143 reports of shock or trauma in 2009/10; of these, 277 (24%) were Class 1[28].

[28] Shock/trauma resulting from being involved in a train accident, or witnessing a fatal personal accident, is termed Class 1. All other occasions of shock/trauma are termed Class 2.

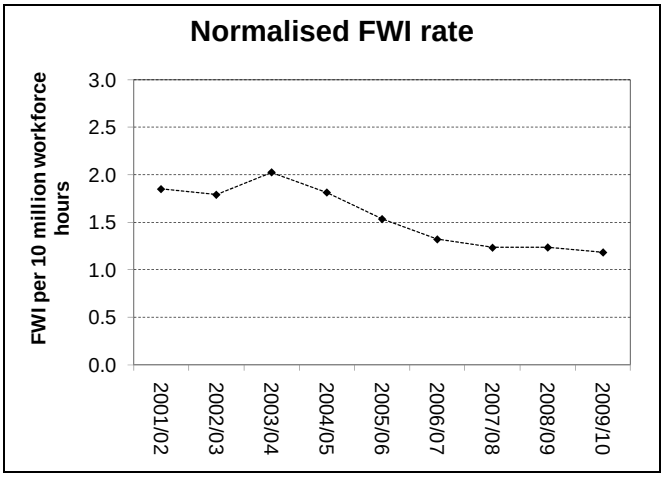
6.3 Trend in workforce harm by injury degree

Based on SRMv6, the average level of harm to the workforce is 29.8 FWI, of which 4.7 (16%) is fatalities. In any given year, the observed levels of harm may differ from SRM estimated values. One factor in this is statistical variation. Another is that the SRM provides an estimate of underlying risk, and includes the risk from events that may not have occurred during the year, such as train accidents with workforce injuries.

Chart 56. Workforce FWI by injury degree



- Overall, workforce harm has remained roughly the same for the last four years. The last four years have seen fewer workforce fatalities. Since recording began, there have been no financial years without workforce fatalities.
- There was a decrease of 6% in total harm compared with 2008/9, due to fewer major and minor injuries, which are both at the lowest levels seen over the analysis period. The normalised rate of harm also shows a decrease, of 4%. The reduction is smaller due to a fall in workforce hours compared with 2008/09.
- Two of the years shown in the chart contain multi-fatality accidents[29]. In 2003/04 four track workers were killed in an accident involving a runaway trailer, at Tebay, and in 2004/05, two track workers at Hednesford were killed in another accident involving a road-rail vehicle.

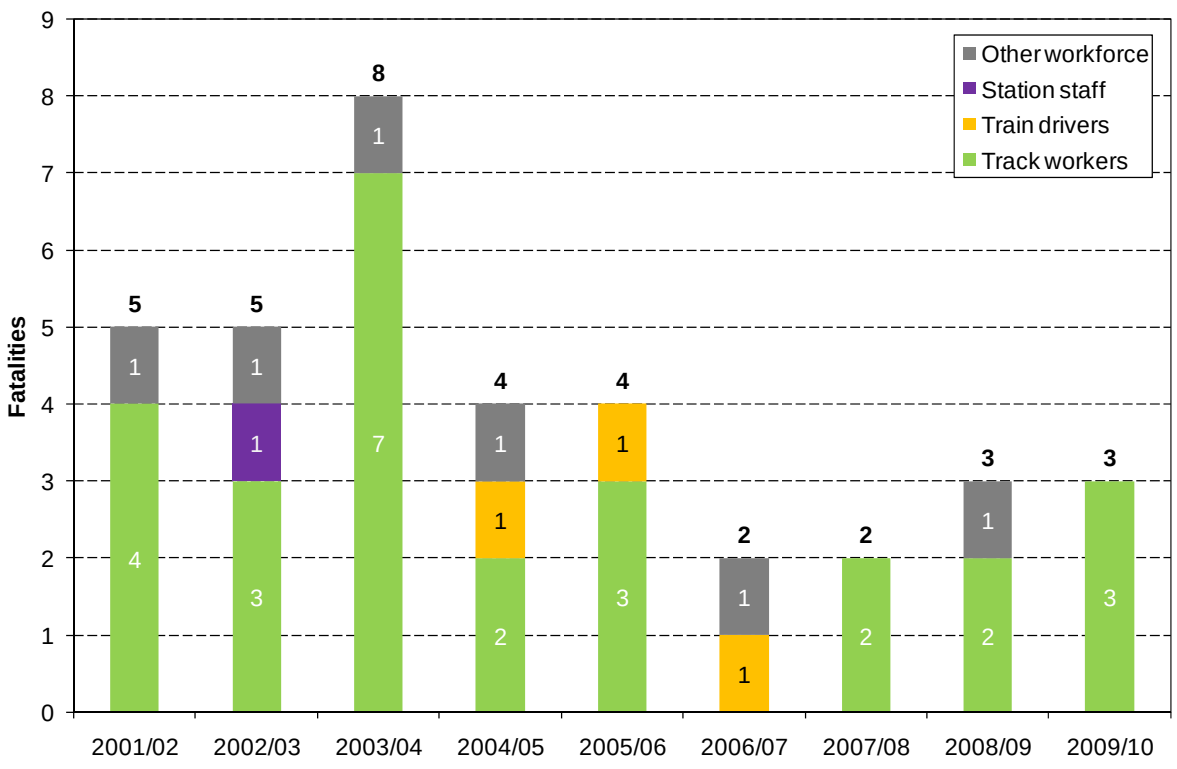


[29] Another multi-fatality event occurred in 2000/01, at Great Heck, when four members of the workforce were killed in the same train accident.

6.3.1 Workforce fatalities

The majority of workforce fatalities occur to those involved in track work, reflecting the higher-risk environment in which this work takes place.

Chart 57. Workforce fatalities by type of worker



- Since 2001/02, there has been a total of 36 fatalities, 26 of which have occurred to track workers[30].
- In 2009/10, there were three workforce fatalities, all track workers. In the case of a look out who was struck by a train, in December 2009, RAIB have initiated an investigation. There have been at least two workforce fatalities every year since 2001/02.
- Over the period shown, the highest number of fatalities occurred in 2003/04, when eight workforce members died, four of whom were the track workers fatally injured in the Tebay incident.
- The fatalities included in the *other workforce* category include two shunters, two machine operatives, a person delivering to site, and a banksman.

[30] Track work can cover a variety of different activities, from track maintenance to civil structure maintenance. A list of different activities all classed as track worker activities is given in Table 12.

Workforce fatality by location

Track workers are not the only workforce group exposed to risk at the trackside. Train crew may also be similarly exposed, for example when a driver changes ends of his or her train. Shunters also have cause to work in a trackside location, often in yards and sidings.

Table 12. Workforce fatalities by location and activity 2001/02 to 2009/10

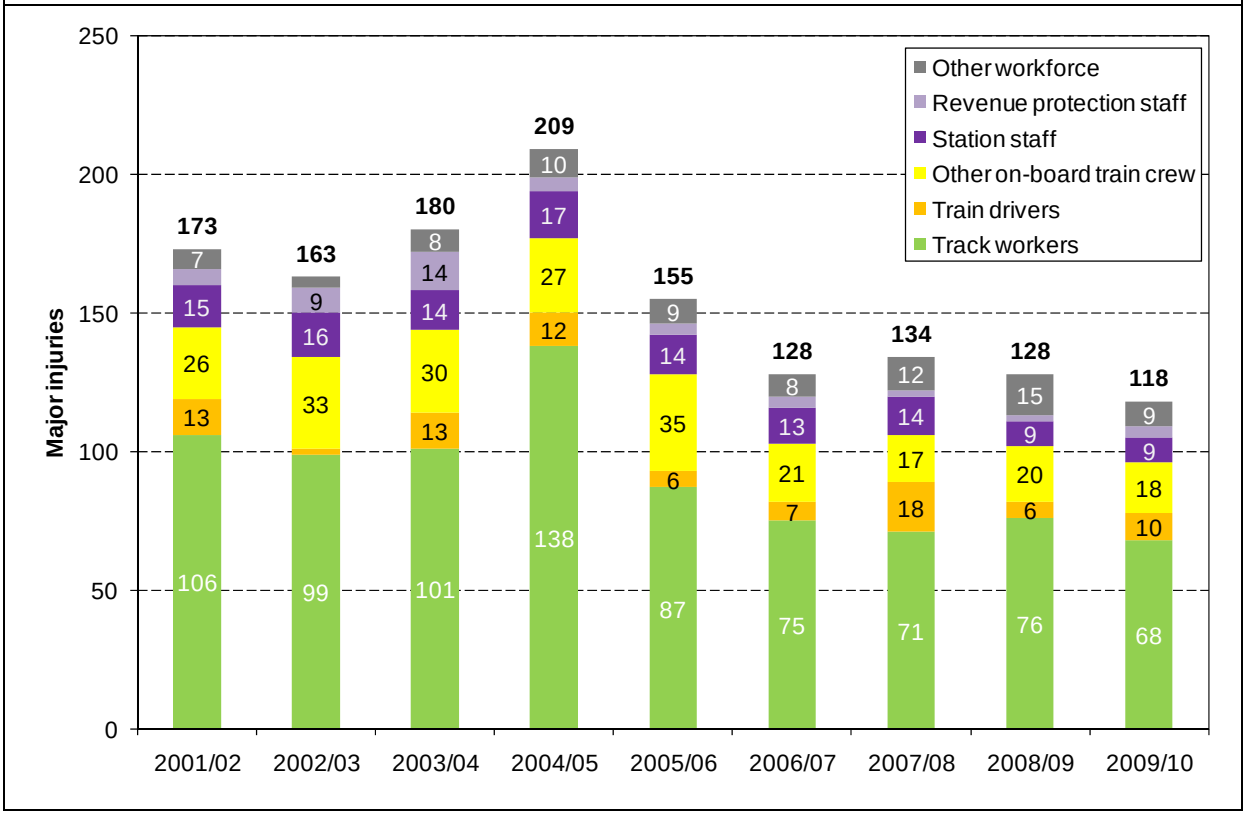
		Site type					
		Running line	In depots, yards and sidings	On trains	On railway infrastructure - not trackside	Public /private property (non railway owned)	Total
Track worker	Track maintenence	11		1			12
	Lookout	4					4
	CoSS	2					2
	Civil structure maintenance				2		2
	Hand Signaller	2					2
	Civil structure inspection				1		1
	S&T renewal/upgrade	1					1
	Electrification maintainence	1					1
	Machine controller	1					1
Train driver		2		1			3
Station staff				1			1
Other workforce	Shunters		2				2
	Fitter/MOM		2				2
	Other					1	1
	Non-railway personnel delivering to site	1					1
	Total	25	4	3	3	1	36

- Most fatalities have occurred to track workers engaged on track maintenance or about the running line. This is a consequence of the number of employees in this group and their exposure to a high-risk environment. Since 2001/02, there have been 11 fatalities in this category.
- Other types of track worker activities have accounted for a further 11 fatalities on the running line.
- Running line fatalities can also occur to other types of workforce who have cause to go on the track. These include a driver struck at Edgeley Junction in April 2005 and a driver electrocuted at Deal in July 2006, as well as a lorry driver delivering sleepers, at Finnieston, in November 2002.
- Since 2001/02, there have been four fatalities in depots, yards and sidings. Non-fatal injuries in these locations are not routinely recorded by RSSB, as they are not within scope.

6.3.2 Workforce major injuries

Workforce major injuries are defined in RIDDOR 1995 Schedule 1, and include losing consciousness (as a result of the injury), fractures (other than fingers and toes), major dislocations and hospital stays of 24 hours or more. SRMv6 estimates workforce major injuries to account for 14.3 FWI per year, which is 48% of the total workforce risk.

Chart 58. Workforce major injuries by type of worker

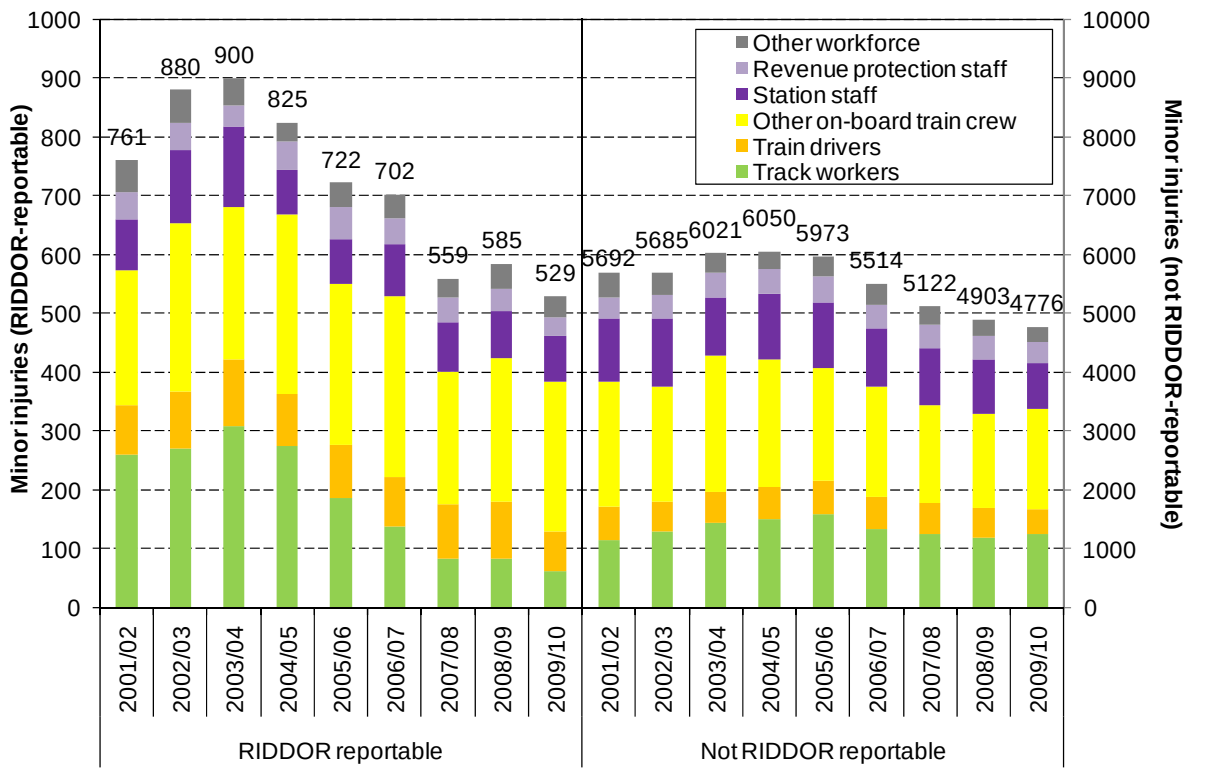


- There was a decrease in workforce major injuries in 2009/10, compared with the previous year. Workforce major injuries now stand at their lowest recorded level. The decrease is due partly to a fall in the number of major injuries occurring to track workers, which also stands at its lowest level.
- Since 2001/02, 59% of all major injuries have occurred to track workers. This proportion has stayed fairly constant over the period shown in the chart. The year with the largest proportion of track worker major injuries was 2004/05.
- One of the 2009/10 major injuries is subject to an investigation by RAIB. On 30 March 2010, a track worker who was working as one of a gang of eight people working on track maintenance at Cheshunt Junction, Hertfordshire, was struck by a passenger train, sustaining serious injuries.

6.3.3 Workforce minor injuries

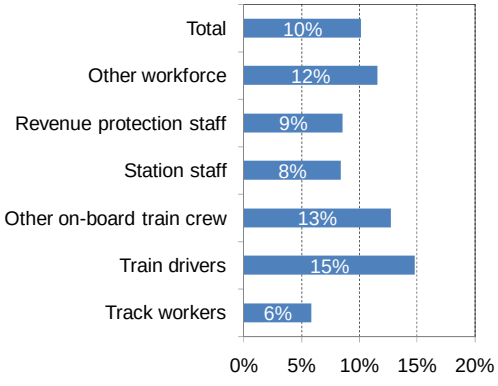
Workforce minor injuries are classed as RIDDOR-reportable if they are not major injuries and they incur more than three days lost time from work. While all fatalities and major injuries occurring to the workforce are recorded, this is not necessarily the case with minor injuries and shock/trauma events, where different worker types may display different reporting cultures. SRMv6 estimates workforce minor injuries to account for 8.4 FWI per year, which is 28% of the total workforce risk.

Chart 59. Trends in workforce minor injuries by worker type



- Unlike major injuries and fatalities, the majority of recorded minor injuries occur to train crew. Until around 2004/05, track workers also recorded a similar level of RIDDOR-reportable minor injuries, but since then there has been a reduction.
- There has been a downward trend in number of RIDDOR-reportable minor injuries since 2003/04, mainly due to the fall in track worker injuries. There has also been a fall in non RIDDOR-reportable minor injuries, due mainly to a fall in reports by other on-board train crew.
- In recent years, there have been marked differences in the proportions of minor injuries which are RIDDOR-reportable for different workforce types, ranging from 6% for track workers to 15% for train drivers.

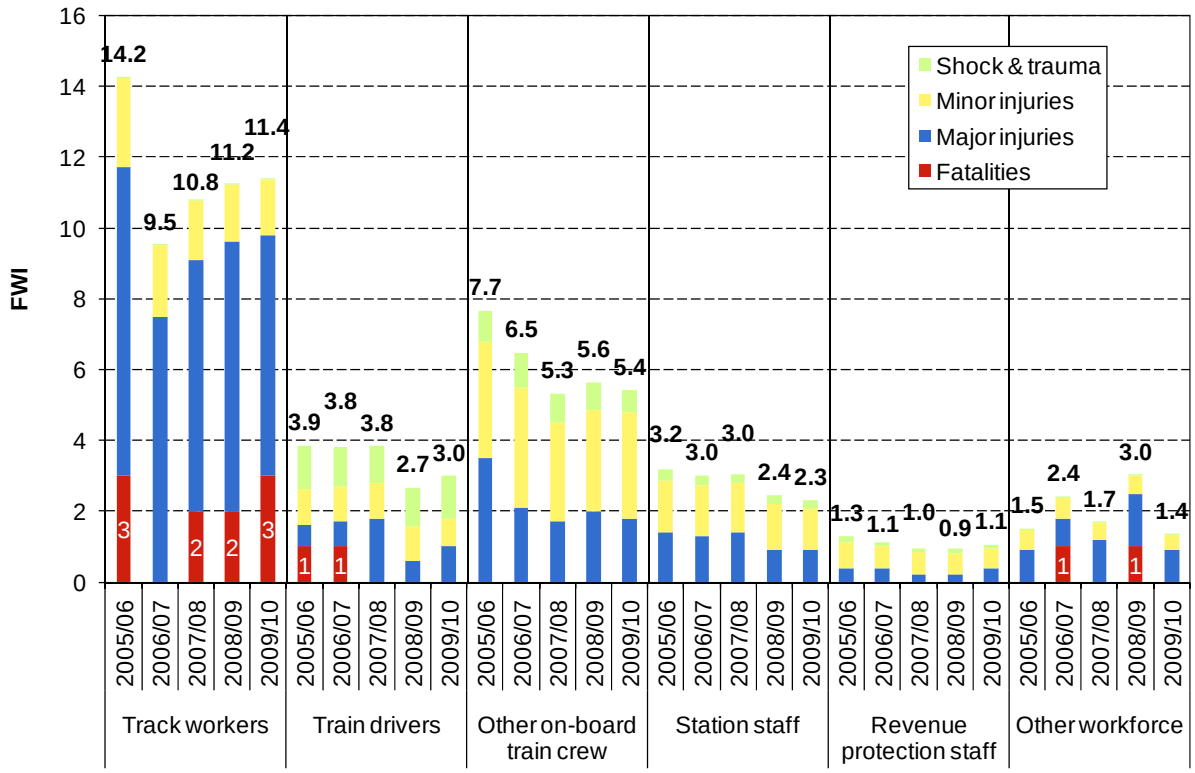
Proportion of RIDDOR-reportable minors since 2007/08



6.4 Trends in workforce harm by type of worker

Different types of rail work show different levels of harm. This is partly due to the number of workforce hours contributed by the different occupations, but also due to the different environments to which each is exposed.

Chart 60. Workforce fatalities and weighted injuries by type of worker



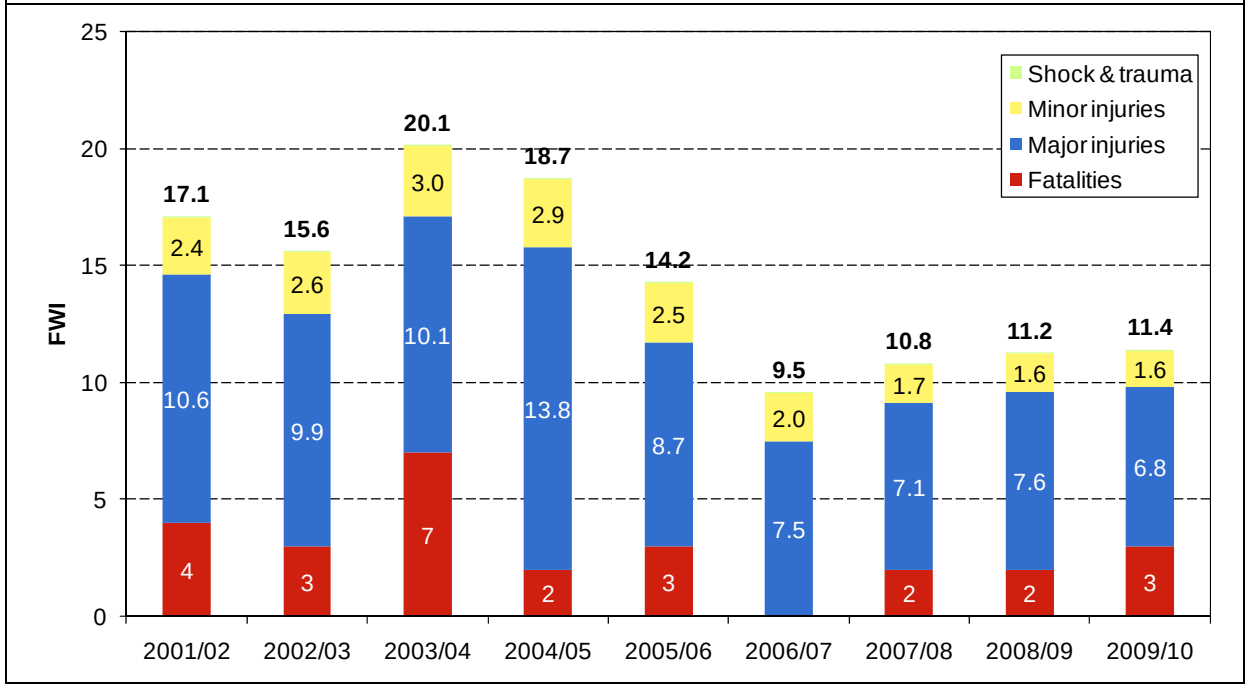
- Track workers suffer the greatest proportion of harm, with 43% of the total workforce harm over the period shown. The total level is affected by the number of fatalities, but is dominated by major injuries. The level of harm to track workers has increased for the past four years, but is still lower than the level for 2005/06.
- Train drivers and other train crew have the next greatest proportion of harm, with 36% of the total workforce harm over the period shown, when combined. Minor injuries make up a much larger proportion of harm to these sectors of the workforce than others. The level of harm for both train drivers and other train crew has generally decreased since 2005/06.
- The overall level of harm for station staff is not dissimilar to train drivers. Over the period shown, they have accounted for 10% of the total workforce harm. However, their injury profile is different, with no fatalities, and considerably lower levels of shock/trauma.
- Revenue protection staff and other staff[31] have recorded the lowest levels of harm over the period, at 4% and 7% respectively. However, their injury profiles are again very different, with other staff having a greater tendency for fatality and major injury.
- The data is not shown normalised by workforce hours; information on differences in individual risk for worker groups is given in section 4.4 of the *Benchmarking* chapter.

[31] The category *other staff* includes shunters, fitters, delivery staff, and mobile operations managers (MOMs).

6.4.1 Track workers

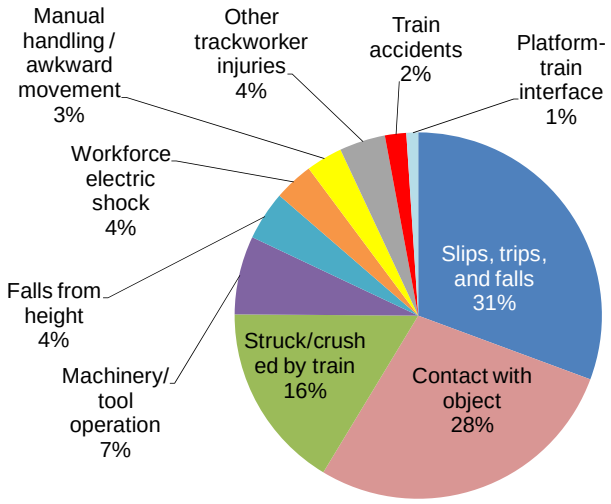
There are around 35,000 people in the workforce classed as track workers. In this report, the term track worker is used to describe a wide range of railway employees. It encompasses those whose work involves inspecting, maintaining and renewing the track, telecommunications and signalling equipment, and other railway infrastructure, such as earthworks and bridges. Since 2001/02, the average level of track worker FWI per year has been 14.3, and the average level of fatalities 2.9 FWI.

Chart 61. Trend in track worker FWI



- Track worker harm peaked in 2003/04 at 20.1 FWI. Following a large decrease over the period up to 2006/07, recent years have seen a slight rising trend. However, levels of track worker harm are still historically low.
- The category which is responsible for the largest proportion of track worker harm is *slips, trips and falls*, which over the period shown has accounted for 31%. This is closely followed by the category *contact with object*, which has accounted for 28%. There is more discussion of these accident types on pages 93 and 94.
- Events due to electric shock, train accidents, or being struck by a train are relatively rare, but because of the seriousness of the event, are more likely to result in fatality than other types of accident.

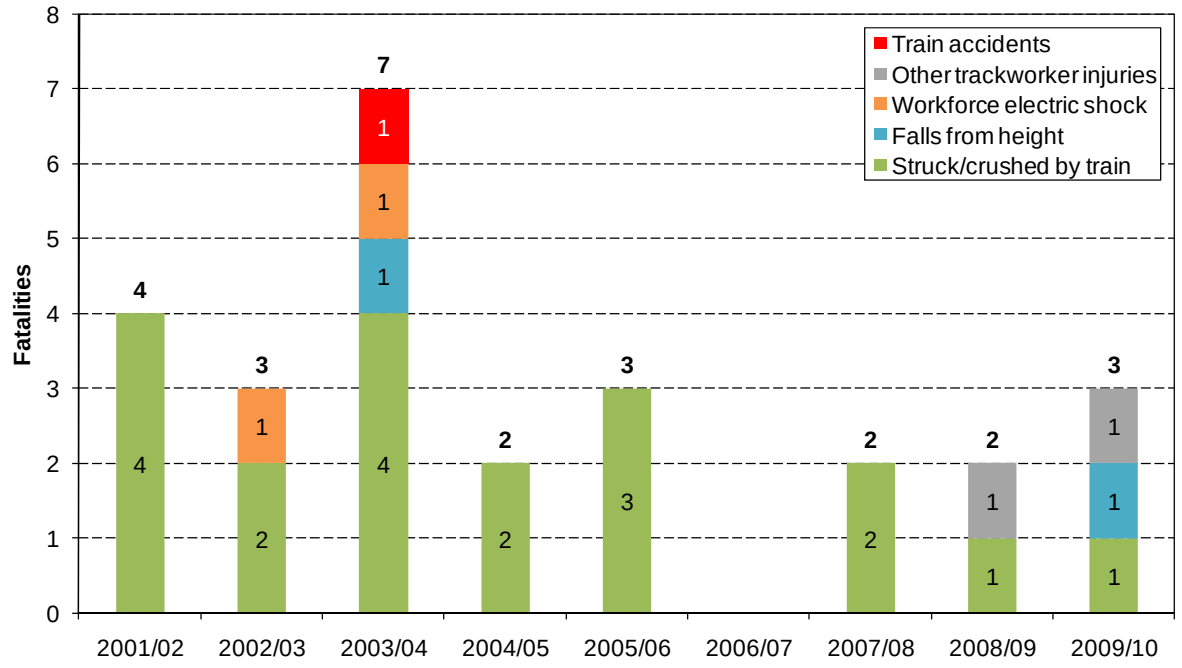
Track worker FWI by accident type since 2001/02



Track worker fatalities

Since 2001/02, around 20% of track worker harm has been due to fatalities. Track workers are exposed to general construction-type hazards, as well as railway-specific hazards that arise from working in proximity to moving trains and unprotected electricity supplies.

Chart 62. Track worker fatalities by accident type



- The most common cause of fatality for track workers is being struck by train, which has occurred at least once a year with the exception of 2006/07, when there were no track worker fatalities. There was one such event in 2009/10.
- Three of the fatalities shown in the chart involved falls from height[32]. In 2003/04, an abseiler working under contract fell around 80ft down a ventilation shaft at Fareham Tunnel. In 2008/09, three members of staff were injured, one fatally, when the basket of a road-rail machine, in which they were working, sheared away. This is classed under *other track worker injuries* in the chart above, because it involved working with on-track plant. In 2009/10, a track worker involved in bridge maintenance work fell from scaffolding. There is more analysis of falls from height on page 95.
- In 2009/10, there was a second fatality occurring to a person working on bridge maintenance, when a track worker was overcome by fumes while grit-blasting.
- Working in proximity to the third rail carries the risk from electrocution, which has caused two fatalities since 2001/02.
- The final fatality in the chart, which is categorised under *train accidents*, occurred in 2003/04 at Ancaster, and was the result of a collision between two rail vehicles in an engineering possession. This type of event is not what might typically be thought of as a train accident (eg passenger/freight collision or derailment) but is still classed as such under RIDDOR.

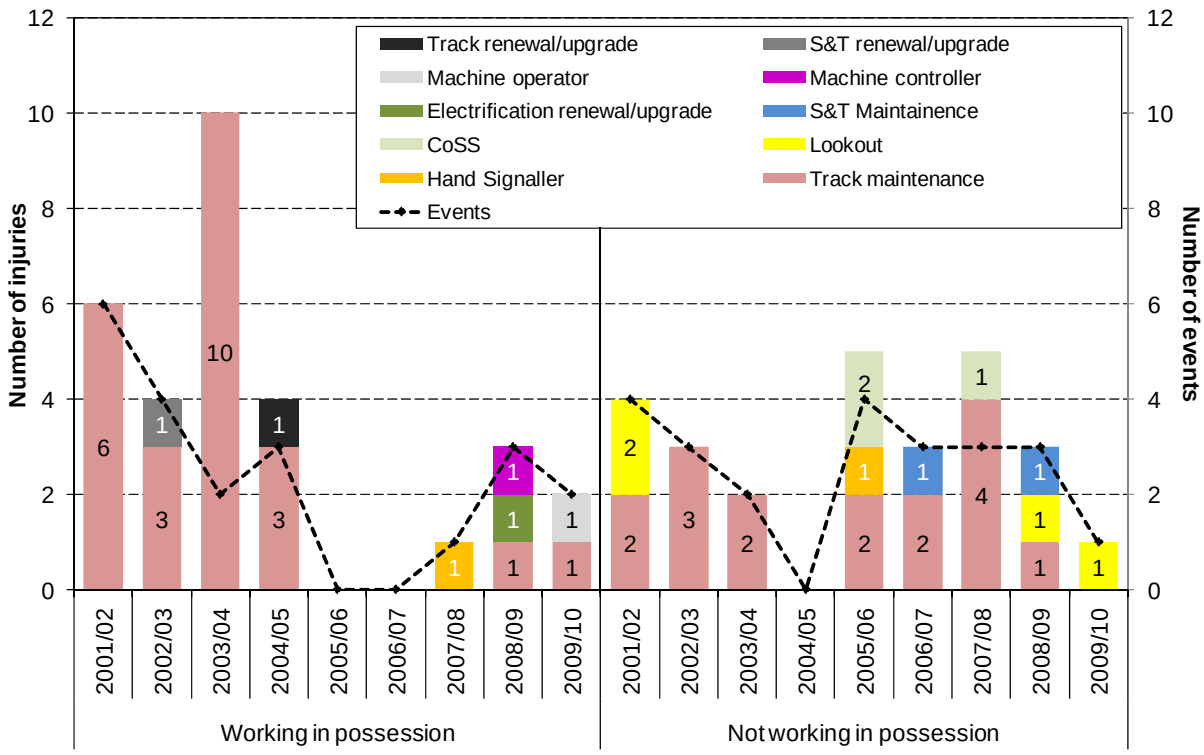
[32] A further *fall from height* incident occurred in April 2010, at Stewarton. A member of staff working in a cherry picker basket, for the purposes of bridge strengthening work, suffered fatal injuries when the equipment fell over. This accident is currently the subject of an investigation.

Track worker risk from being struck by train[33]

Since 2001/02, there have been 44 events in which track workers were struck by trains. Four of these resulted in multiple injuries; of these, two events involved multiple fatalities (Tebay and Hednesford).

The previous chart showed that the majority of track worker fatalities are the result of being struck by a train: nearly three quarters of fatal injuries have been due to this cause since 2001/02.

Chart 63. Events in which track workers were struck by trains 2001/02 to 2009/10



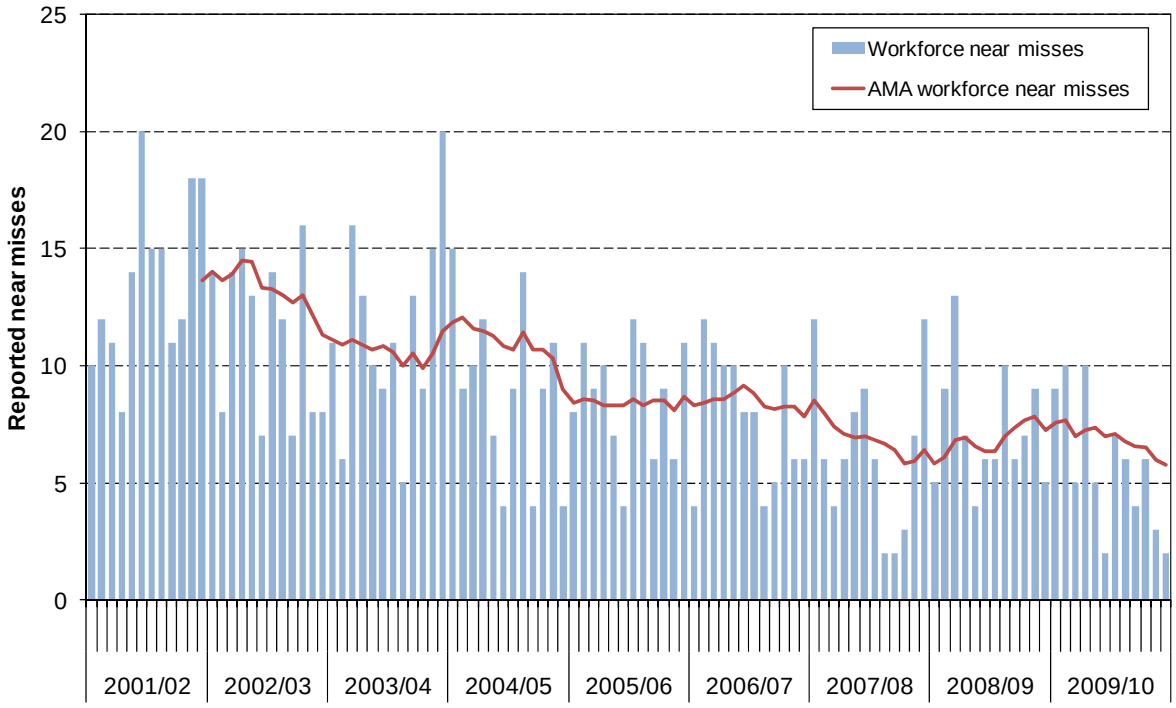
- The 44 events resulted in 56 injuries. Of these, 19 were fatal, 21 were major, 13 were minor, and 3 were shock/trauma. The total FWI since 2001/02 has been 21.1 FWI.
- The events are split roughly equally between those occurring to people working in a possession (21) and outside a possession (23). The 21 events in possessions resulted in 30 injuries, and the 23 events outside possessions resulted in 26 injuries.
- On-track plant and engineers machines were involved in 15 of the events involving people working within a possession. In the remaining six events, the person was struck by a train on an open line, after moving out of the possession.
- A review of the incidents identified the following themes: poor planning; failure to establish a safe system of work; poor communication; procedures not followed. In some cases, additional factors such as unfamiliarity with the work site, or complacency due to familiarity with the site, were cited.

[33] Under RIDDOR, rail vehicles such as on-track plant and engineers machines are also classed as trains.

Track worker near misses

Although the worker type is not usually noted in workforce near miss reports, it can be assumed that most will be with track workers. Track worker near misses are an indicator of the risk from being struck by a train, which is the major cause of track worker fatality. In addition, near misses can be a cause of shock and trauma to drivers.

Chart 64. Near misses with the workforce



- The number of recorded near misses varies month by month, but not in any stable seasonal pattern. There was a general falling trend in the annual moving average of incidents from 2002/03 until the end of 2007/08, since when it has plateaued.
- Most near misses are reported during the day-time period, from 08:00 to 17:00, with the peak times being between 10:00 and 12:00. The factors involved are likely to be visibility and times that certain types of track work are taking place.

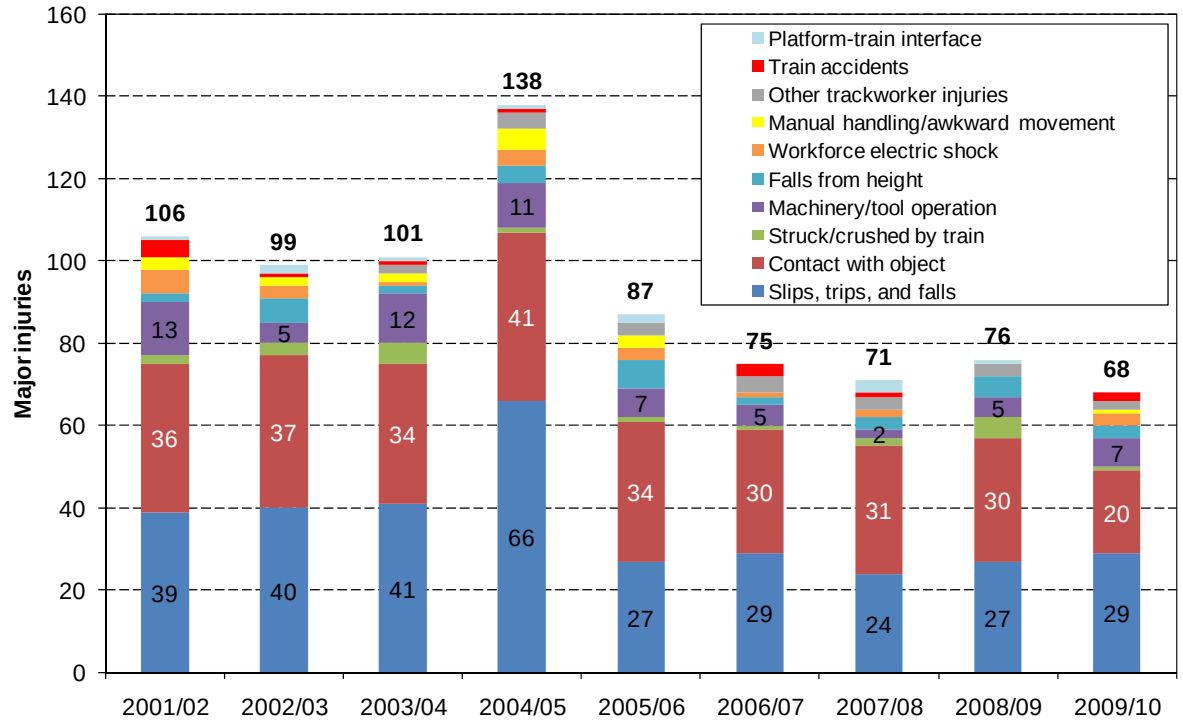
Number of workforce near misses since 2001/02

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
0	4	3	1	1	7	4	3	2	1	4	4	1	35
1	0	2	1	1	1	0	5	3	2	1	2	0	18
2	0	1	0	1	2	1	1	2	1	0	0	2	11
3	0	1	0	2	0	0	3	0	0	0	3	0	9
4	1	2	0	0	2	0	0	3	1	1	3	1	14
5	0	1	1	0	0	1	1	1	1	2	2	0	10
6	1	1	0	0	0	0	4	0	0	0	1	0	7
7	0	1	2	3	0	0	2	2	2	1	1	0	14
8	3	3	2	2	3	7	5	0	1	1	4	5	36
9	9	13	7	6	9	9	7	12	10	9	10	6	107
10	10	12	16	20	18	15	23	11	13	17	13	9	177
11	13	9	16	19	10	12	16	14	9	12	6	9	145
12	7	11	12	10	6	12	2	5	6	13	10	5	99
13	8	5	7	9	9	7	6	6	8	6	8	3	82
14	7	3	7	4	5	5	4	6	5	11	4	5	66
15	3	5	4	4	3	6	2	4	2	1	1	0	35
16	4	1	0	3	0	1	0	3	2	1	0	2	17
17	2	2	4	0	1	4	0	2	3	1	0	0	19
18	1	1	1	0	1	0	1	0	0	0	2	3	10
19	1	2	1	0	1	1	1	0	0	1	3	2	13
20	5	1	0	1	0	1	0	0	1	1	0	2	12
21	2	1	0	2	1	1	2	1	0	3	1	1	15
22	0	0	2	0	2	1	2	1	0	1	1	1	11
23	0	2	2	0	2	5	1	0	1	1	0	1	15
Total	81	83	86	88	83	93	91	78	69	88	79	58	977

Track worker major injuries

Since 2001/02, 64% of track worker harm has been due to major injuries.

Chart 65. Track worker major injuries by accident type

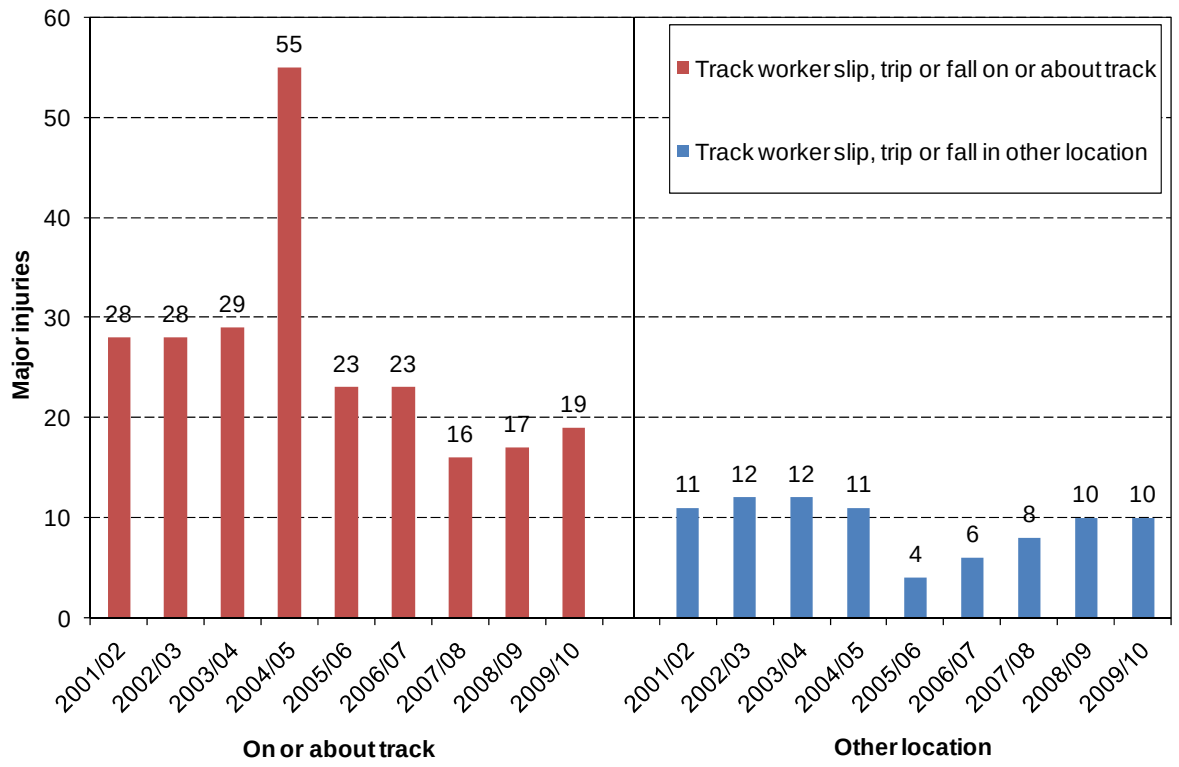


- There was a decrease in the total number of major injuries to track workers in 2009/10 compared to 2008/09; the level now stands at its lowest recorded number. The decrease is due mainly to a fall in the number of events due to contact with objects.
- With the exception of 2004/05, the trend in track worker major injuries has been generally downward. The large peak in 2004/05 occurred around the time that Network Rail brought track maintenance in house. It is possible that when working during a time of large industry changes, staff are more prone to injury, due to distraction. The number of slips, trips and falls rose by more than 50% during this period, and injuries due to contact with object rose by around 20%. However, the increase in both was short-lived.
- Since 2001/02, 39% of track worker major injuries have been due to slips, trips and falls, and a further 36% have been due to contact with objects. The types of incident that cause fatalities - e.g. being struck by train, electric shock and falls from height – cause proportionately fewer major injuries. By their nature, these types of accidents have a higher likelihood of resulting in fatality.

Track worker slips, trips and falls: major injuries by location

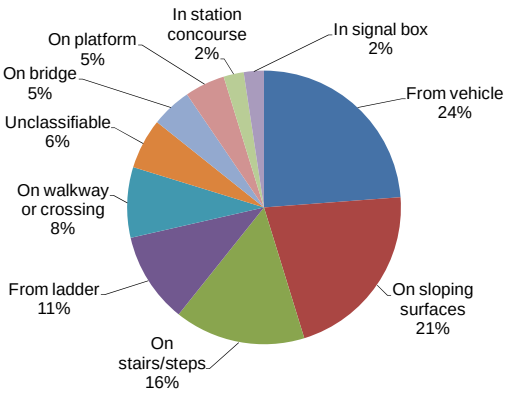
Within SMIS, track worker slips, trips and fall are classed by location. The category of *slips, trips and falls* does not include falls from height, which are analysed separately.

Chart 66. Track worker major injuries due to slip, trips and falls



- The majority of track worker slips, trips and falls occur on or about the track. The peak in slips, trips and falls that occurred during 2004/05 was due to this type of event. Slips, trips and falls at other locations showed no change.
- Looking particularly at slips, trips and falls at locations that are not on or about the track, nearly one quarter are from vehicles. A further 21% occur on sloping surfaces, with stairs, steps and ladders together contributing another 27%.
- This analysis excludes falls of more than 2m. Such accidents are categorised as falls from height and analysed separately, on page 95.

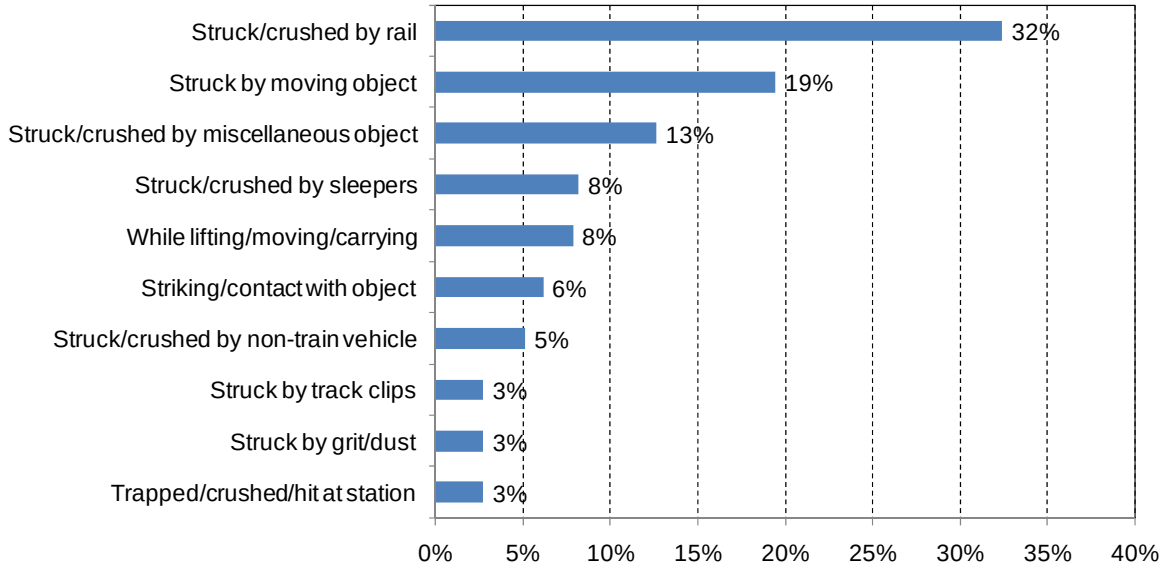
Slips, trips and falls at other locations since 2001/02



Track worker contact with object: major injuries by cause

The category of *contact with object* includes injuries while lifting, moving or carrying objects (e.g. dropping or striking injuries) but does not include manual handling injuries (e.g. strains or sprains) which are categorised separately.

Chart 67. Track worker major injuries due to contact by object since 2001/02



- Since 2001/02, 32% of contact with object injuries have been categorised under the incident precursor *struck/crushed by rails*. A further 8% have been categorised under *struck/crushed by sleepers*.
- Around half of events are categorised under an incident precursor that does not specify the object. For these events, analysis of the narrative is necessary. Examples of events occurring in 2009/10 where the precursor does not specify the object are shown below.

Table 13. Examples of contact with object injuries occurring in 2009/10

Precursor	Narrative
Striking/contact with object	A member of staff was assisting with point grinding. Their ankle became caught between the crank and the stock rail, resulting in a broken foot bone.
Struck by moving object	A contractor sustained a broken left leg after being knocked into a lift pit by a bundle of steel bars being moved on a forklift.
Struck by moving object	A member of staff was assisting with the removal of material from an arch, when pieces of corrugated sheeting at a high level became dislodged, striking the person on their leg and breaking their shin.
Struck by moving object	A track worker was placing a piece of wood under a section of rail that was being lowered, when the wood snapped and struck him in the face, fracturing his jaw and damaging teeth.
Struck by moving object	A track worker was clearing ballast from gripe by means of banging gripe on the railhead, when a piece of ballast or metal flew up and hit him in the eye.
Trapped/crushed/hit at station	A member of staff cut the back of his right hand when moving a roof panel into position at Victoria station. A tendon had been severed and injured party was kept in hospital more than 24 hours.
While lifting, moving or carrying	A contractor was picking up two fishplates when one slipped from his grasp and fell on his foot, which became painful and swollen.

Falls from height

Since 2001/02, there have been 145 incidents classed as falls from height. Nine of the events involved more than one injury; the total number of injuries was 157.

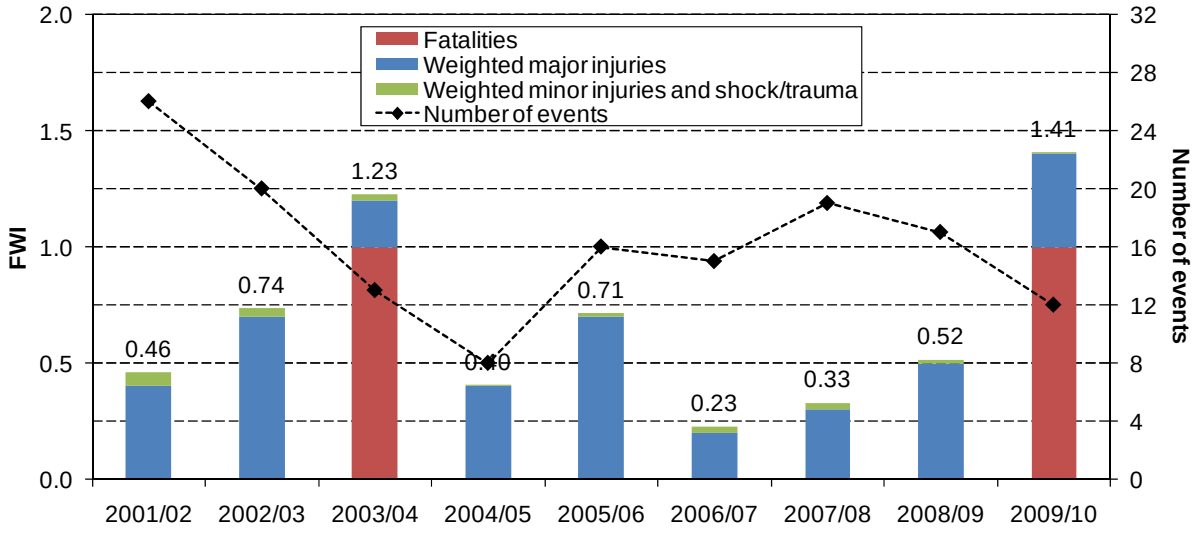
Table 14. Injuries involving falls from height since 2001/02

Type of fall	Track worker	Station staff	Other workforce	Train driver	Total events
Equipment/vehicle	24	0	2	0	26
Catch pit	23	0	2	0	25
Other	21	0	1	2	24
Ladder	13	4	3	0	20
Embankment	11	0	3	2	16
Scaffold	6	3	0	0	9
Station roof	3	5	0	0	8
Tree	6	1	0	0	7
Bridge	4	0	0	1	5
Manhole	4	0	1	0	5
Total events	**115**	**13**	**12**	**5**	**145**

Injury degree	Track worker	Station staff	Other workforce	Train driver	Total injuries
Fatal	2	0	0	0	2
Major	34	3	1	0	38
Minor	88	10	11	5	114
Shock/trauma	3	0	0	0	3
Total injuries	**127**	**13**	**12**	**5**	**157**

- The majority of *falls from height* events have involved track workers. There have been 115 such events, resulting in 127 injuries, two of which were fatal. The total level of harm was 6.0 FWI. Track workers have been the only group involved in events with multiple injury outcomes.
- The most frequent types of event for track workers are falls from equipment or vehicles. Four incidents involved people falling from baskets or cradles, as in the fatal accident at Margaretting, in 2008/09. Twenty-three events involved falls into catch pits; in all but two cases the injuries were minor.
- The types of falls involving station staff occur mostly from ladders or station roofs. Ladders are also involved in a number of track worker and other workforce falls. Contributory factors included using the ladder in wet or icy conditions, on uneven ground, or without securing it properly.

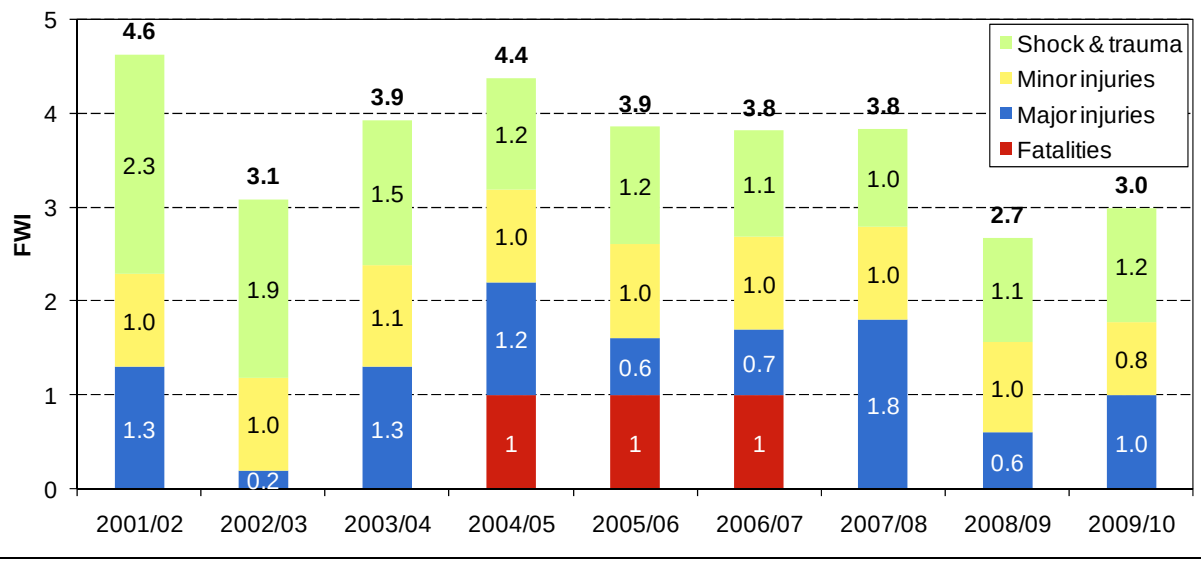
Chart 68. Injuries involving falls from height since 2001/02



6.4.2 Train drivers

Since 2001/02, the average level of FWI per year for train drivers has been 3.7, and the average level of fatality has been 0.3 per year.

Chart 69. Trend in train driver FWI



- There has been a slight increase in train driver harm in 2009/10 compared with the previous year, but the level is the second lowest over the period shown.
- The largest contributor to train driver FWI is shock or trauma as a result of being affected by suicide and trespass fatalities and injuries. The remaining categories of injury show the wide and varied range of risk to which train drivers are exposed.
- Train driver fatalities are relatively rare events. Over the period shown in the chart, there have been three train driver fatalities, one due to electrocution, one struck by a train, and one due to a train accident.

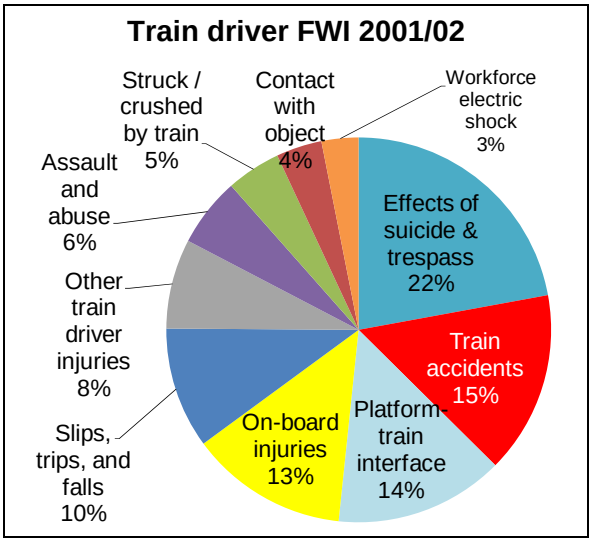


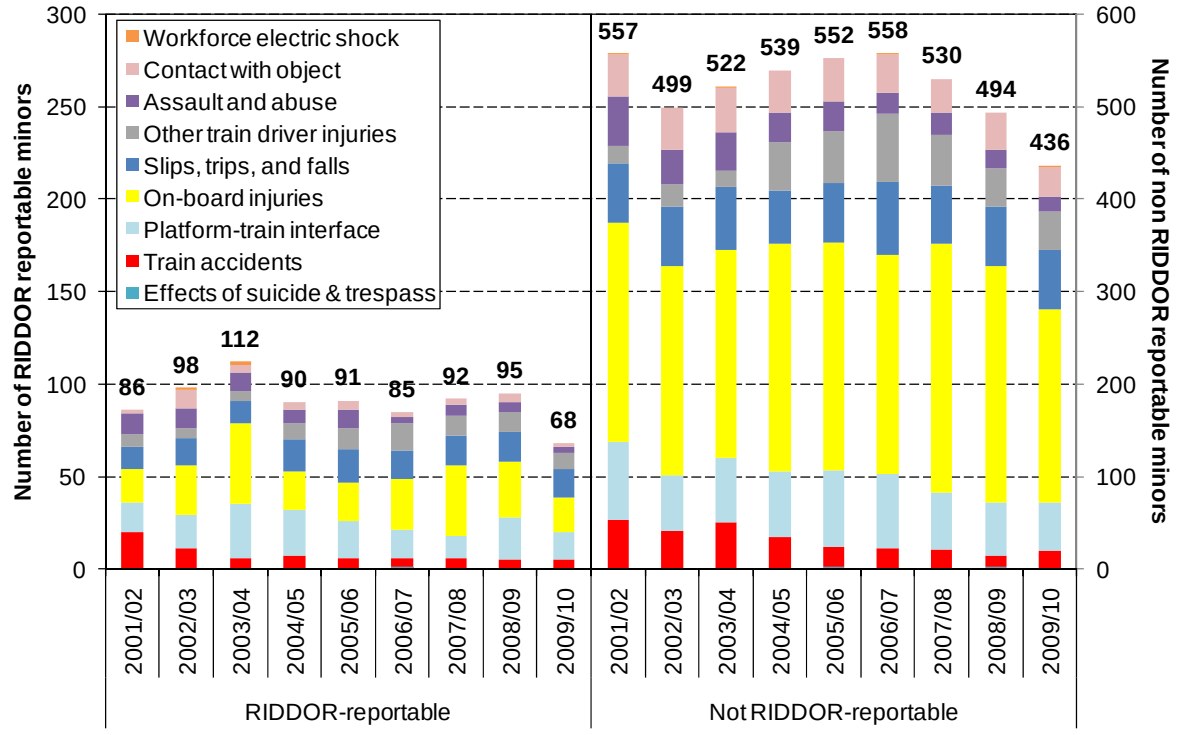
Table 15. Train driver fatalities since 2001/02

2004/05 Train accidents: collisions with road vehicles at level crossings	Train driver and five passengers were killed as a result of a train collision with a car parked on a level crossing at Ufton Nervet. The car driver, who was also killed, had deliberately parked on the crossing to commit suicide.
2005/06 Struck/crushed by train	A driver walking along the track to change ends of his train was hit by another train.
2006/07 Workforce electric shock	A driver investigating smoke coming from his train was electrocuted after coming into contact with the third rail.

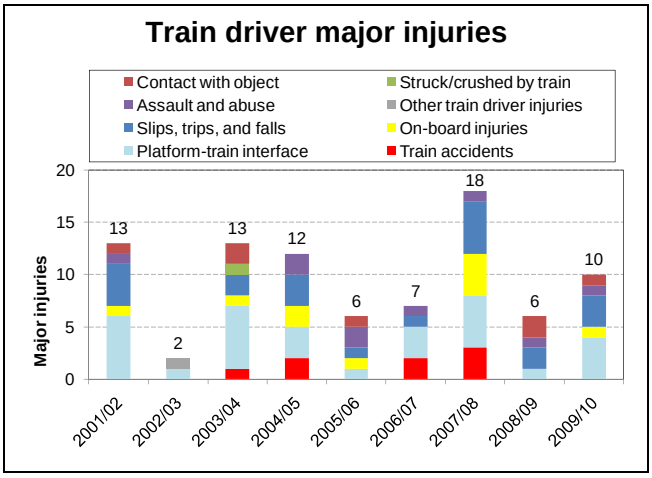
Train driver minor injuries

Since 2001/02, 26% of train driver FWI has been due to minor injuries.

Chart 70. Train driver minor injuries by type



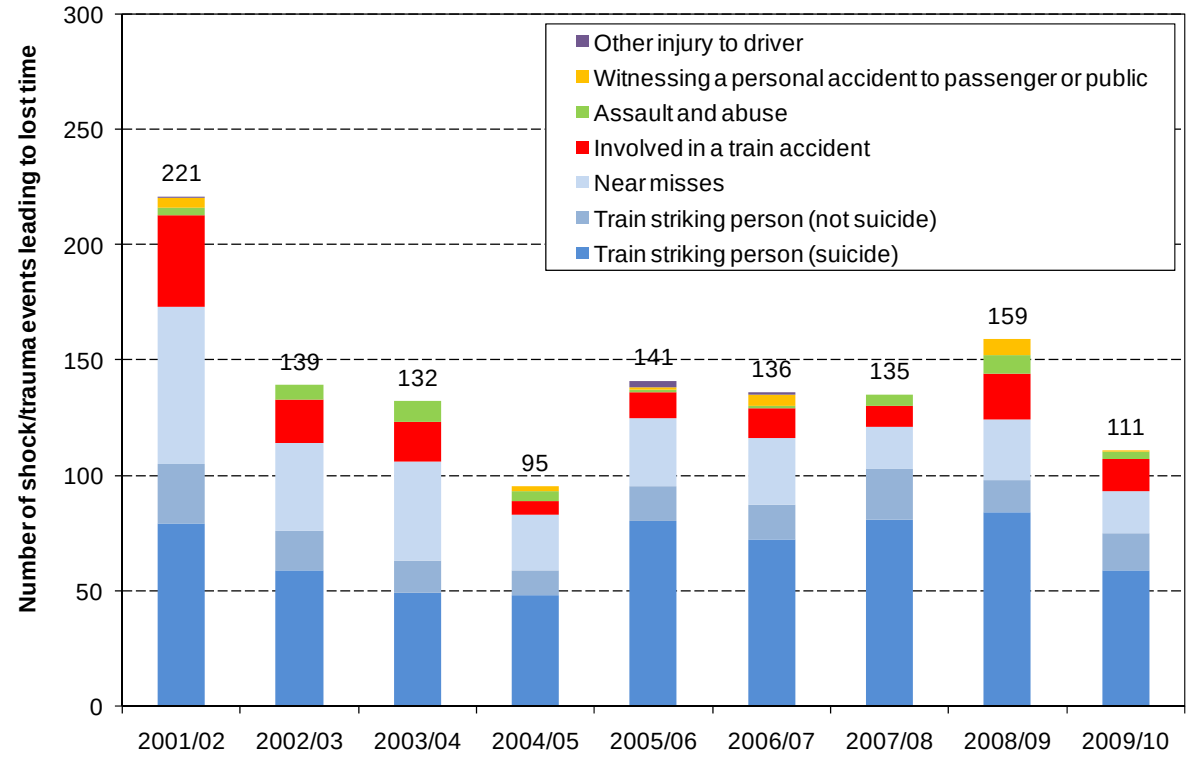
- There have been decreases in both the number of RIDDOR-reportable and non-RIDDOR-reportable minor injuries in 2009/10 compared with 2008/09. Each now stands at its lowest recorded level. The decrease in both categories has been mainly due to falls in the number of injuries on-board trains.
- On-board injuries have accounted for 30% of RIDDOR-reportable minors, and 46% of non-RIDDOR-reportable minors over the period. These accidents include instances of drivers striking or being struck by objects on the train, of awkward movements while working, and of slips, trips and falls occurring within the train.
- The number of major injuries has been quite variable from year to year; numbers are relatively low and it is not possible to attach any statistical significance to the trends. Since 2001/02, major injuries have contributed 26% of the total train driver FWI.



Train driver shock and trauma

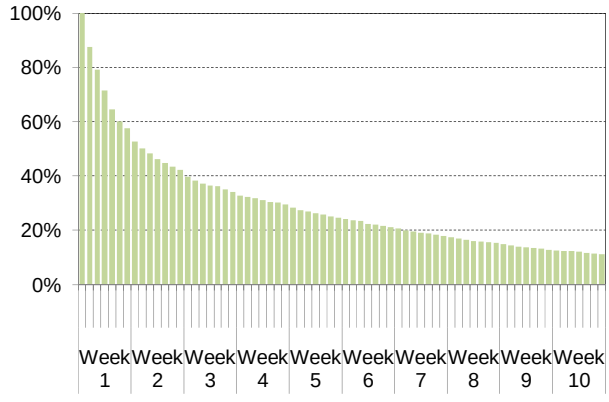
Relative to other worker types, train drivers experience a higher level of incidents resulting in shock or trauma. Since 2001/02, 38% of train driver FWI has been in this category. Fatalities and injuries to people involved in trespass or attempting suicide are one of the main causes of workforce shock for this group.

Chart 71. Train driver incidence of shock or trauma leading to lost time



- The number of recorded incidents of shock and trauma leading to lost time is quite variable. The level for 2009/10 is the second lowest over the period shown.
- The most common cause of recorded shock/trauma to drivers is the train striking a person. Suicides account for around 48% of these events and trespassers account for a further 9%.
- Since 2001/02, there has been a decreasing trend in recorded shock/trauma resulting from near misses. The proportion has fallen from 31% in 2001/02, to 16% in 2009/10.
- Of those cases involving lost time, over half have resulted in the driver being absent from work for a week or more. One quarter involved more than five weeks off, and just over 10% involved more than 10 weeks absence.

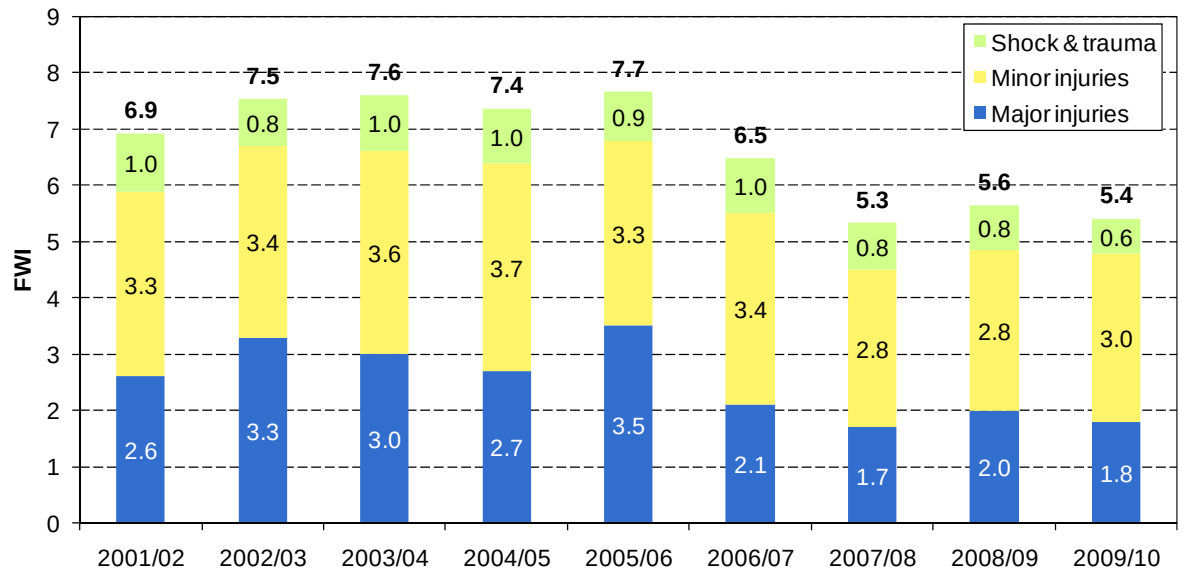
Lost time durations since 2001/02



6.4.3 Other on-board train crew

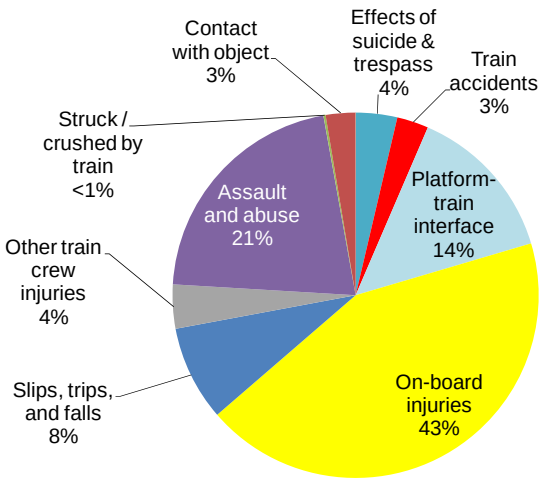
Around 10,500 people are employed as non-driving train crew. The majority (around 70%) work as guards or conductors, with train hosts or catering staff comprising most of the remainder. Since 2001/02, the average level of harm to other on-board train crew has been 6.7 FWI per year. As can be seen from the *Benchmarking* chapter (section 4.4) other on-board train crew appear to have relatively high levels of personal risk compared with other rail occupations, although fatality risk comprises a relatively low part of this: most of the risk profile comprises non-fatal injuries.

Chart 72. Trend in other on-board train crew FWI



- Harm to on-board train crew has been at lower levels since 2007/08 than previously.
- The largest contributor to other on-board train crew FWI is on-board injuries, which have accounted for 43% over the period shown. The next largest contributor is assault and abuse, which has accounted for 21% of the total FWI since 2001/02.
- There have been no fatalities involving other on-board train crew during the period shown in the chart. The last such incidents occurred in the train accident at Great Heck in February 2001, where two train drivers, a train guard, and a member of catering staff lost their lives.

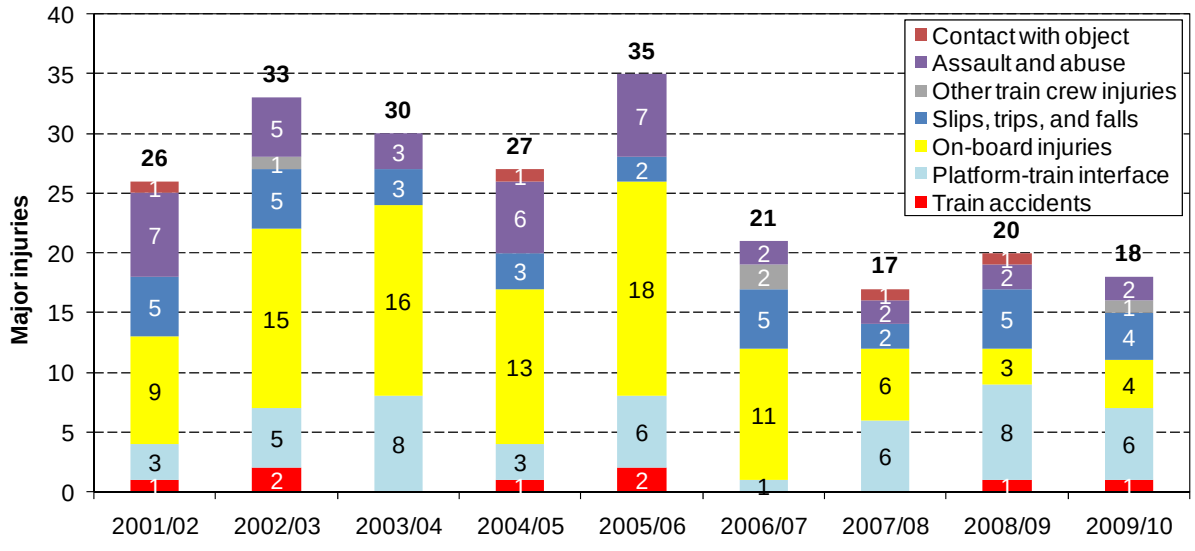
Other on-board train crew FWI since 2001/02



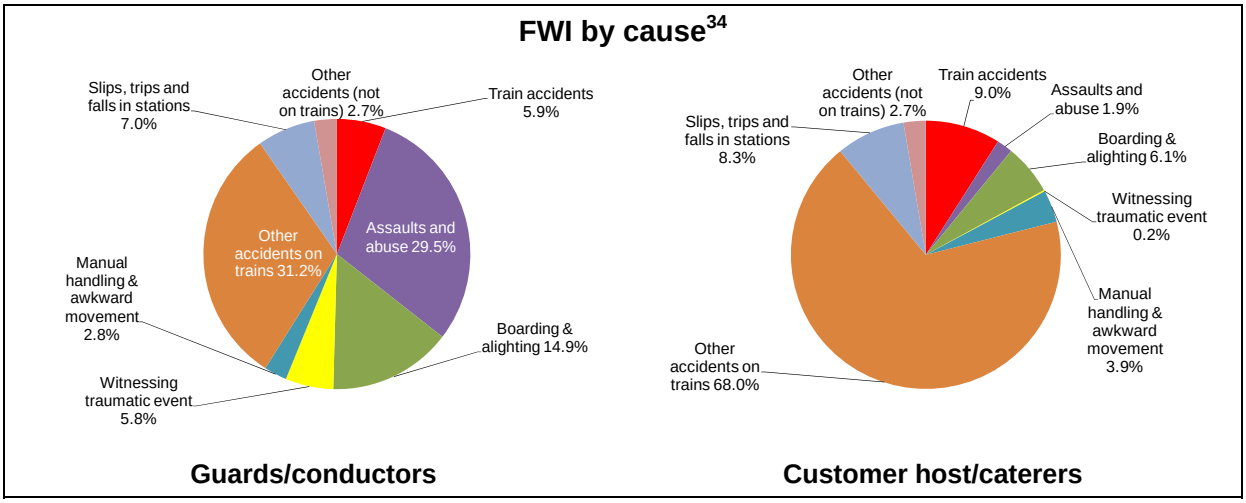
Other on-board train crew major injuries

Since 2001/02, 38% of the total FWI occurring to other on-board train crew has been due to major injuries.

Chart 73. Other on-board train crew major injuries



- The number of major injuries occurring to other on-board train crew has been notably lower since 2006/07, and has averaged around 19 per year.
- Up until 2007/08, the dominant type of major injury was on-board injuries, but since then, platform-train interface incidents have been more prevalent.
- In 2009/10, a major injury was recorded occurring in a train accident, when a train conductor suffered smoke inhalation as a result of a train fire, at Abergavenny.
- Different members of train crew undertake different tasks, which expose them to different hazards. Guards and conductors, who tend to be responsible for duties such as train despatch and ticket examination, are more prone to injuries from assault and during boarding/alighting. Customer hosts and caterers are more prone to personal accidents on trains.

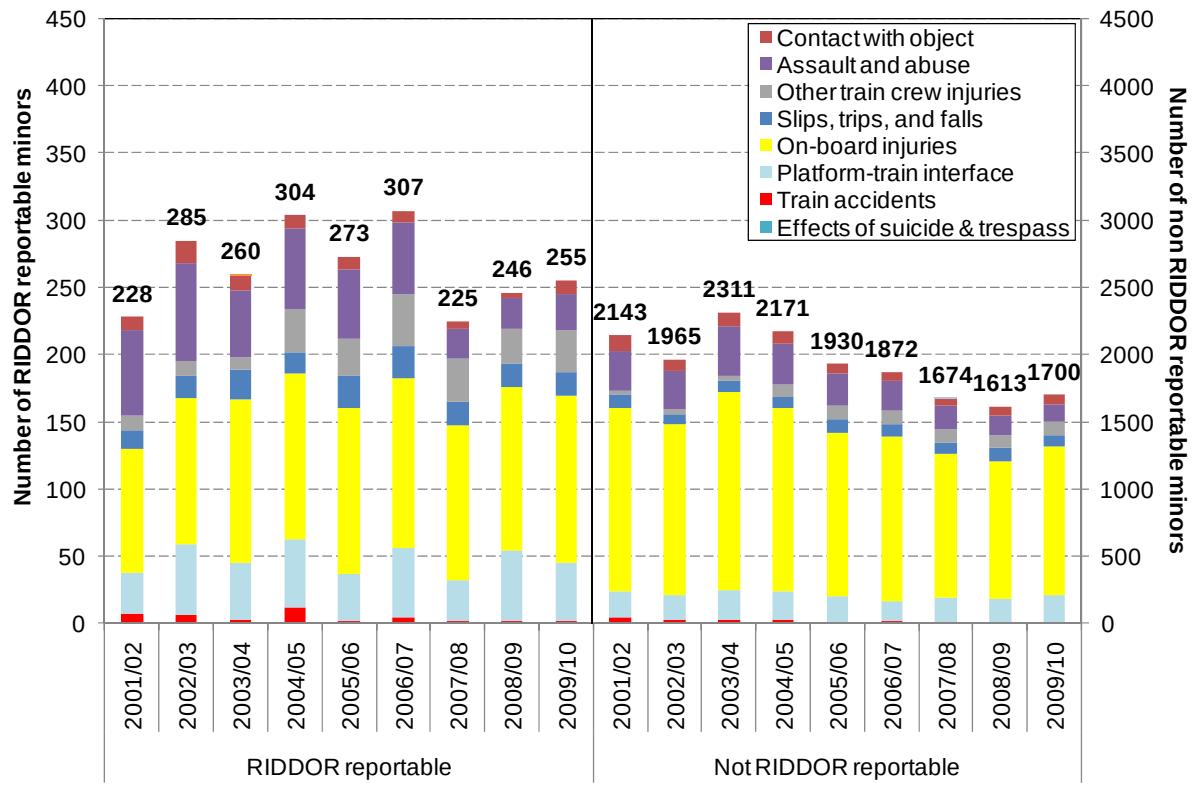


[34] Taken from *Workforce Risk* paper to RSSB Board, July 2009. Source: SMIS data from 2001 to 2009.

Other on-board train crew minor injuries

Since 2001/02, 49% of the total FWI occurring to other on-board train crew has been due to minor injuries.

Chart 74. Other on-board train crew minor injuries



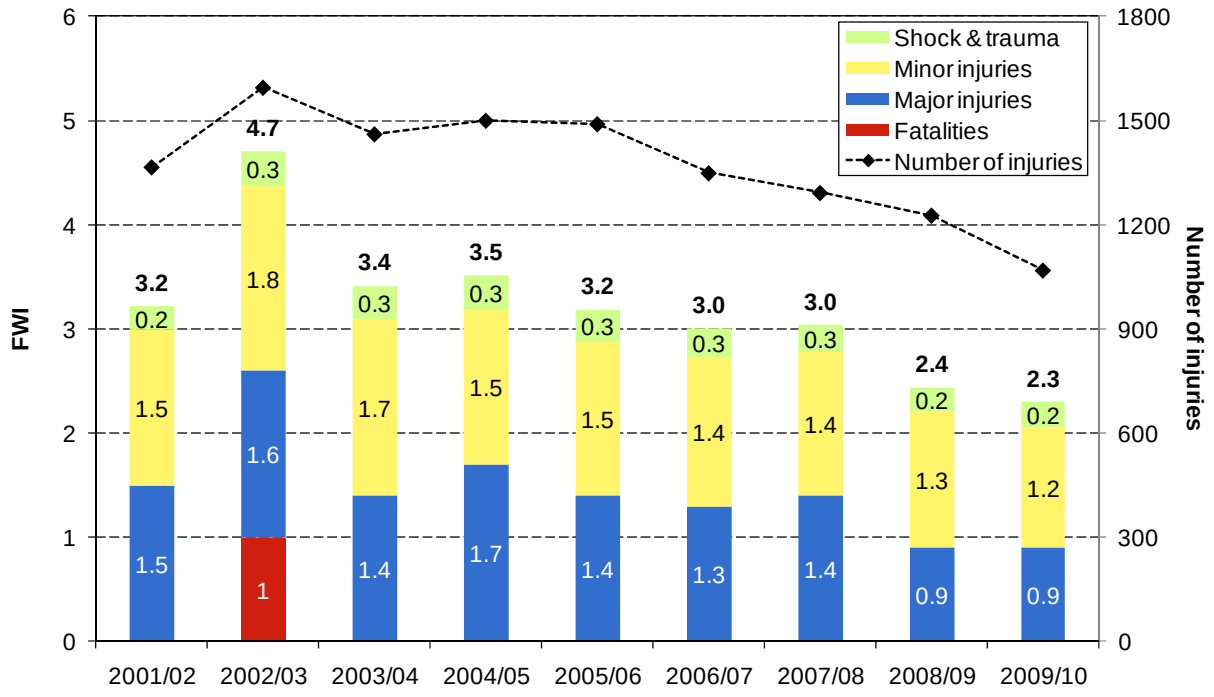
- Over the period shown, there has been no real trend in the number of RIDDOR-reportable injuries occurring to other on-board train crew, compared with a generally decreasing trend in the number of non-RIDDOR-reportable minors, despite a slight rise in number for 2009/10.
- On-board injuries have accounted for 44% of RIDDOR-reportable minor injuries, and 64% of non-RIDDOR-reportable minor injuries over the period.
- Train drivers and other train crew are exposed to different working environments, and exhibit different levels of reported minor injuries. As a whole, other on-board train crew report around three to four times more minor injuries than train drivers.

6.4.4 Station staff

There are around 12,000 members of staff working in railway stations. There are a wide range of activities carried out by staff in stations, such as train despatch on the platforms, manning ticket gates and cleaning.

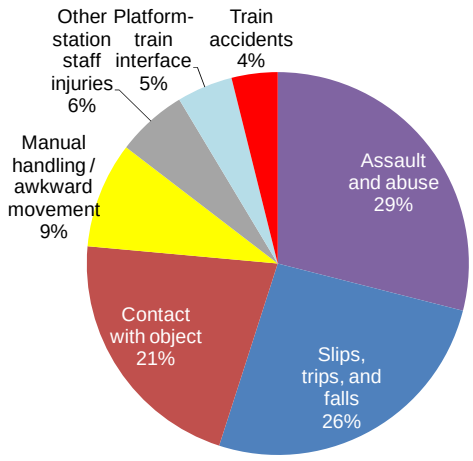
Over the period 2001/02 to 2009/10, the average level of harm per year to station staff has been 3.2 FWI.

Chart 75. Station staff FWI and number of injuries



- The number of recorded injuries to station staff has shown a gradual decrease since 2002/03, as has the associated level of FWI.
- Fatalities to station staff are rare events. Over the period shown, there was one fatal event, in 2002/03. A member of station staff was overcome by fumes when tackling a train fire, at Purley station. Train fires have also caused a small number of minor injuries and shock/trauma events since 2001/02.
- The overall decrease in FWI has been mainly due to reductions in the level of FWI arising from assault and abuse, and slips, trips and falls.
- Over the period 2001/02 to 2009/10 as a whole, the three largest contributors to station staff FWI have been *assault and abuse*, *slips, trips and falls*, and *contact with object*.

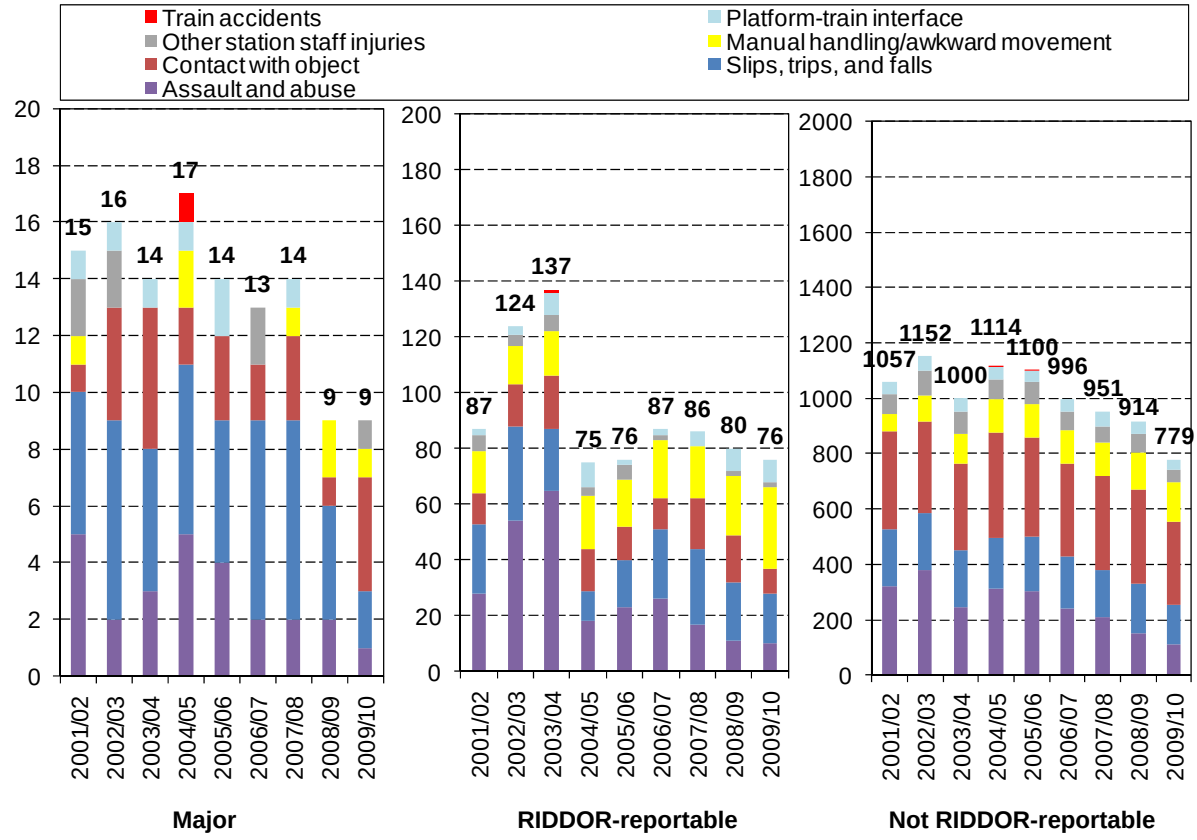
Station staff FWI by type since 2001/02



Station staff major and minor injuries

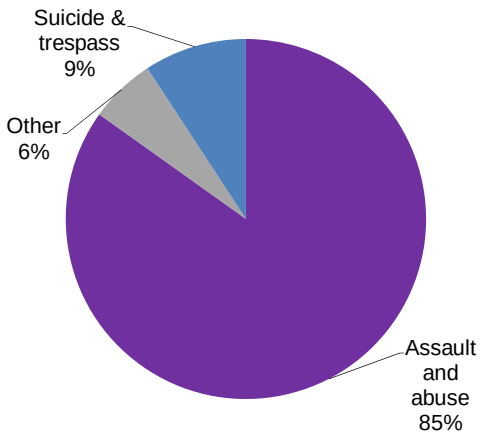
Since 2001/02, 42% of harm to station staff has been major injuries, and 46% has been minor injuries.

Chart 76. Station staff injuries by injury degree



- The number of major injuries occurring has been lower for the past two years than previously. However, numbers are small, so it is difficult to discern trends.
- Lower numbers of RIDDOR-reportable minor injuries have been seen since 2004/05. Since then, there has been a decreasing trend in the number of non-RIDDOR-reportable minors, due mainly to a reduction in events due to assault or abuse.
- Shock and trauma have caused 9% of the total station staff FWI since 2001/02. By far the greatest cause has been assault and abuse.

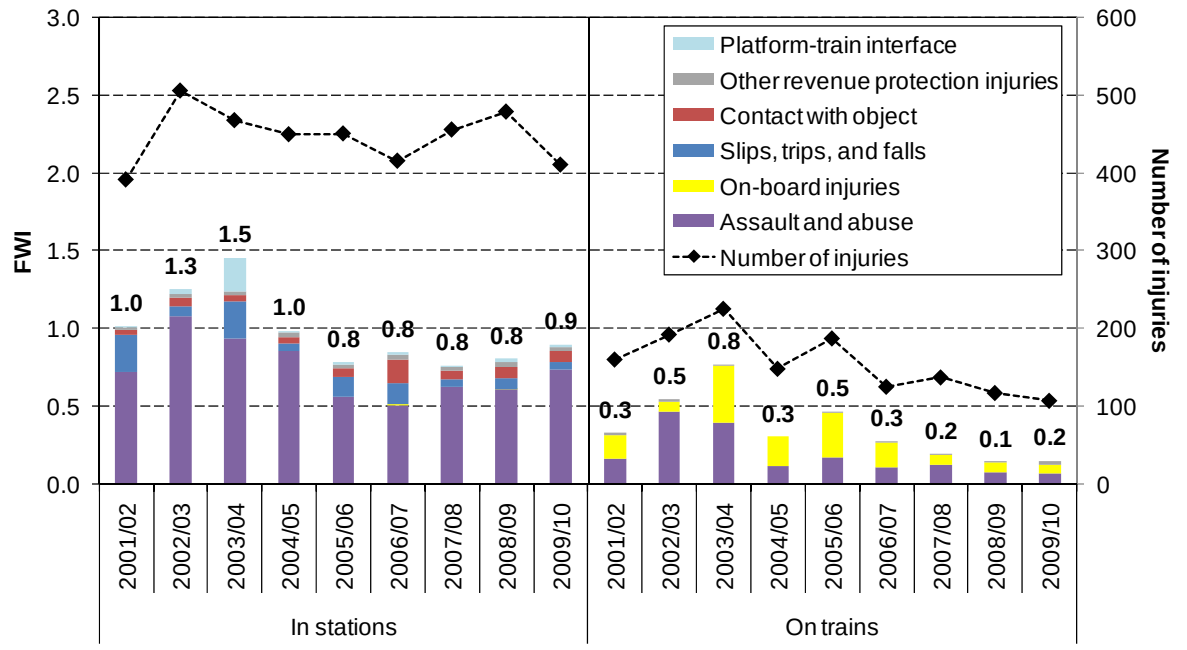
Station staff shock/trauma since 2001/02



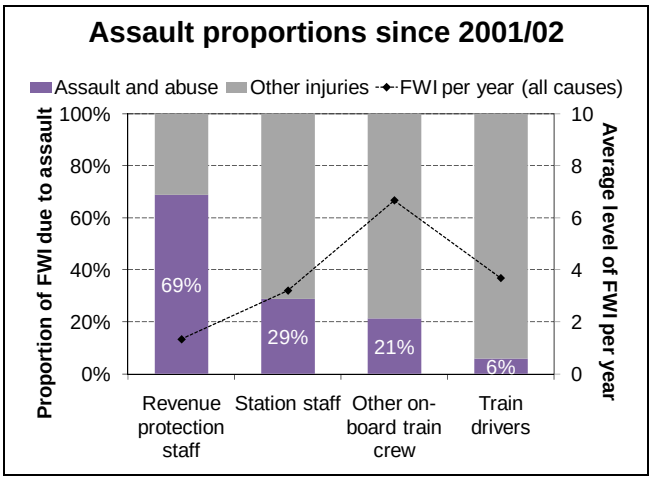
6.4.5 Revenue protection staff

There are an estimated 2,600 revenue protection staff working in the rail industry, who work both in stations and on trains[35]. Over the period 2001/02 to 2009/10, the average level of harm to revenue protection staff has been 0.7 FWI.

Chart 77. Revenue protection staff injuries by cause and site type



- Since 2001/02, three quarters of injuries, and three quarters of the total FWI to revenue protection staff, have occurred in stations.
- Of the injuries that have occurred in stations, 75% have been due to assault or abuse. Of the injuries that have occurred on trains, 53% have been due to assault or abuse.
- Contact with object injuries and slips, trips and falls account for 12% and 7% of the injuries in stations. On trains, accidents involving either of these events will simply be classed as on-board injuries.
- When locations are combined, assault and abuse injuries account for 69% of total FWI. This compares with proportions of 29% for station staff, 21% for on-board train crew, and 6% for train drivers. More analysis of workforce personal security issues is presented in section 6.5.



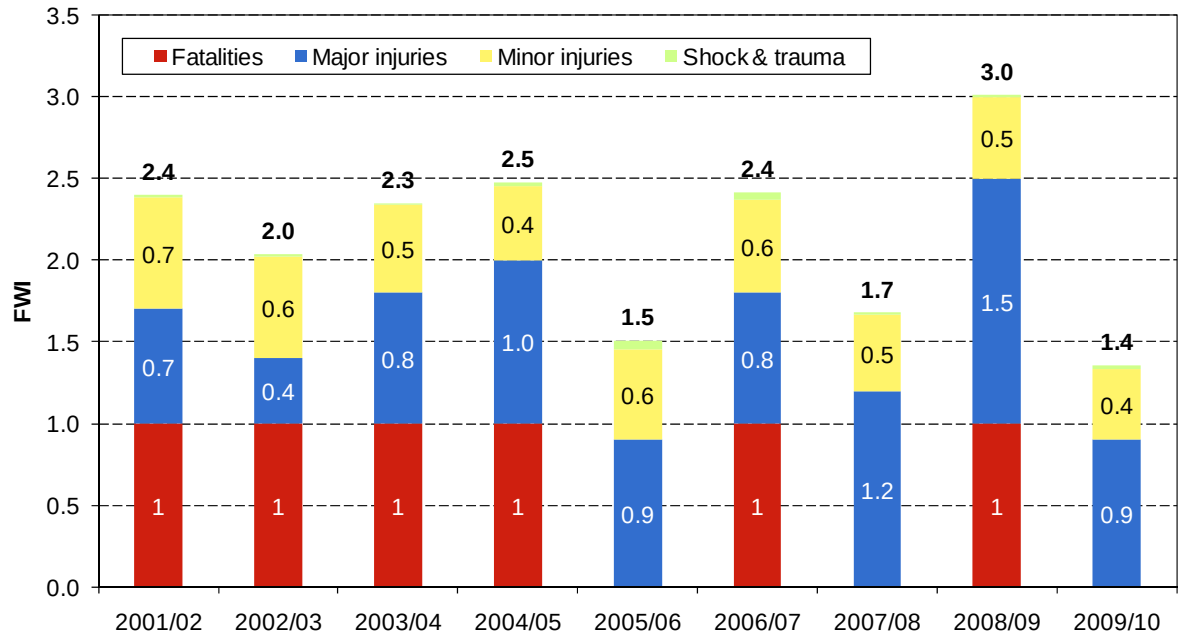
[35] It is not always clear in SMIS records if an incident has occurred to a member of revenue protection staff specifically, rather than a member of station staff or other train crew. Therefore some revenue protection staff may be included in the previous analyses for these two occupations.

6.4.6 Other workforce groups

The type of workers covered by the *other workforce* grouping includes shunters, machine operatives, fitters, signallers, level crossing keepers, and non-rail personnel delivering to work sites.

Over the period 2001/02 to 2009/10, the average level of FWI for this combined group has been 2.1 FWI.

Chart 78. Trend in FWI for other workforce groups



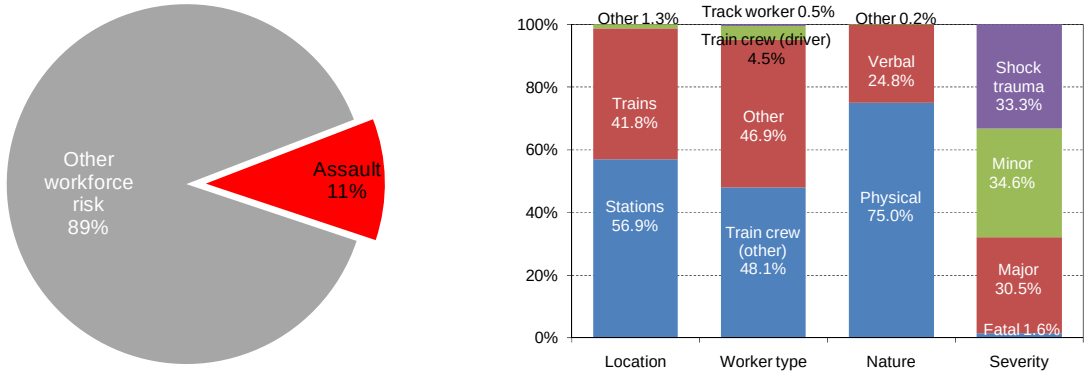
- Many of the locations where injuries occur are not within the scope of SMIS or the ASPR. Although all fatalities in such locations will be recorded, this is not true of non-fatal injuries; the true level of FWI is therefore likely to be higher than shown on the chart.
- The six fatalities occurred to two shunters, two machine operatives, a person delivering to site, and a banksman. Shunters in particular are believed to be exposed to higher levels of individual risk than most other types of rail worker[36].
- In 2009/10, there were nine major injuries within the other workforce group. Some examples are shown below:
  - A signaller fell while descending the steps from the signal box and broke his ankle.
  - A signaller broke his wrist after slipping on ice on a walkway.
  - A machine operative dislocated his shoulder after falling through the cover of a catch pit.

[36] RSSB's report on shunting risk, which was published in February 2008, is downloadable from the RSSB website: http://www.rssb.co.uk/SPR/REPORTS/Pages/default.aspx.

6.5 Workforce personal security

Violence at work is a significant issue, but it is not unique to the rail industry. As with other public-facing services (the NHS, for example), staff assaults occur on a daily basis. Attacks can take the form of verbal abuse and threats, or actual physical assault. For assaults on members of the workforce, SMIS contains good data on the number of incidents and the resulting injuries, and has been used to estimate the risk for SRMv6.

Chart 79. Workforce assault risk in the context of all workforce risk (3.3 FWI per year)



Source: SRMv6

- The SRM estimates that 11% of all workforce risk is due to assaults. This equates to 3.3 FWI per year. Most workforce assault risk (just under 60%) occurs within stations.
- The members of the workforce who are most at risk from assaults are those who have the most contact with passengers and members of the public. For example, station staff, train guards and revenue protection staff have much higher risk from assault than train drivers or track workers.
- Three quarters of the risk is from physical assaults. The remainder comprises shock and trauma arising from verbal abuse and threats.
- The risk is fairly evenly split between major injuries, minor injuries and shock/trauma.
- During 2009/10, there were eight major injuries, 527 minor injuries, and 727 cases of shock/trauma to the workforce, as a result of assault, giving an overall FWI of 2.3. Details of the major injuries are shown below.

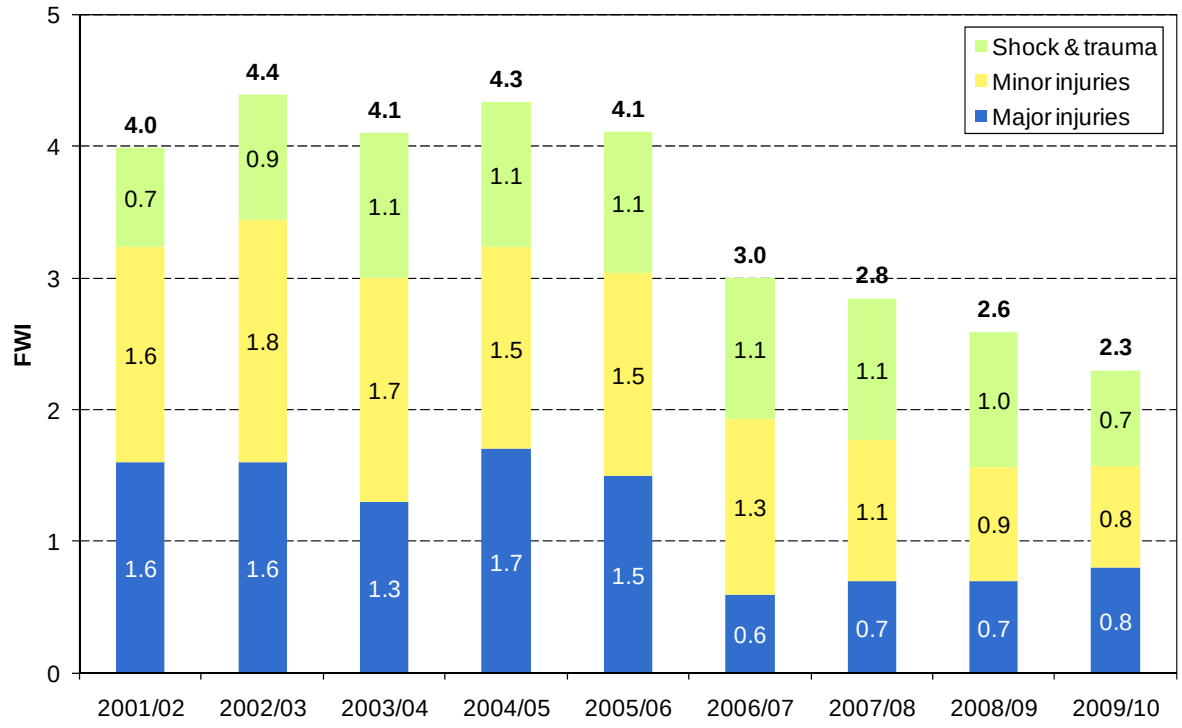
Table 16. Workforce assault in 2009/10 resulting in major injury

Revenue protection staff	Two customers avoiding fare payment pushed member of staff to floor, resulting in cracked rib.
	Member of staff suffered broken wrist after being struck by fare evader as he jumped over a barrier.
	Fare evader head butted member of staff, who lost consciousness.
	Member of staff fractured shoulder blade, after being knocked over by fare evader.
Station staff	Member of station staff was tied up during a robbery, sustaining a dislocated shoulder.
Train drivers	Driver was punched and hit over the head with a glass bottle by two assailants.
Other on-board train crew	Train conductor was assaulted by three youths, and sustained fractured wrist.
	A Train conductor asked a passenger to refrain from smoking on train. When the passenger did not comply, conductor requested passenger to leave at next station. Passenger subsequently head butted conductor, fracturing his jaw.

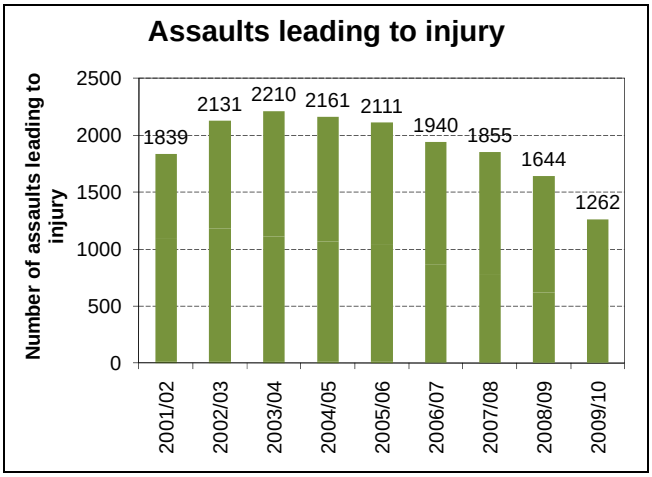
6.5.1 Overall trends

Trends in workforce harm are based on data from SMIS, rather than BTP data.

Chart 80. Harm from workforce assaults



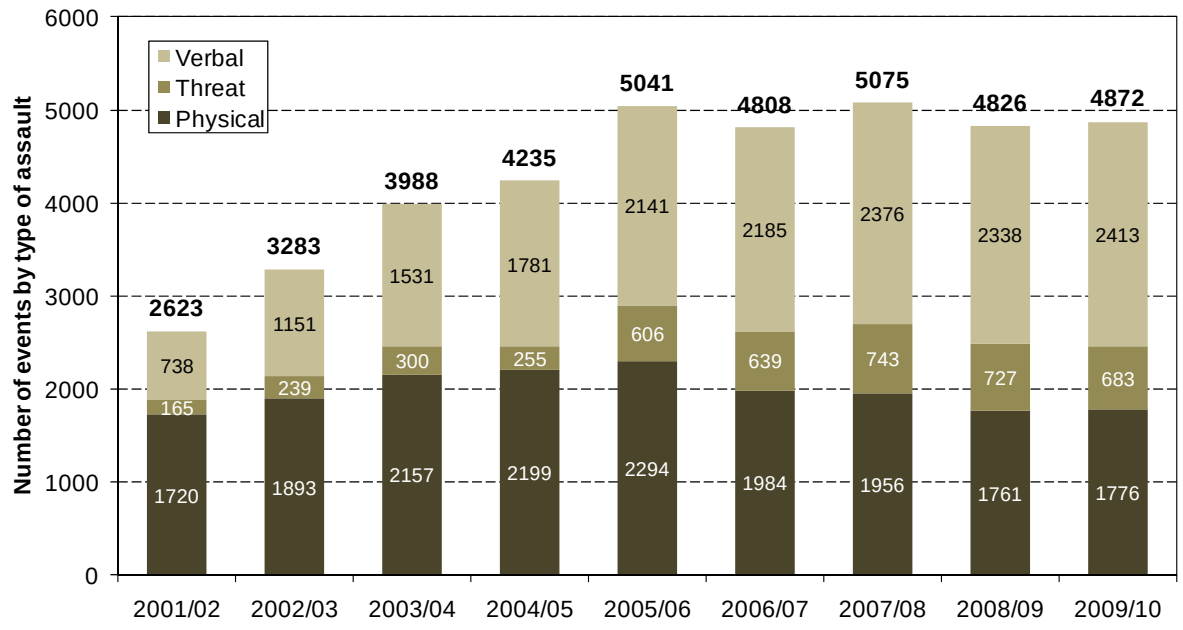
- The overall harm suffered by members of the workforce fell by 11% in 2009/10 compared with 2008/09. The decrease is due to reductions in the level of minor injuries and shock/trauma.
- The level of harm from minor injuries has been reducing steadily since 2002/03. Since 2006/07, the number of major injuries per year has been below 10 (1.0 FWI).
- Since reaching a peak in 2003/04, the number of assaults leading to injury (i.e. major, minor or shock/trauma) has been falling, with the number for 2009/10 being the lowest yet, and a reduction of 23% over the previous year.



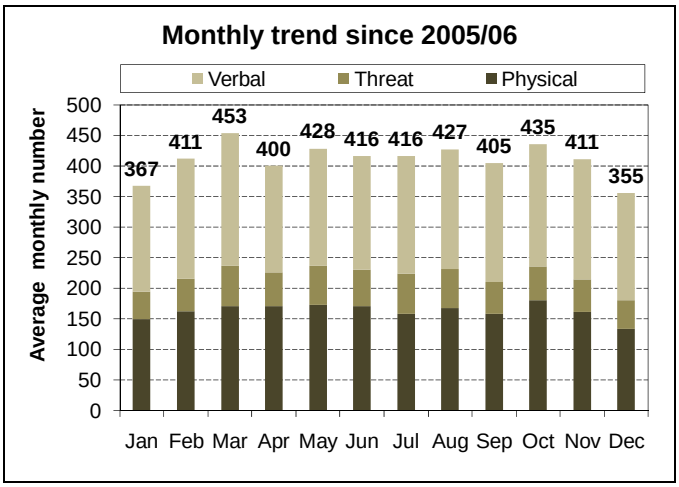
Workforce assaults, threats and cases of abuse

Improvements in reporting as a result of industry initiatives can be seen from consideration of the changing proportions of assault by type of event. Verbal abuse and threats account for an increasing proportion of reported attacks. The following analysis also includes events that do not lead to injury or shock/trauma.

Chart 81. Assaults, threats and verbal abuse against members of the workforce



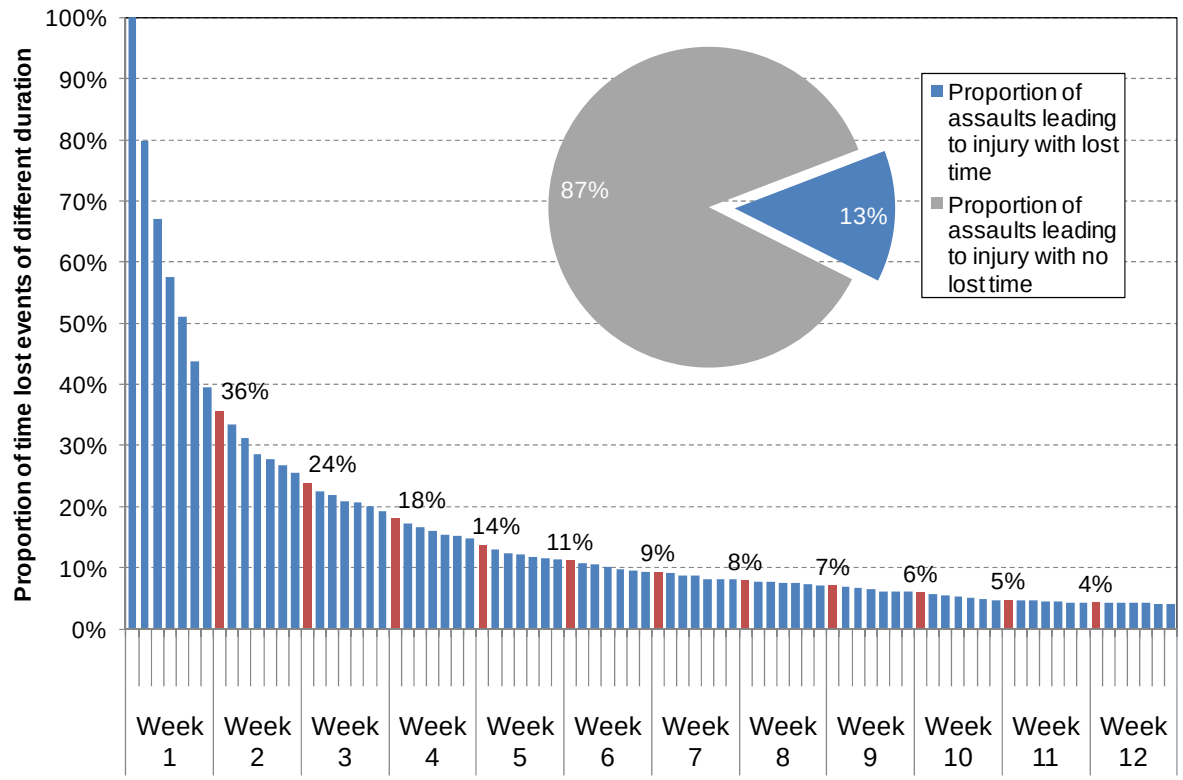
- The total number of recorded attacks remained fairly static in 2009/10, as did the number of events classed as physical.
- Prior to 2005/06, there were increasing numbers of incidents of all types, but particularly those classed as verbal or threat. This is believed to be due to industry drives to encourage staff to report all events. Since around 2005/06, the reporting rate appears to have become more stable.
- Not all physical assaults lead to physical injury or shock/trauma. The number of such events is therefore higher than the number of assaults leading to injury, shown in the analysis on the previous page.
- Analysis of trends by month, since reporting stabilised in 2005/06, shows that the winter months have notably lower levels of assaults and abuse recorded.



Time lost as a result of workforce assaults that lead to injury

As well as leading to physical injury, assault and abuse can have a profound psychological effect. In the most severe cases, some victims are still unable to return to work for months after the event.

Chart 82. Time lost as a result of workforce assaults and abuse 2005/06 to 2009/10

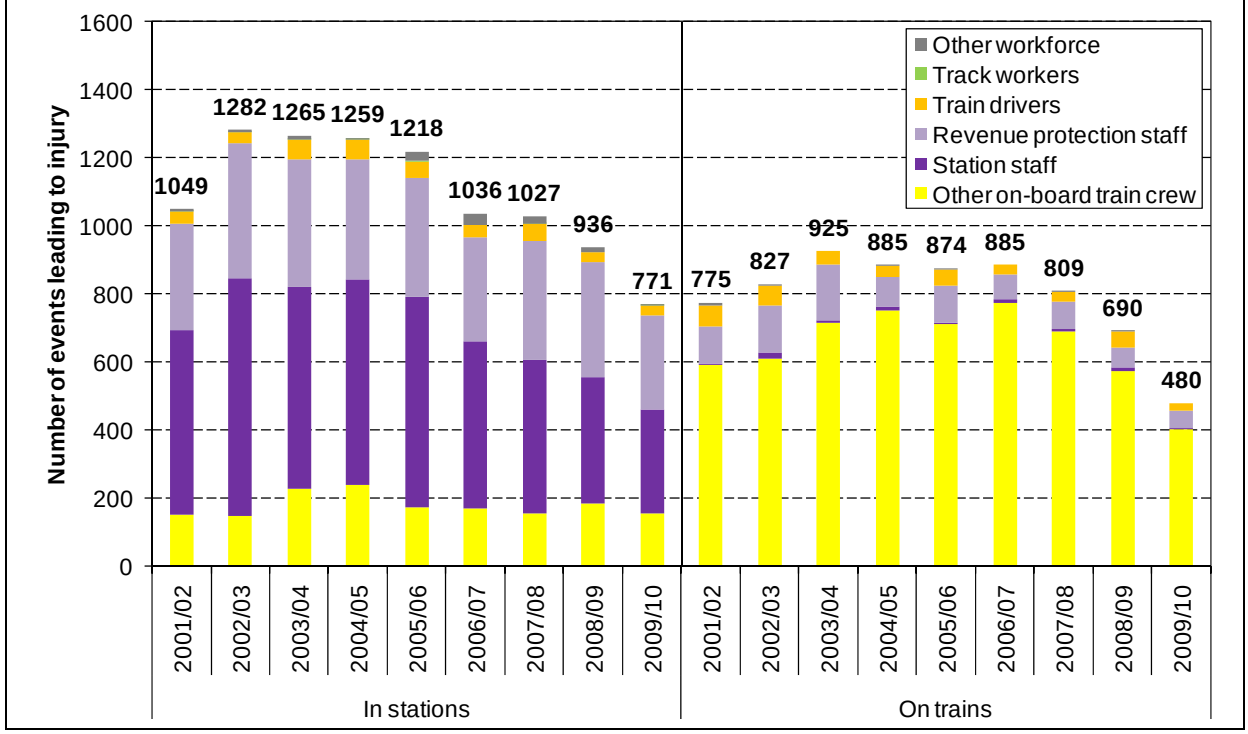


- Of the assaults that lead to injury (major, minor or shock/trauma) 13% result in a loss of time from work of at least one day. In the average week, there will be around four to five such events.
- Of those resulting in absence, 36% will be for longer than a week. On average, this will occur around once every four days.
- Around 11% of events will result in more than five weeks off; in the average year, there will be around 26 of these events. Around 5% of events will result in more than 10 weeks off; in the average year, there will be around 11 of these events.

Location of workforce assaults that lead to injury

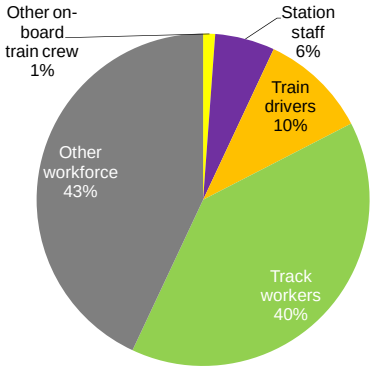
Most assaults leading to injury take place in stations. This may be because there are more station staff than customer-facing train crew, and more people congregate in stations than on board trains. It may also be related to revenue protection activity and attempts to prevent potential trouble-makers from travelling (the industry has an ongoing programme of ticket barrier installation in stations). Ticket disputes and fare evasion are known forerunners to assaults.

Chart 83. Trends in workforce assaults by location



- The number of assaults both in stations and on trains fell in 2009/10, continuing the decreasing trend that has been seen in recent years.
- As would be expected, the worker type profiles differ by location, with station staff predominating in stations, and train crew on trains.
- Assaults on revenue protection staff occur more often in the station than on the train. It is possible that perpetrators feel more able to escape in stations, as well as more revenue protection activity taking place in this location.
- Assaults involving track workers and other workforce types are rare in stations and on trains. Since 2005/06 (when reporting trends became more stable) there have been 86 assaults recorded at other locations. The mini-chart indicates that more than 80% involved track workers and other workforce types.

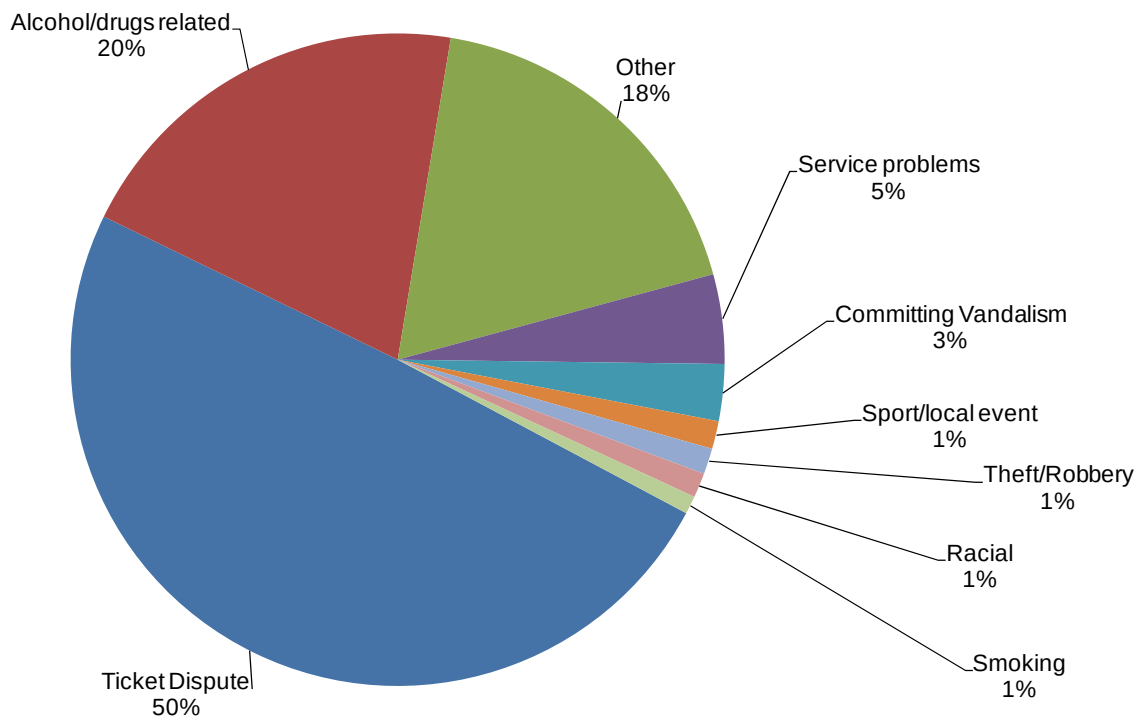
Assaults in locations other than trains and stations, by person type since 2005/06 (86 events in total)



Workforce assault by instigating event

Since 2005/06, SMIS has recorded more detailed data on the types of event that cause or contribute to workforce assaults. The range of different causes highlights the challenge faced by the industry in managing risk from assault. The following analysis is based only on those physical assaults in stations and on trains where the cause is known. Since 2005/06, 18% of such events do not have the cause specified.

Chart 84. Primary contributory factors to attacks on rail staff since 2005/06, where cause is known

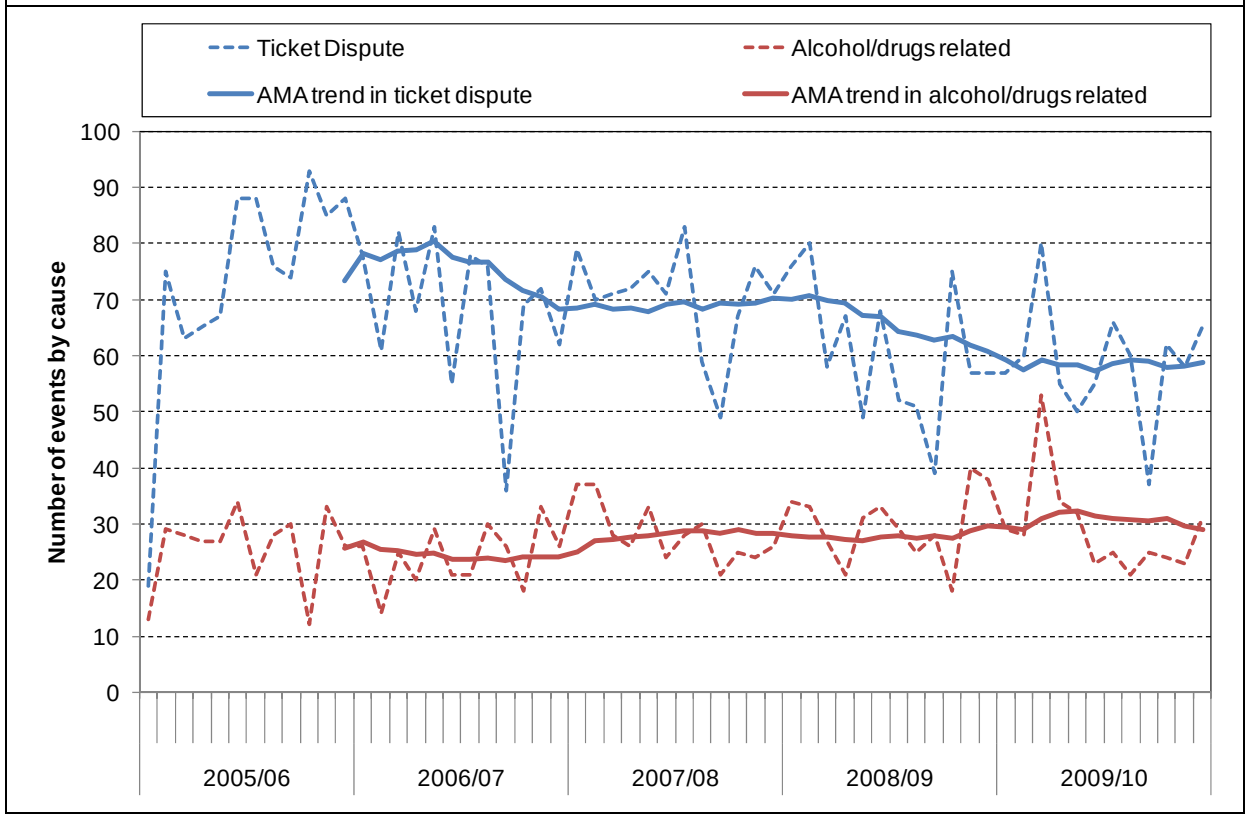


- The biggest factor by far is a ticket dispute, which was identified as the primary contributory factor in 50% of all workforce physical assaults where a cause was specified.
- The next highest single factor is alcohol/drugs, which were recorded as the primary cause in 20% of incidents where the cause was specified.
- RSSB, through work being undertaken as part of the data quality project (see Chapter 10), continues to promote the use of SMIS to capture as much information as possible about these incidents. This has resulted in a reducing trend in the number of events with no cause specified.

Trends in the main instigating events

The trends in two of the highest contributory factors to physical assaults are illustrated in the chart below. The analysis looks at physical assaults on trains and in stations.

Chart 85. Trends in the top contributory factors to physical attacks on rail staff



- The average monthly number of physical attacks as a result of ticket disputes followed a decreasing trend until the beginning of 2009/10, since when it has been more stable.
- Conversely, the average monthly number of physical assaults where alcohol or drugs was listed as the main instigating factor followed an increasing trend up until the first part of 2009/10, since when it has also appeared to stabilise.

6.6 Workforce key safety facts

Workforce	2005/06	2006/07	2007/08	2008/09	2009/10
Fatalities	**4**	**2**	**2**	**3**	**3**
Track worker	3	0	2	2	3
Train driver	1	1	0	0	0
Other train crew	0	0	0	0	0
Station staff	0	0	0	0	0
Revenue protection	0	0	0	0	0
Other workforce	0	1	0	1	0
Major injuries	**155**	**128**	**134**	**128**	**118**
Track worker	87	75	71	76	68
Train driver	6	7	18	6	10
Other train crew	35	21	17	20	18
Station staff	14	13	14	9	9
Revenue protection	4	4	2	2	4
Other workforce	9	8	12	15	9
Minor injuries	**6695**	**6216**	**5681**	**5488**	**5305**
RIDDOR-reportable	722	702	559	585	529
Non RIDDOR-reportable	5973	5514	5122	4903	4776
Incidents of shock	**1525**	**1470**	**1421**	**1358**	**1143**
Class 1	280	265	219	234	277
Class 2	1245	1205	1202	1124	866
Total FWI	**31.73**	**26.35**	**25.61**	**25.92**	**24.47**
Track worker	14.24	9.52	10.79	11.22	11.35
Train driver	3.85	3.81	3.83	2.67	2.99
Other train crew	7.66	6.49	5.33	5.64	5.41
Station staff	3.19	3.00	3.04	2.44	2.30
Revenue protection	1.28	1.12	0.95	0.95	1.06
Other workforce	1.51	2.42	1.68	3.01	1.36

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7 Risk to members of the public

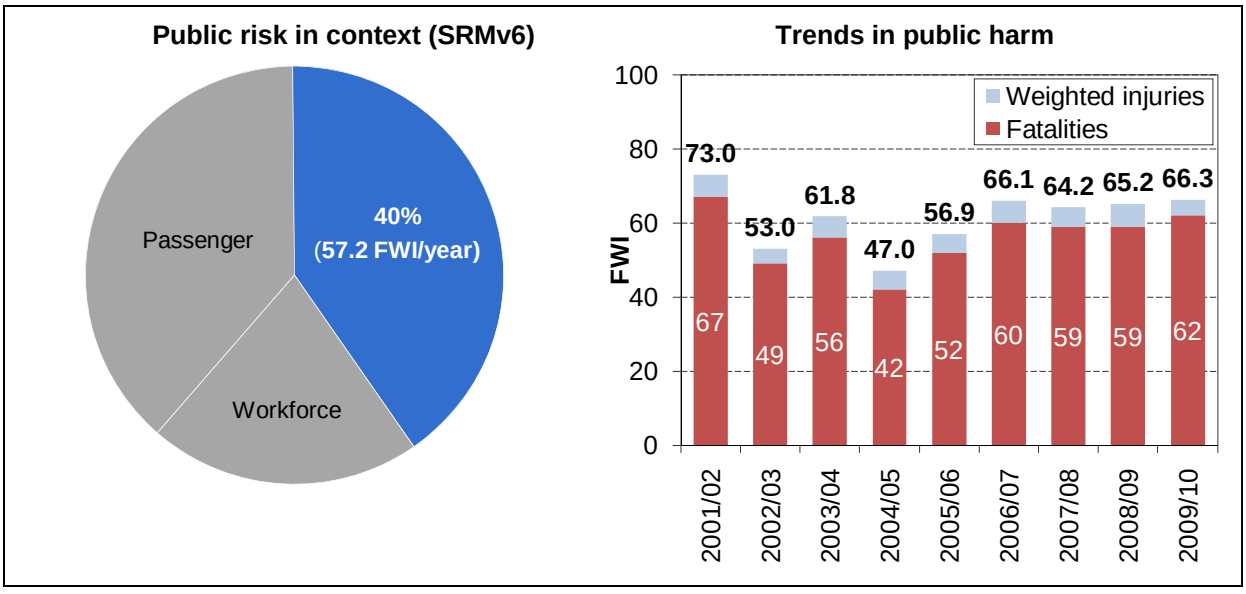
A person is considered to be a member of the public if he or she is classed as neither a passenger nor a member of the workforce. Passenger trespassers are classed as members of the public for the purposes of this report, and are included in the analyses in this section.

In the majority of cases, the risk to members of the public is the direct result of their own behaviour, either deliberate or accidental, rather than the operation of the railway. While most of the risk caused by public behaviour is borne by the public themselves, some types of behaviour, such as misuse of level crossings by road vehicle drivers, can result in train accidents. These sources of train accident risk are discussed more in Chapter 9 (*Risk at the road-rail interface*) and Chapter 8 (*Risk from train accidents*).

2009/10 Headlines

- Excluding suicides and suspected suicides, there were 62 fatalities to members of the public during 2009/10. When non-fatal injuries are taken into account, the total public FWI was 66.3, compared with 65.2 FWI (59 fatalities) recorded for last year.
- Of the 62 fatalities, 49 occurred to trespassers, 12 to level crossings users, and one to a member of the public who accidentally fell on to the track from outside railway property. In 2008/09, there were 44 trespass fatalities, 12 level crossing fatalities, and three public fatalities not involving trespass or level crossings.
- In addition to the accidental fatalities, there were 236 suicides and suspected suicides. This is an increase of 21 compared with 2008/09, and represents the highest financial year total since 2001/02.

Public safety at a glance (excluding suicides and suspected suicides)

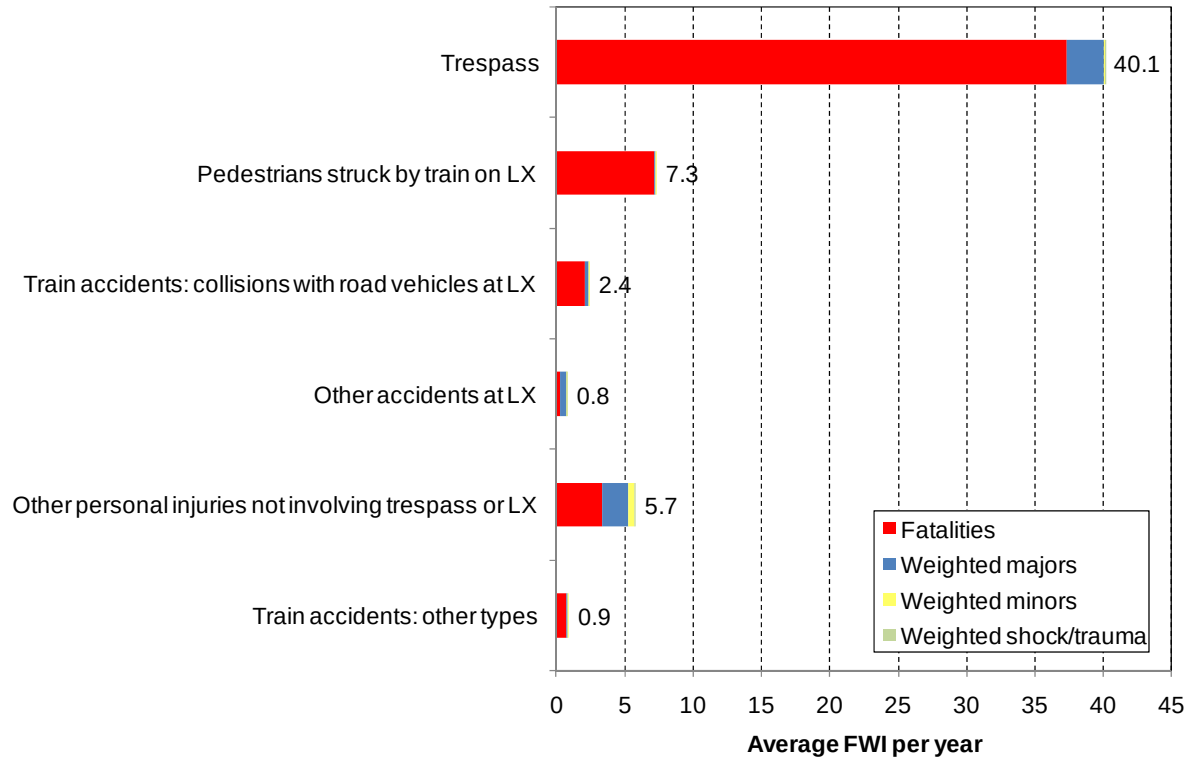


7.1 Public risk profile by accident type

The risk to members of the public is dominated by fatality risk, with weighted injuries accounting for a very small part of the FWI total. This is partly because non-fatal injuries to the public are less likely to be reported to rail companies, and partly because the hazards that account for most of the risk (in particular, being struck by trains) are more likely to result in fatality than injury.

Brief descriptions of the sorts of events that have been included in each accident type are shown in Appendix 5.

Chart 86. Risk to members of the public by accident type: 57.2 FWI per year



Source: SRMv6

- Trespass accounts for 70% of risk to members of the public.
- Accidents at level crossings account for a further 18%. Of these, the majority involve pedestrians struck by trains. Most of the rest occur to road vehicle occupants involved in collisions with trains. The small remainder are the result of slips, trips or falls, or being hit by level crossing equipment.
- Around 10% of public risk does not result from trespass, train accidents, or level crossing usage. Many of the accidents in this category are similar to those affecting passengers, and include slips, trips and falls in stations and falls from the platform edge.
- The category *train accidents: other types* mainly covers the risk from train collisions with road vehicles not at level crossings (i.e. vehicle incursions), but also includes the small residual risk to third parties from other train accidents, such as derailments or collisions. The last third party fatality from a train accident occurred in the Potters Bar train derailment, when a member of the public outside railway property was fatally injured by debris from the accident.

7.2 Public injuries in 2009/10

There were 62 accidental fatalities in 2009/10, 49 of which involved trespass. Of the non-trespass fatalities, seven pedestrians and five road vehicle occupants were fatally injured at level crossings. The remaining non-trespass fatality involved a member of the public who was hit by a train after accidentally falling down a rail embankment onto the track, while walking along property at the side of the railway.

Two of the trespass fatalities occurred in the same incident, and also resulted in a train accident:

- In December 2009, two men driving were fatally injured when the quad bike, which they were riding along the railway line during night time, was hit by an empty passenger train on its way into service.

In addition to the accidental public fatalities listed above, there were 236 suicides and suspected suicides during 2009/10.

Distinguishing between suicide and accidental death

When categorising public fatalities, it is useful to distinguish between suicides and accidental deaths, because the means of addressing these issues will be different. For the rail industry, determining that a fatality was a suicide is straightforward where this was the conclusion of a coroner's inquest. Similarly, where a coroner's report concludes that a death was accidental, the industry classes the fatality accordingly. The difficulty lies in incidents where the coroner has yet to return a verdict, or returns an open verdict.

Most coroners' reports take around six months to complete, and some verdicts are not returned until several years after the event. A coroner will then only return a suicide verdict if there is evidence that proves *beyond reasonable doubt* that the deceased intended to take his or her own life. If the cause of death cannot be established, an open verdict is returned. The industry's own investigations suggest that the majority (around four-fifths) of these fatalities are most likely to have been suicides.

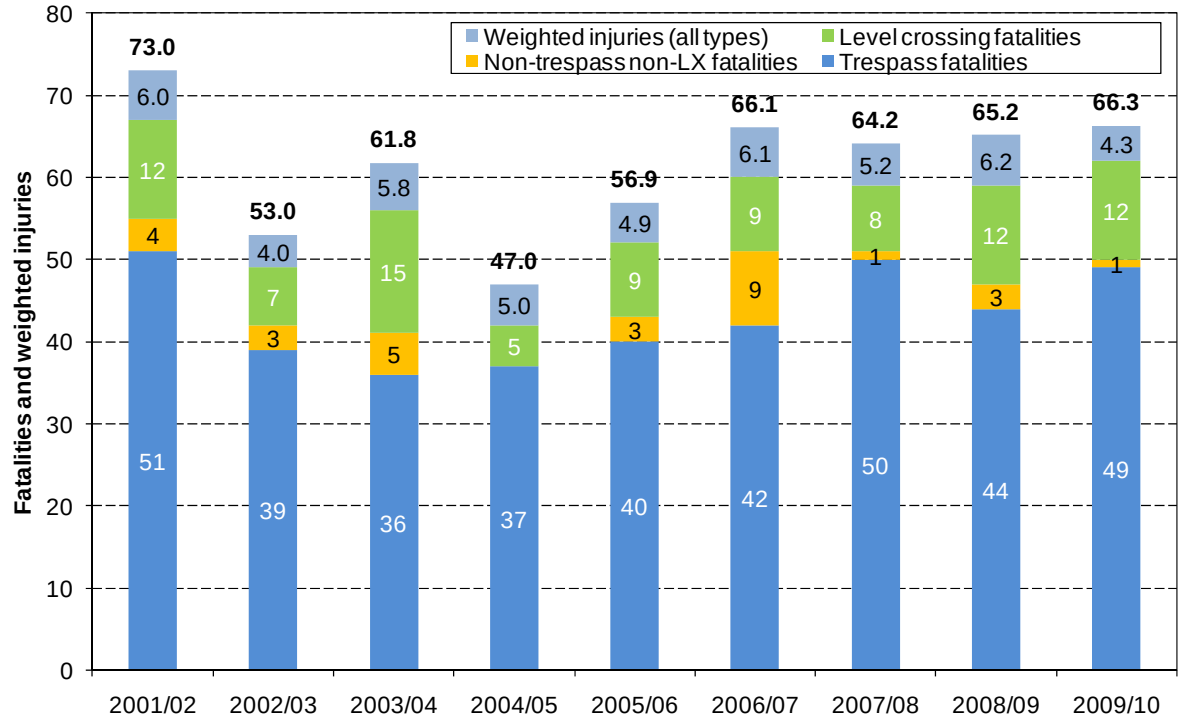
In order to generate timely statistics that are as accurate as possible (if a coroner has yet to return a verdict or has returned an open verdict), the industry applies rules known as the Ovenstone criteria (see Appendix 3) to determine *on the balance of probability* whether a fatality was the result of an accident or suicide. The decision is based on all the information available, which might include evidence gathered by the local Network Rail manager and a BTP report. This approach enables the industry to implement timely preventative measures applicable to the appropriate problems of both suicide and trespass incidents. Fatalities that have been judged by the industry to have been suicides, but have not been classed as such by the coroner, are referred to as *suspected suicides*.

To ensure that statistics are as accurate as possible, the classification of suicide and trespass fatalities is reviewed on an on-going basis, in the light of new information from coroners' reports, as and when they become available. Re-classification of the event is then carried out for historical data, where appropriate. RSSB recently completed a project to obtain missing coroners' reports from previous years, which has led to the re-classification of a number of fatalities from suspected suicide and trespass, and vice versa. The year most affected was 2005/06.

7.3 Trends in harm to members of the public

Based on SRMv6, the average level of harm to members of the public is estimated to be 57.2 FWI, of which 51.0 (89%) is fatalities. In any year, levels of actual harm may differ from the SRM estimate; public behaviour is the main source of risk to members of the public, and risk levels may therefore be more variable. In addition, the SRM estimate was based partly on the period most affected by the reclassification exercise mentioned in section 7.2, which at the time would have a number of trespasser fatalities recorded as suspected suicides.

Chart 87. Trends in public FWI by accident type



- Since 2006/07, the level of public FWI has been consistently higher than previously. The current year shows the highest total since 2001/02.
- At 49, the number of trespass fatalities was higher than average.
- There were 12 level crossing fatalities, which is the joint second highest total over the period shown.
- Five of the twelve level crossing fatalities occurred to road vehicle occupants. Three of these occurred in one incident, at Halkirk level crossing, in September 2009. This incident is under investigation by RAIB.
- Comparatively few non-fatal injuries are recorded for members of the public. As stated earlier, this is partly because these injuries are less likely to be reported to rail companies, and partly because the hazards that account for most of the risk have a comparatively high likelihood of a fatal outcome.

7.4 Trends in public harm by accident type

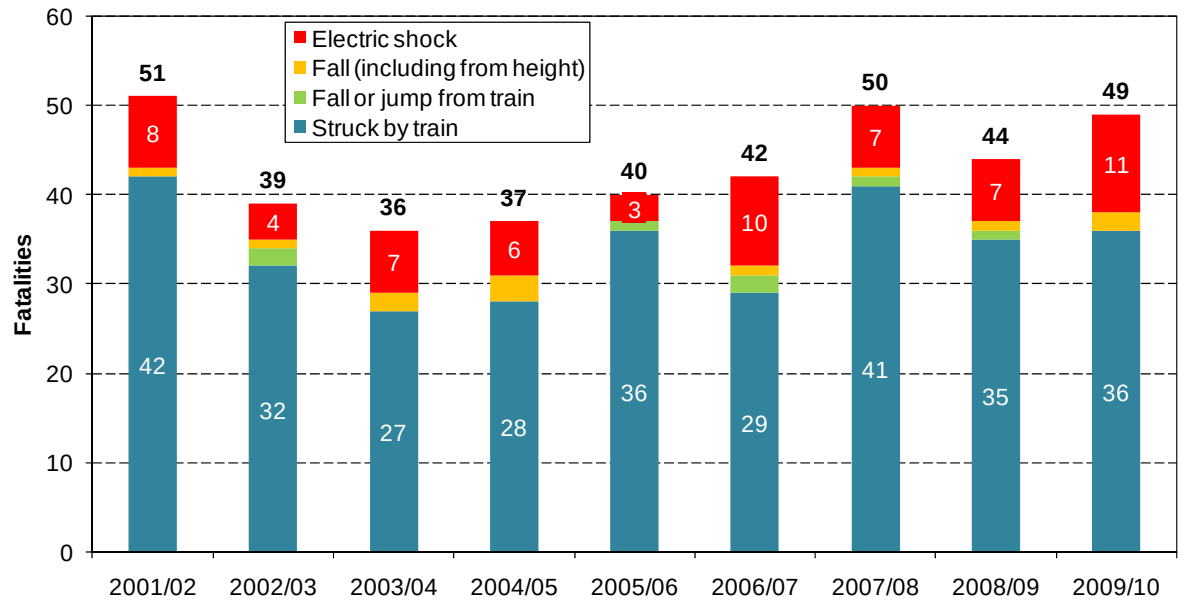
7.4.1 Trespass

A trespasser is someone who goes where they are never authorised to be (for example, someone who accesses the track from a station platform). The term is not applied to level crossing users, even if they are misusing the crossing. SRMv6 estimates trespasser harm to be 40.1 FWI per year, which is 70% of the total risk to members of the public.

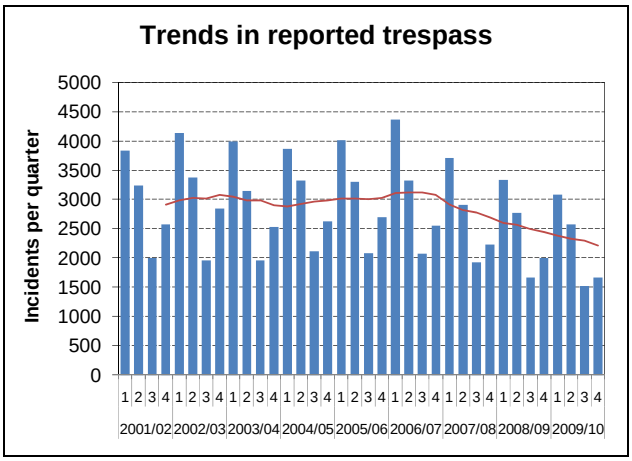
Trespasser fatalities by cause

The railway represents a hazardous environment for trespassers. As well as being struck by trains, fatalities are caused by electrocutions, falls from height and persons jumping from moving trains. The majority of trespasser risk is fatality risk.

Chart 88. Trespass fatalities by cause



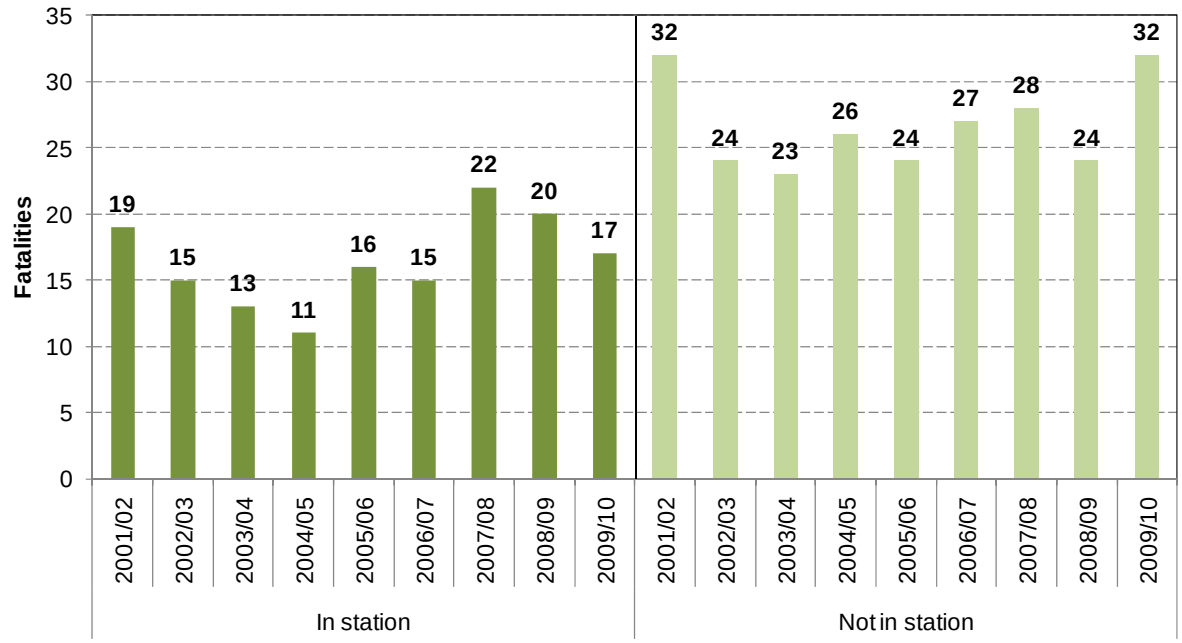
- The total number of trespass fatalities increased from last year, and is above average for the period shown.
- Electrocution and being struck by trains account for around 95% of all trespasser fatalities over the last nine years.
- After a period of below average numbers of trespass fatalities, the past three years have seen a return to higher numbers. This is in contrast to reported trespass, which has shown lower levels in recent years.



Trespasser fatalities by location

Nearly all trespass fatalities occur in stations or on the running line. A small number of fatalities occur to people who are 'train-surfing' or who deliberately choose to exit a train in running.

Chart 89. Trespass fatalities by location

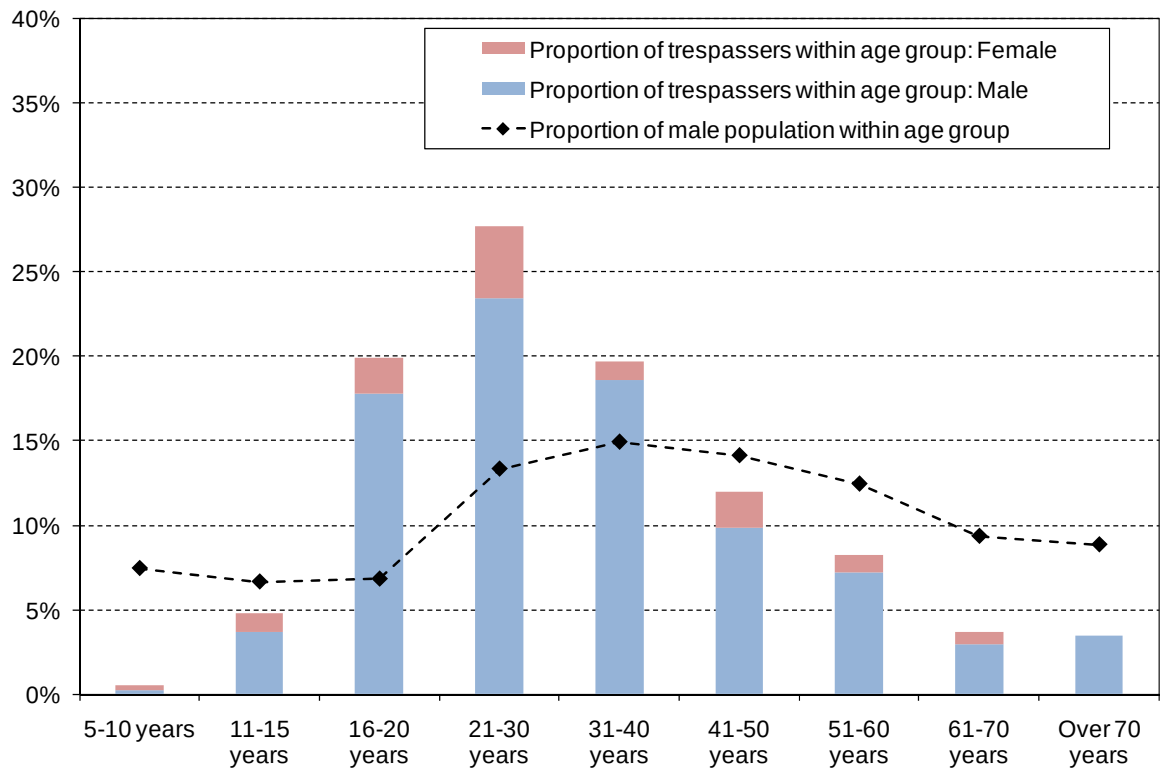


- The majority of trespass fatalities occur away from stations. This has been the case in each of the last nine years. Nearly all of these occur to people trespassing on the running line, but the category also includes the small number of people who have died as a result of train-surfing or jumping from trains in running. Fatality numbers in both locations show no clear trend.

Trespass fatalities by age and gender

The trespass fatality profile is dominated by males, particularly those in the younger age groups.

Chart 90. Breakdown of trespass fatalities by age and gender 2001/02 to 2009/10



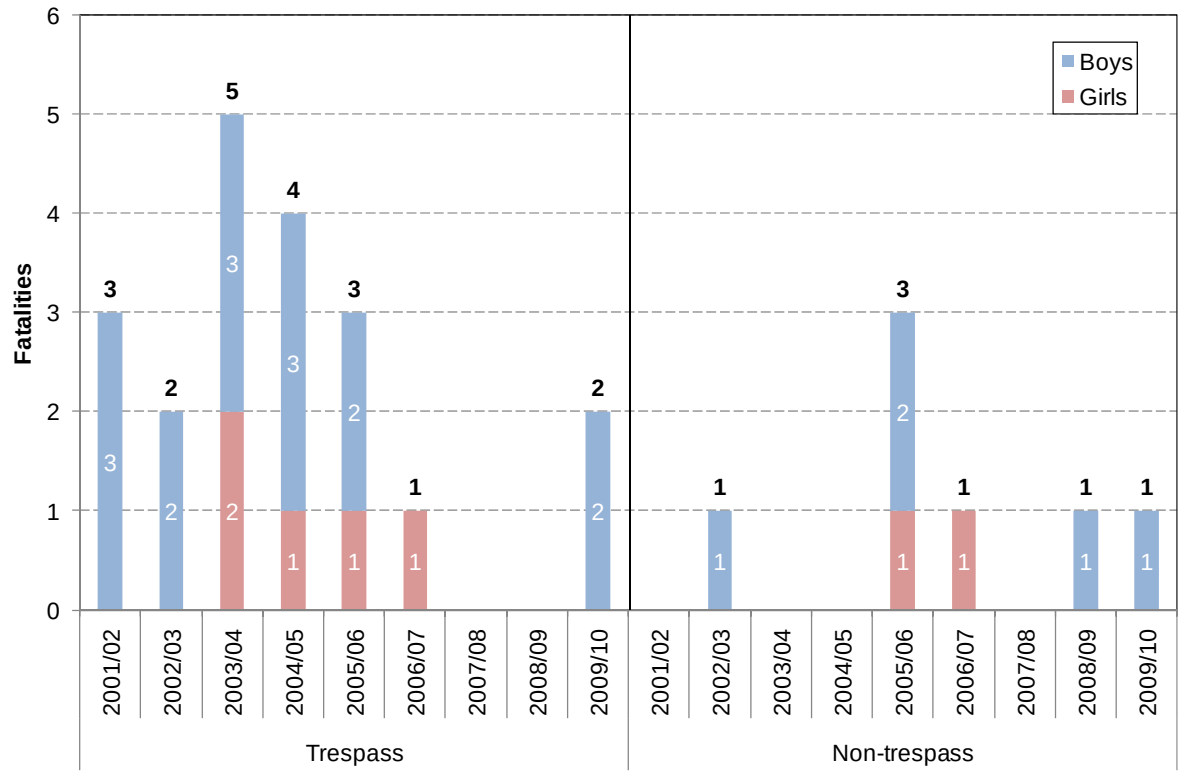
Source: SMIS for trespass fatality data; Office for National Statistics for population data (estimates cover years 2001 to 2009).

- A disproportionately high number of trespass fatalities involve males aged between the ages of 16 and 40.
- The peak ages for trespass fatalities are the later teens and the twenties.
- The percentage of male trespass fatalities is disproportionately high compared to their level of the overall population; although males make up just less than 50% of the total population, they have accounted for more than 85% of trespass fatalities over the past nine years.
- The chart is based on 376 trespass fatalities occurring since 2001/02, where the age and sex were known. In addition, there were a further 13 trespass fatalities where the age was not recorded: nine of these were male, one was female, and three records did not specify the gender.

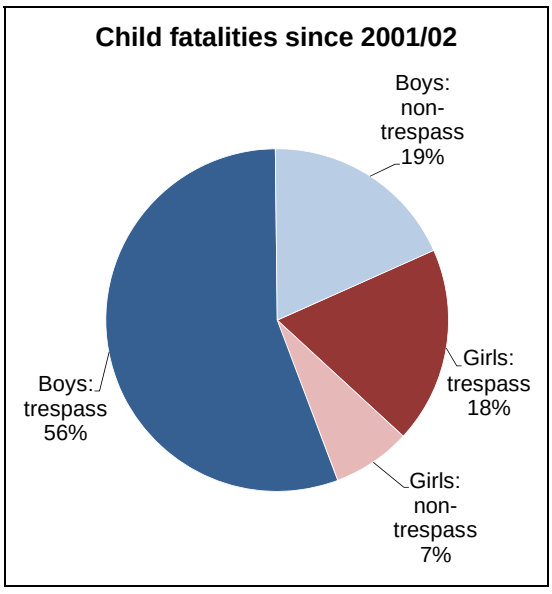
Public fatalities to children

Fatalities to children are relatively rare. Since 2001/02, around 5% of all the accidental fatalities to members of the public have involved persons under the age of 16. However, due to their distressing nature, child fatalities receive a greater degree of media focus.

Chart 91. Public fatalities occurring to children



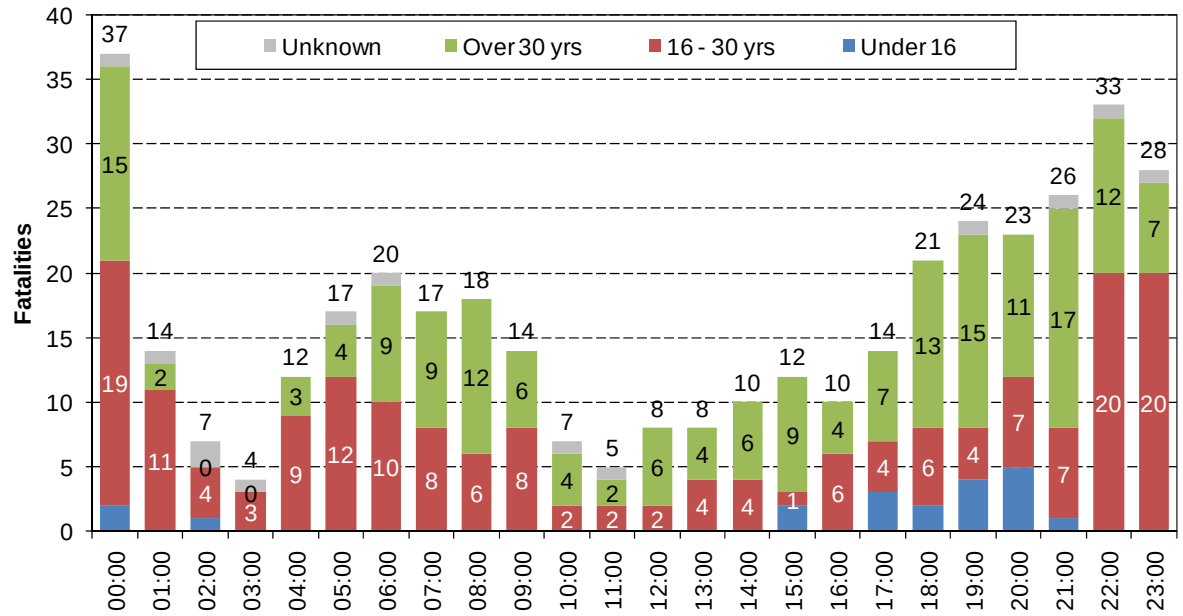
- For the first time since 2006/07, there were trespass fatalities involving children, both boys[37]. In one incident, a 14-year-old boy deliberately got down from the platform at a station to retrieve something that had fallen on the track. He was electrocuted. In the second incident, a 14-year-old boy was on an elevated pipe next to a bridge, apparently to write graffiti. He fell off, hit power lines and was electrocuted.
- In the last nine years, the ratio of boy to girl trespass fatalities has been 3:1. The ratio for non-trespass fatalities is similar, although numbers are smaller. This contrasts with the ratio of male to female trespass fatalities for those 16 and over, which is closer to 9:1.



[37] Another child trespass fatality occurred when a young teenage boy came into contact with the overhead line whilst climbing on wagons at a freight depot, and was electrocuted. This fatality was off NRMI, so is not shown in the charts.

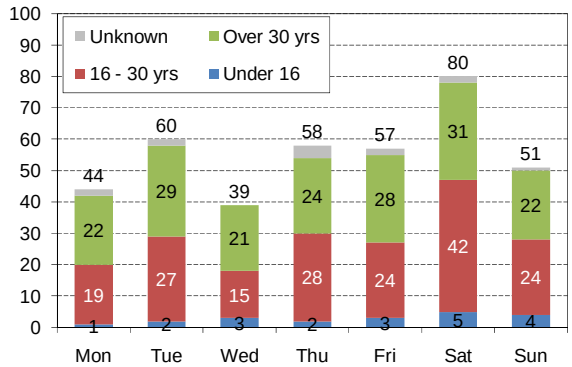
Trespass fatalities by time of day, week and month

Chart 92. Trespass fatalities by time of day and age since 2001/02

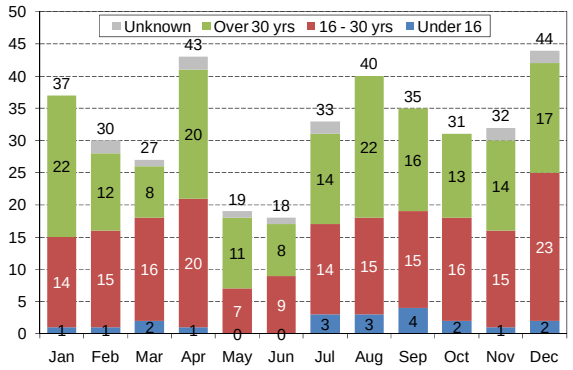


- The majority of the under 16 fatalities have occurred in the late afternoon to early evening hours. During term times, this would form the after-school hours. The 16 to 30 age group predominate in the very late evening and very early morning, which is the time after many pubs and bars are closing. Fatalities involving older adults have a small peak in the pre-morning rush hour period, and another peak around the early evening. A notable number also occur around midnight, similar to younger adults.
- Over the past nine years, the greatest number of trespasser fatalities has occurred on a Saturday. This is true of all of the age groupings, where age was known.
- April and December are the months with the highest number of total trespass fatalities, with May and June having the lowest. The summer months of July, August and September are when more of the under-16 fatalities have occurred. The occurrence of school holidays may be a factor. For the 16 to 30 age group, December has recorded the most fatalities.

Trespass fatalities by day since 2001/02



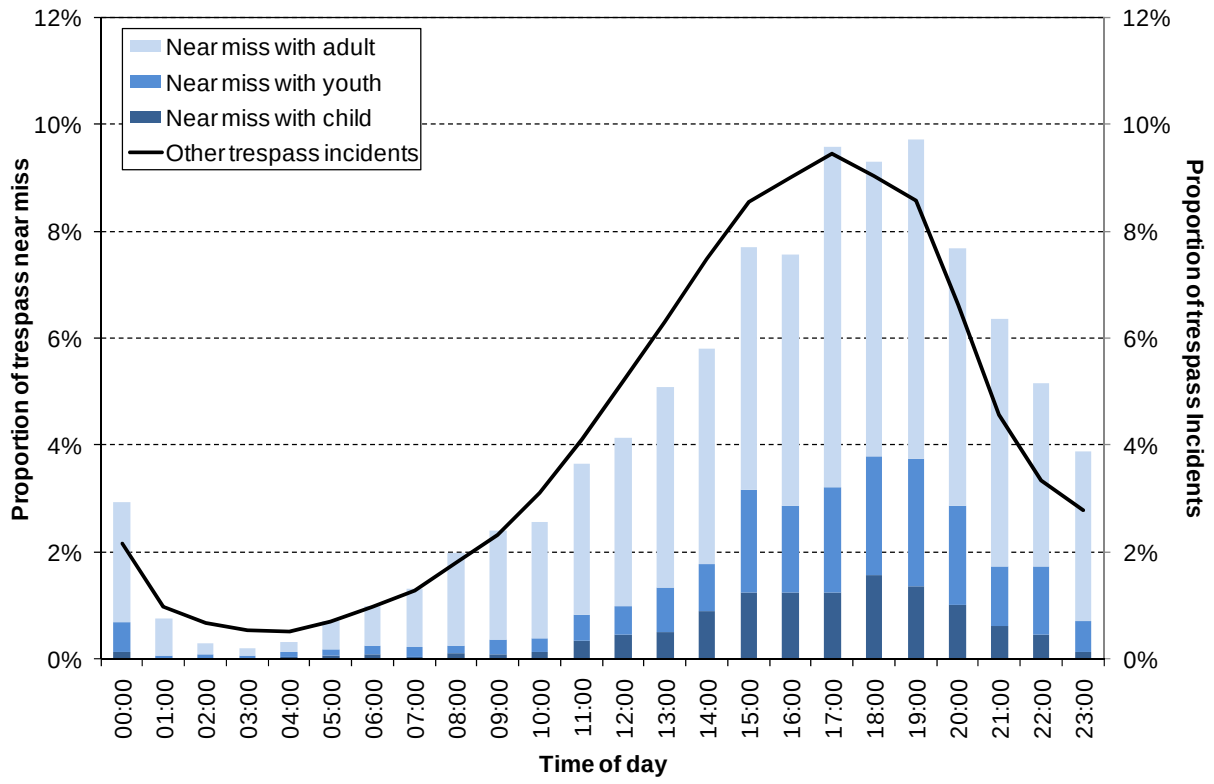
Trespass fatalities by month since 2001/02



Trespass near misses by time of day and age group

The chart below shows the number of trespass near misses reported by time of day, the age description of the reported trespasser and the total number of trespass incidents by time of day. Because near-miss incidents do not include detailed information on the age of those involved, it is likely that they do not correspond exactly to the groupings of *under 16*, *16-30 yrs*, and *over 30 yrs*, as used in the trespasser fatality analysis.

Chart 93. Near misses by age group and time of day since 2001/02



- The peak time for near miss reports is the early evening. Near misses with children, youths and other adults occur in roughly equal proportions at this time.
- Children account for a much higher proportion of reported near misses than fatalities. Around 20% of near miss reports identify children, while the proportion of trespass fatalities occurring to children is 5%. Drivers may be more likely to report a near miss if the people involved are young, out of greater general concern for their safety, if they witness them engaging in specific 'thrill-seeking' behaviour.
- In contrast to the distribution of trespass fatalities by time of day, there is no peak in the morning for reported near misses or other trespass incidents.
- The correlation of near miss reports to trespass fatalities is quite low. One likely factor behind this is that many fatalities occur during night-time hours, when visibility for drivers will be lower.

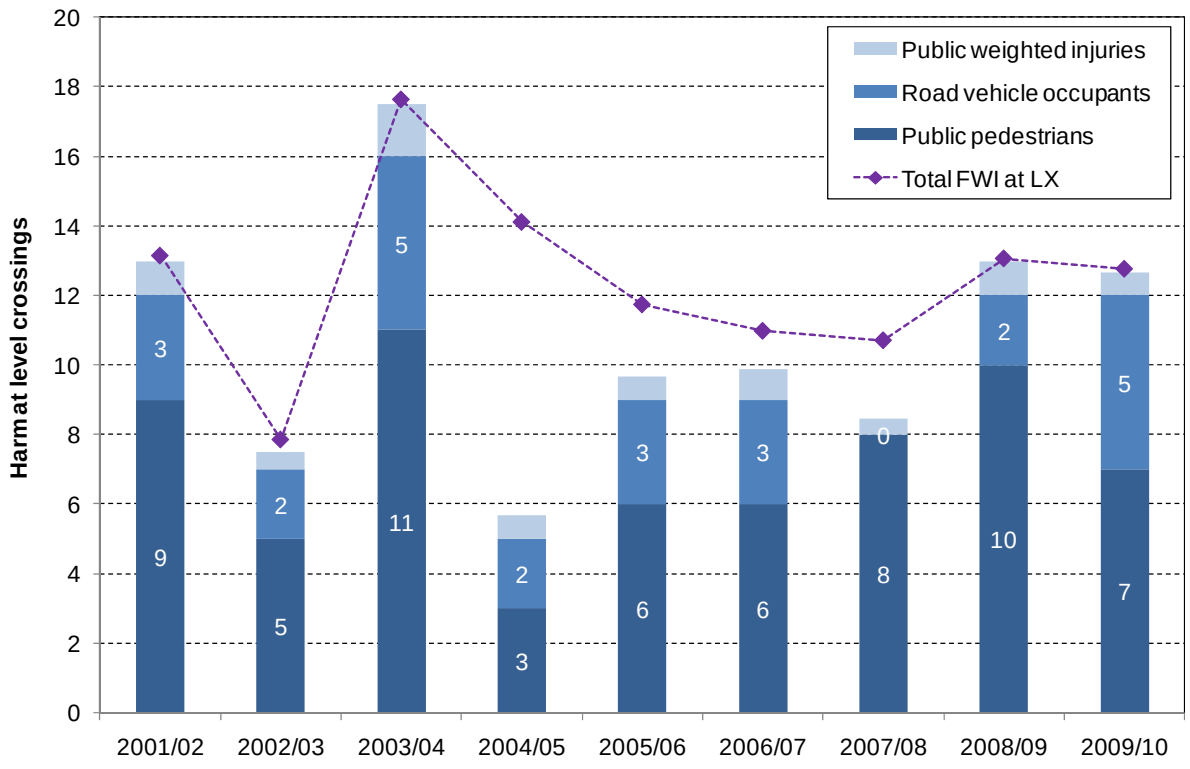
The age ranges used in this chart are based on the narrative descriptions of the incident because the exact age of the trespasser is usually unknown. They should only be considered indicative and are not necessarily comparable to the other age ranges used in this chapter.

7.4.2 Level crossing users

SRMv6 estimates that 8% (11.8 FWI) of the total system FWI risk occurs at level crossings. This includes risk to train occupants as a result of road user behaviour, as well as risk to level crossing users. (It also includes the small amount of risk at level crossings that is not due to public behaviour, e.g. injuries due to workforce error or equipment failure.)

Of the total level crossing risk of 11.8 FWI, 10.5 FWI occurs to members of the public.

Chart 94. Trend in public injuries at level crossings

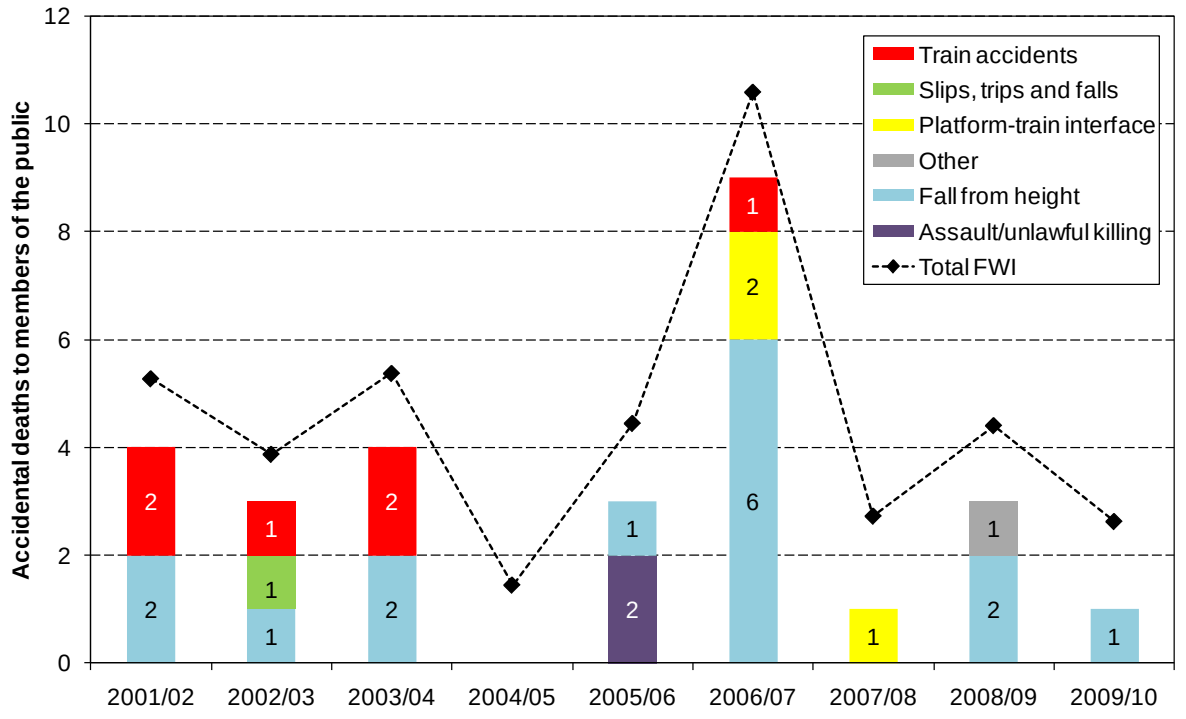


- At 12, the number of fatalities for 2009/10 is equal to the previous year, and higher than average. Seven of the twelve fatalities occurred to pedestrians (including one cyclist); this number is average for the period shown on the chart. The remaining five occurred to road vehicle occupants; this is above average. Three of the fatalities occurred in one accident, at Halkirk level crossing, in September 2009.
- Over the period shown there was one train collision with a road vehicle that resulted in fatalities to train occupants: the road user suicide at Ufton in November 2004, which resulted in the deaths of five passengers and the train driver. Suicides by level crossing users are not shown in the above chart, although injuries to other persons as a result of their actions are. Since 2001/02, there have been seven road vehicle driver suicides at level crossings in total.
- The total FWI line in the chart shows the total harm at level crossings, i.e. including passenger and workforce injuries at level crossings, either pedestrian or train occupants. With the exception of 2004/05, when the collision at Ufton occurred, the majority of level crossing harm has occurred to members of the public. More information on risk at level crossings can be found in Chapter 9 - *Risk at the road-rail interface*.

7.4.3 Harm to members of the public not involving trespass or level crossings

Although most public harm arises either from trespass or at level crossings, each year members of the public are injured in other types of accidents. Many are similar to the types of accidents that occur to passengers, for example falls from the platform edge. Industry initiatives addressing passenger risk will therefore address these areas of public risk.

Chart 95. Public fatalities not involving trespass or level crossings

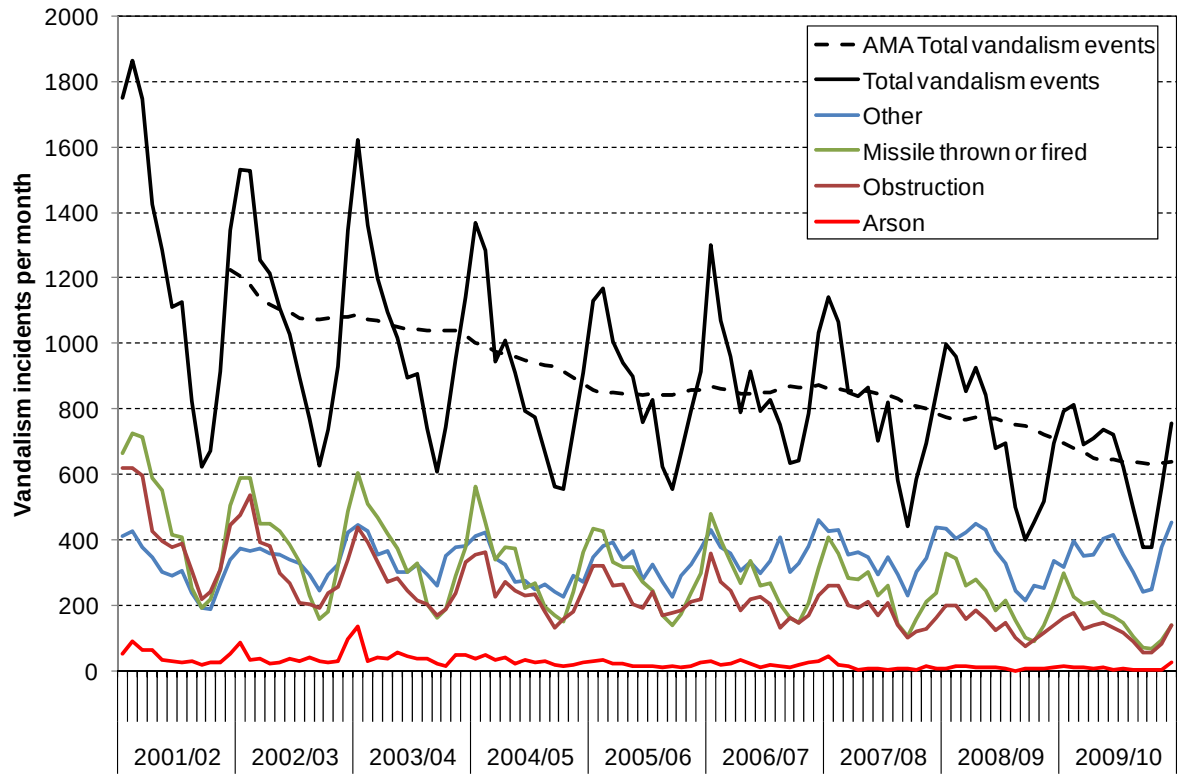


- Since 2001/02, there have been six public fatalities in train accidents not at level crossings. Five of these were train collisions with road vehicles away from level crossings, as a result of vehicle incursion. The remaining fatality occurred in the Potters Bar train derailment in May 2002, when a member of the public walking near the railway was struck by debris from the accident.
- The most common type of public fatality not involving trespass or level crossings is falls from height. In 2006/07, an unusually large number occurred. In 2009/10, one such fatality occurred, when a man walking alongside railway property fell down the embankment onto the track and was hit by a train.
- A fall from height is classed as trespass if the person involved is deliberately venturing somewhere they are not permitted to go. In 2009/10, a trespass-related fall from height occurred when a boy climbing on the outside of a bridge over the railway line fell on to the track. In some falls from height, it is difficult to assess whether or not trespass was involved, and if in doubt, the incident is classed as non-trespass.

7.5 Vandalism

Vandalism on the railway encompasses any kind of deliberate damage or defacement to the property of the railway. 'Superficial' vandalism, like graffiti, can cause fear among passengers and raise doubts about the safety of public transportation while 'structural' vandalism has the real potential to result in safety risk. With all kinds of vandalism, there is also the personal risk that the vandals themselves may run when committing unsafe acts.

Chart 96. Trends in reported vandalism

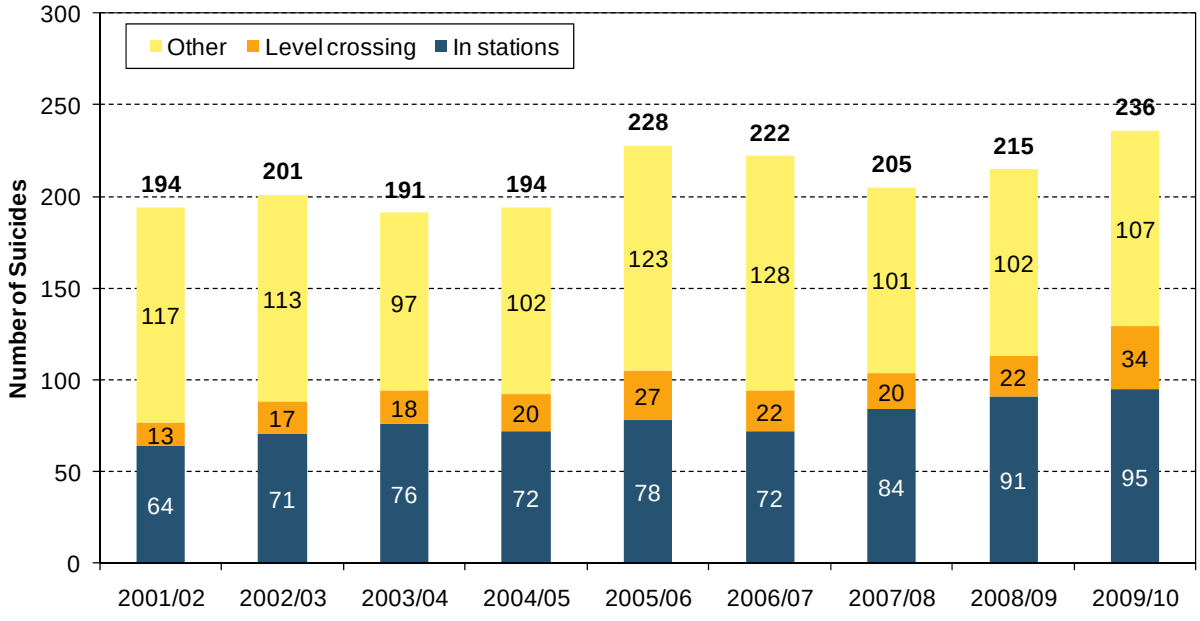


- A clear seasonal pattern is evident: reported vandalism peaks in April at over twice the number of incidents seen in December.
- The annual moving average trend in reported vandalism fell steadily until early 2005/06, after when there was a period of stability until the beginning of 2007/08. Since then, the trend at has begun to decrease once more.
- The decrease in the overall total is due mainly to falls in the incidence of missiles thrown or fired at trains, and obstructions placed on the line. Arson has also decreased, but its contribution to the total number is relatively small. Improvements in rolling stock mean that train windows are more resistant to breakage, and train materials are less flammable. The trend in other forms of vandalism has been slightly increasing over the same period. This category of vandalism covers events such as interference with equipment or trains, including theft and malicious damage.

7.6 Suicide

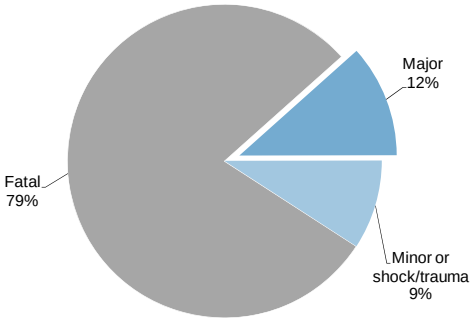
The railway uses the Ovenstone criteria to differentiate between suicides and accidental fatalities (see Appendix 3 for criteria details). Any passengers who committed suicide are classed as members of the public for the purposes of this report, and are included in the analysis in this section.

Chart 97. Suicides and suspected suicides by location



- 2009/10 saw an increase in the total number of suicides: the level represents the highest number recorded.
- The locations of stations and level crossings both show generally increasing trends. The category *other* mostly comprises suicides on the running line, but also includes a small proportion (less than 3%) occurring at other railway locations, e.g. bridges. There has been no real trend in this category over the period shown.
- Nearly 80% of recorded suicide attempts have a fatal outcome. Of those that do not, more than half of the people involved will be left with major injury, many of which will be severe and life-affecting.

Suicide attempts by outcome since 2001/02

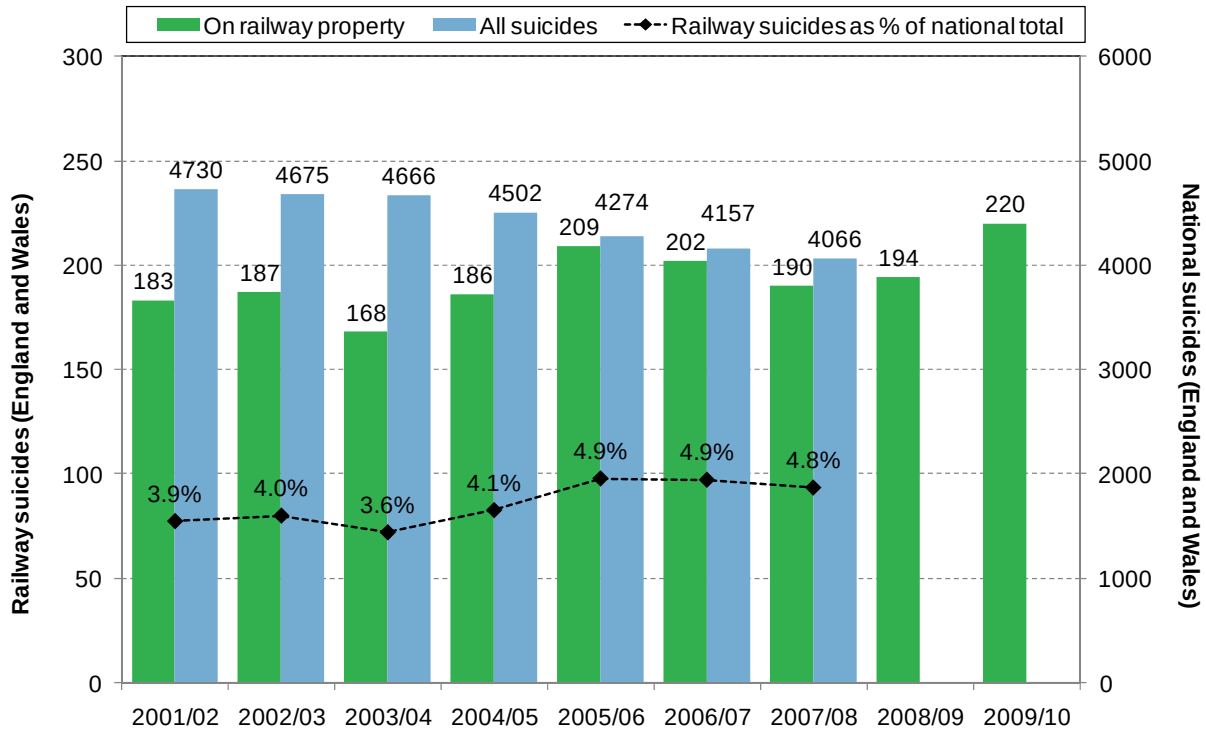


- Network Rail has embarked on a long-term project to reduce suicides on its infrastructure, by looking into the underlying trends and developing targeted measures to help prevent suicides. As a consequence, this will also reduce the service delays that can result. RSSB is managing research (T845) alongside the project, to support the development of new interventions and to assess their effectiveness as they are rolled out, so that the best ones can be used more widely. The research seeks to measure the reduction in suicides and to give a clearer description of the economic benefits also seen by doing so.

7.6.1 Railway suicides in the wider context

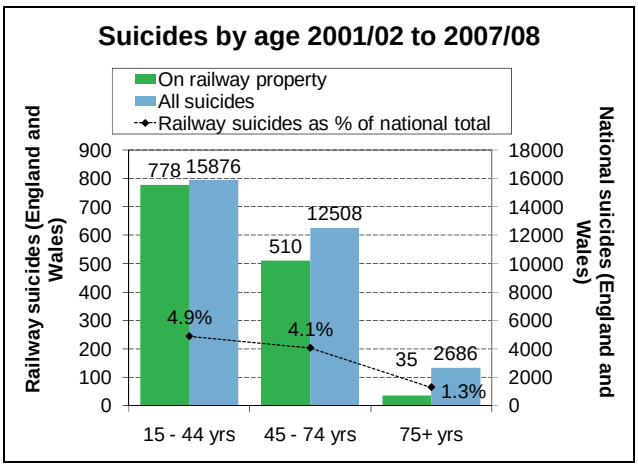
Suicides on the railway represent by far the largest proportion of railway-related fatalities, but they represent a relatively small percentage of suicides on a national level. National suicide figures are not available to as recent a date as railway figures; the chart shows the latest available national data. All figures relate to fatalities in England and Wales only.

Chart 98. Railway suicide trends in the wider context (England and Wales only)



Source: SMIS data for railway suicides; Office of National Statistics for national suicides.

- Between 2001/02 and 2007/08, the number of national suicides has been falling. In contrast, the number of railway suicides has shown a variable and generally increasing trend. The proportion of the national total that occurs on railway property has thus shown an increase. The average proportion over the period 2001/02 to 2007/08 has been 4.3%
- The age demographics of railway suicides varies from national suicides. Compared with the national profile, a slightly greater proportion of railway suicides are in the 15 – 44 years age bracket, while a slightly smaller proportion are in the 45 - 74 years age bracket. The group showing the greatest difference is the 75+ years age group; far fewer rail suicides are committed by people of this age, compared with what is seen nationally.



7.7 Public key safety facts

This table will also include any incidents of passenger trespass, suicide and suicide.

Public	2005/06	2006/07	2007/08	2008/09	2009/10
Trespass					
Fatal	40	42	50	44	49
Major	27	35	29	37	19
Minor	32	33	25	21	32
Shock/trauma	0	1	0	1	1
Total trespass FWI	**42.81**	**45.61**	**52.99**	**47.78**	**51.03**
Level crossings					
Fatal	9	9	8	12	12
Major	6	8	4	9	7
Minor	32	34	18	19	23
Shock/trauma	2	0	1	3	1
Total level crossings FWI	**9.00**	**9.00**	**8.00**	**12.00**	**12.00**
Non-trespass non-LX					
Fatal	3	9	1	3	1
Major	13	14	15	12	14
Minor	53	92	98	87	127
Shock/trauma	6	2	6	3	1
Total non-trespass non-LX FWI	**4.45**	**10.59**	**2.73**	**4.41**	**2.63**
Total public accidental FWI					
Fatal	52.00	60.00	59.00	59.00	62.00
Major	4.60	5.70	4.80	5.80	3.90
Minor	0.31	0.39	0.35	0.34	0.39
Shock/trauma	0.02	0.00	0.01	0.02	0.01
Total accidental FWI	**56.93**	**66.09**	**64.16**	**65.16**	**66.30**
Suicide					
Fatal	228	222	205	215	236
Major	32	33	24	29	25
Minor	12	8	8	17	13
Shock/trauma	2	1	0	0	1
Total suicide FWI	**231.27**	**225.34**	**207.44**	**217.98**	**238.57**

8 Risk from train accidents

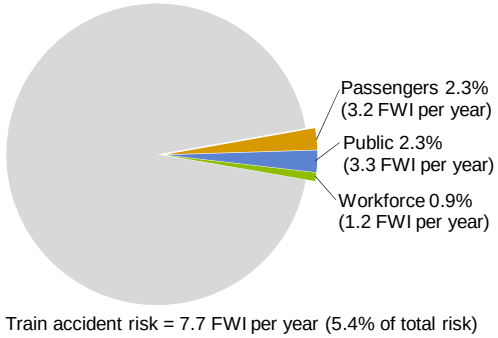
October 2009 marked the tenth anniversary of the collision at Ladbroke Grove, prompting the industry to reflect on the significant progress that has been made since that accident and the challenges that remain[38]. This chapter covers the risk from all types of train accident, from collisions and derailments to those with typically less serious consequences, such as trains being struck by stones thrown by vandals.

2009/10 Headlines

- There were no passenger or workforce fatalities in train accidents in 2009/10. The last train accident with an on-board fatality was the derailment at Grayrigg in February 2007.
- Total harm from train accidents in 2009/10 was seven fatalities (all road vehicle[39] users), eight major injuries and 123 minor injuries or cases of shock/trauma. This equates to 8.2 FWI.
- Five road vehicle users were fatally injured in collisions with trains on level crossings (including three in one vehicle). Two people died when a quad bike they were riding along the track was struck by a train. The cause of one of the fatal level crossing accidents (at Moreton-on-Lugg) appears to have been under railway control rather than user error.
- There were 42 potentially higher-risk train accidents, which is the lowest financial year total on record.
- There were 20 derailments, eight of which involved passenger trains. This compares with 15 derailments (three involving passenger trains) in 2008/09.
- There were four reportable collisions between trains. All occurred at low speed; two resulted in injuries to train occupants.
- The PIM indicator, which measures changes in train accident risk, stood at 39.1 at the end of the year, compared with 46.2 at the end of 2008/09.

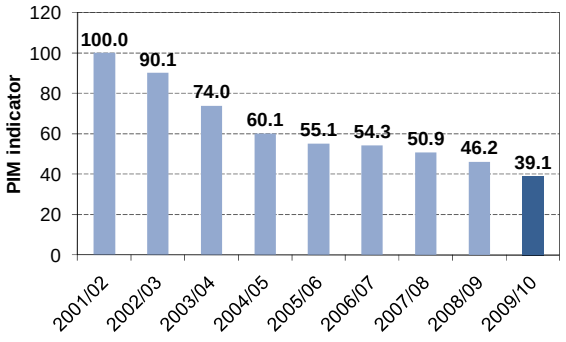
Train accident risk at a glance

Train accident risk in context (SRMv6)



Train accident risk = 7.7 FWI per year (5.4% of total risk)

Trends in train accident risk (PIM)



[38] For more information, see *Report on improvements in the safety of passengers and staff involved in train accidents*, which is available from www.rssb.co.uk.
[39] The term *road vehicle* is used in this report to describe a range of vehicles, including farm machinery and off-road vehicles such as quad bikes.

8.1 Types of train accident and train accident risk

A wide spectrum of events are classed as train accidents, from a vandal throwing stones at trains to a high-speed collision between passenger trains. While the industry monitors all types of event, its main focus is on accidents at the more serious end of the scale.

RIDDOR-reportable train accidents

In this report, the term *train accident* covers eleven types of RIDDOR-reportable events, which are set out in Table 17.[40] To be reportable under RIDDOR, the accident must be on or affect a running line. Additional criteria apply to different types of accident and these are summarised in Appendix 6. Events that are not reportable under RIDDOR are generally omitted from the analysis in this chapter.

Accidents are usually categorised by their initial event. For example, a derailment that resulted in a collision between trains would be classed as a derailment, even if it was the subsequent collision that caused most of the harm.

Potentially higher-risk train accidents (PHRTAs)

Many train accidents carry little risk. The types of train accident with the most potential to result in harm are known as PHRTAs. This group comprises RIDDOR-reportable derailments, trains striking road vehicles, buffer stop collisions and collisions between trains (excluding roll backs and open doors).

The Safety Risk Model

The SRM models all sources of risk on the railway, including the risk from train accidents. Of the total risk of 141.3 FWI per year, train accidents account for 7.7 FWI (5.4%).

Train accidents with on-board fatalities occur very infrequently but have the potential to result in a large number of casualties. The SRM contains detailed models of the causes and consequences of train accidents, encompassing 18 hazardous events and 1,286 separate accident precursors. It can thus provide an estimate of the underlying level of risk associated with accident types that have not occurred for many years or have never occurred at all.

The SRM provides an estimate of the predicted level of risk at a point in time. It is updated periodically, with the next version (SRMv7) scheduled for release in summer 2011.

The Precursor Indicator Model

The Precursor Indicator Model (PIM) measures the risk from train accidents by tracking changes in the occurrence of accident precursors. It uses risk weightings derived from the SRM and allows train accident risk to be monitored on an ongoing basis.

The PIM and its outputs are discussed in more detail in section 8.7.

[40] The term *train* covers a wide range of rail vehicles, including on-track plant. See Appendix 6 for more detail.

Table 17 shows the 11 categories of RIDDOR-reportable train accident and the risk associated with each. It lists the train accident hazardous events (HETs) from the SRM that make up each category, and indicates which types of accident are considered potentially higher-risk train accidents, and which are covered by the PIM.

Table 17. Types of train accident and their associated risk (SRMv6)[41]

RIDDOR-reportable train accidents	PHRTA	Covered by PIM	Risk (FWI per year)			Constituent hazardous events in the Safety Risk Model (SRM)
			Passengers	Workforce	Public	
Derailments (excluding striking road vehicles on level crossings)	✓	✓	1.9	0.5	0.2	HET-12, HET-13
Collisions between trains (excluding roll backs and open doors)	✓	✓	0.8	0.3	0.2	HET-01,HET-02, HET-03, HET-06B, HET-06C, HET-26
Roll back collisions	×	✓	<0.1	<0.1	0	HET-06A
Buffer stop collisions	✓	✓	0.1	<0.1	0	HET-09
Collisions with road vehicles at level crossings (including derailments)	✓	✓	0.3	0.1	2.4	HET-10, HET-11
Collisions with road vehicles at other locations (excluding derailments)	✓	used as a precursor	<0.1	<0.1	0.5	Part of HET-04
Open door collisions	×	×	<0.1	<0.1	<0.1	Part of HET-04
Collisions with animals (excluding derailments)	×	used as a precursor	<0.1	<0.1	<0.1	Part of HET-04
Collisions with other objects (excluding derailments)	×	used as a precursor	<0.1	<0.1	<0.1	Part of HET-04
Trains struck by missiles	×	×	<0.1	0.1	0	Part of HET-04
Train fires	×	✓	0.1	0.1	<0.1	HET-17, HET-20

- Most of the risk to passengers arises from train derailments, which account for 1.9 FWI per year. The total risk for all person types from train derailments is 2.5 FWI per year. These figures include the risk from collisions or fires following a derailment.
- Collisions with road vehicles at level crossings is the second-largest risk area, with members of the public incurring most of the risk (2.4 FWI per year).
- PHRTAs cover 93% of all train accident risk (7.2 FWI per year).
- The PIM covers 87% of all train accident risk (6.7 FWI per year).

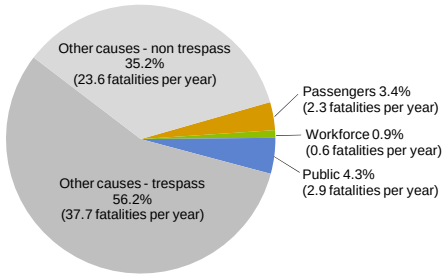
[41] The three accident types that are recorded as being *used as a precursor* contribute to the PIM estimate of derailment risk (each can be a precursor to a derailment as well as an accident in its own right) but the PIM does not cover the risk from these accidents when no derailment results.

8.2 Train accident risk

The SRM estimates the risk from train accidents to be 7.7 FWI per annum, which is around 5.4% of total risk (excluding suicide). Of this, fatality risk is 5.8 per year, which is around 8.6% of the total fatality risk.

- The group with the highest fatality risk is members of the public, with a risk of 2.9 fatalities per year. The greatest risk arises from trains striking road vehicles at level crossings.
- The next highest risk group is passengers, with a risk of 2.3 fatalities per year. The greatest risk to this group arises from train derailments.

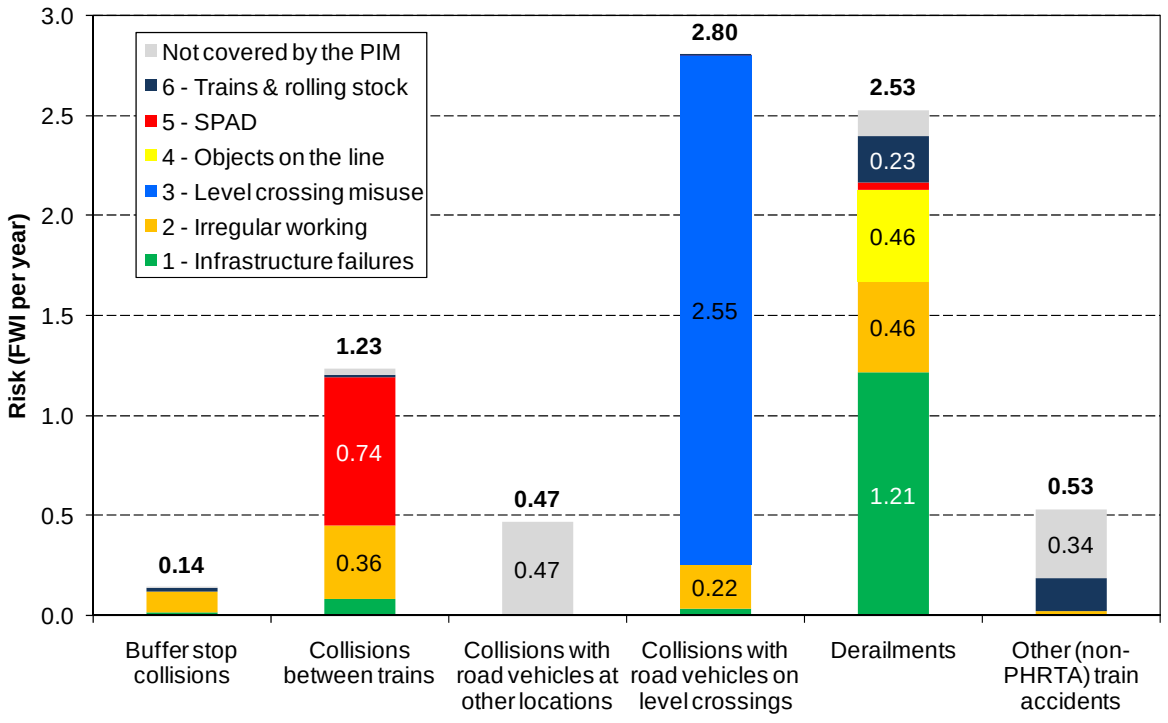
Train accident fatality risk in context



Train accident risk 5.8 fatalities per year (8.6% of total fatality risk)

The PIM is structured around causes of train accidents, and comprises six main groups. More information on the PIM, and each of its categories, can be found in section 8.7. Chart 99 shows train accident risk broken down by accident type and PIM group.

Chart 99. Train accident risk by accident type and cause (PIM group)



- Overall, the greatest risk arises from collisions with road vehicles at level crossings. This is mostly caused by crossing user behaviour and principally affects members of the public rather than train occupants.
- Derailments are the next largest source of train accident risk. Infrastructure failures account for just under half of derailment risk.
- Collisions between trains account for around half as much risk as derailments. Most of the risk from collisions between trains arises as a result of signals passed at danger (SPADs).

8.3 Fatalities and injuries in train accidents

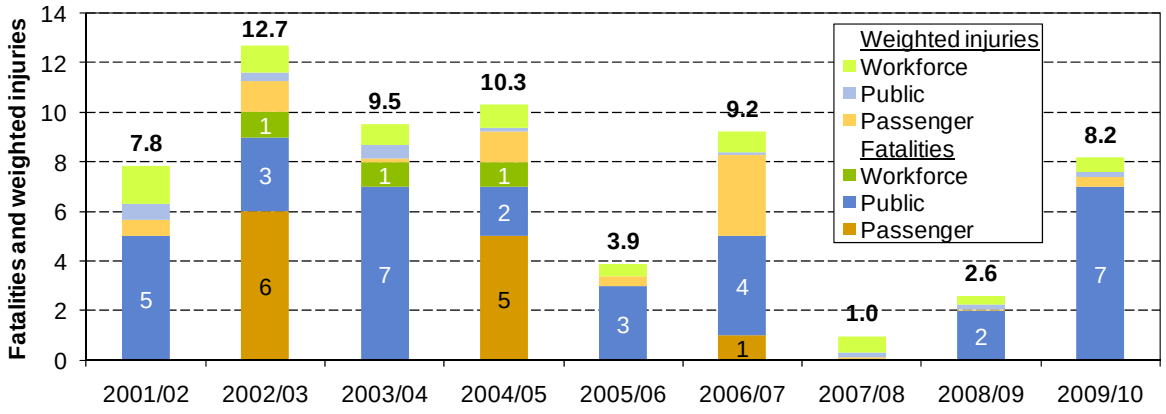
Seven members of the public were killed in train accidents in 2009/10. Five road vehicle occupants died in collisions with trains on level crossings (including three in one accident). Two other people died when a quad bike they were riding along the track was struck by a train. Further details of these incidents can be found in section 8.5.3.

Two train collisions resulted in major injuries to three passengers during the year. On 3 October 2009, a passenger received a major injury to his shoulder in a low speed collision at Darlington station, and on 4 January 2010, one passenger was knocked unconscious and another suffered a slipped disc as a result of a low speed collision at Exeter St David's.

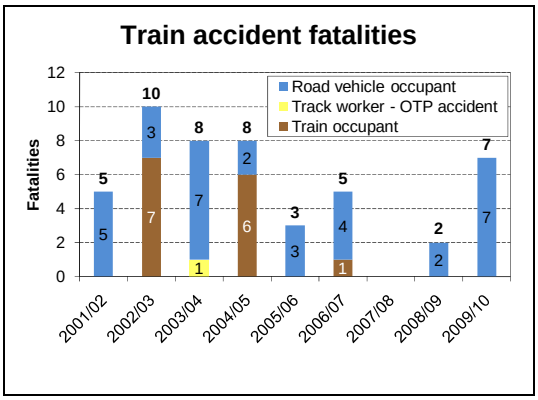
Three members of the workforce also suffered major injuries in separate train accidents. A conductor was hospitalised as a result of inhaling fumes from a train fire; a track worker was struck on the leg by a shoe[42] that broke from a passing train when it ran into an obstruction, and another track worker received crush injuries to his leg when a road-rail vehicle collided with a generator, knocking it onto him.

There were 83 reports of minor injuries as a result of train accidents in 2009/10. These arose from the collisions listed above (21 minor injuries), derailments (19), trains struck by missiles (20), collisions with objects on the line (16) and train fires (7).

Chart 100. Fatalities and weighted injuries from train accidents (excluding suicides)



- There was a higher level of harm from train accidents in 2009/10 than in the previous two years. This was due to the number of road vehicle occupants killed.
- The mini chart shows that since 2001/02, 33 road vehicle occupants, 14 train occupants and one track worker using on-track plant have died in train accidents.
- The level of harm to passengers from train accidents varies considerably from year to year, and a single major accident can dominate that year's figures. This is seen in Chart 100: major train accidents occurred in 2002/03 (Potters Bar), 2004/05 (Ufton) and 2006/07 (Grayrigg).

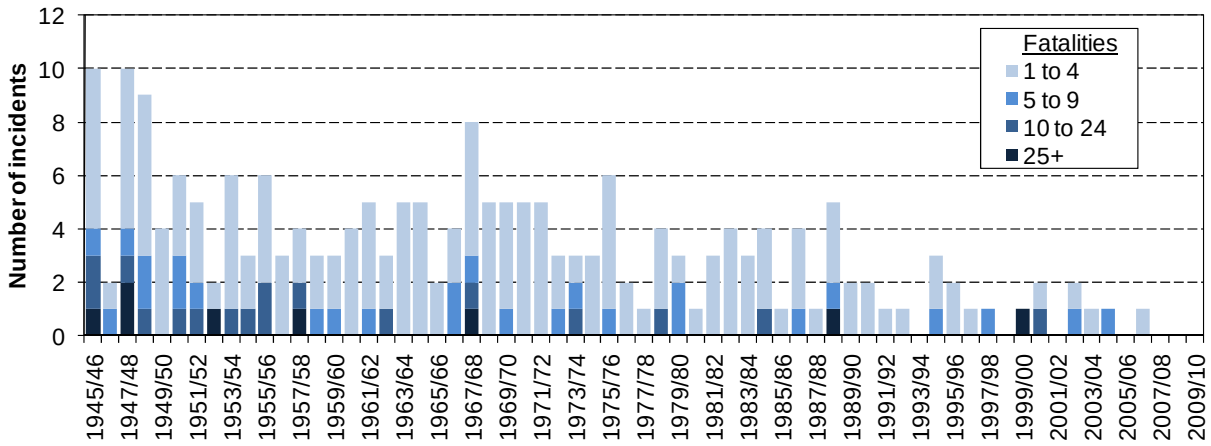


[42] A shoe is a piece of equipment for collecting traction current from the electrified third rail.

8.4 Long-term trends in fatal train accidents

The railway has introduced many improvements over the years to reduce the frequency and consequence of train accidents. Historically, continuously welded rail, multi-aspect colour signalling, continuous braking and buckeye couplings all helped to create a safer railway. More recent developments include the introduction of the Train Protection and Warning System (TPWS), advances in train crashworthiness, and an improved understanding of human factors.

Chart 101. Train accidents leading to passenger and workforce fatalities



- The rate of fatal accidents has fallen significantly over the last 60 years.
- The most recent train accident involving a passenger or workforce fatality occurred in February 2007, at Grayrigg: one passenger was fatally injured.
- Train accidents with ten or more fatalities occurred around once per year on average until the late 1950s. Such events are now very rare; the last occurrence was at Great Heck in 2001.

The SRM can be used to predict the average number of years between train accidents. It estimates that if current levels of safety and usage remain unchanged then a train accident with ten or more fatalities would occur on average around once every 15 years.

Table 18. SRM estimated frequency of train accidents by severity

		SRM v1 / v2	SRM v3	SRM v4	SRM v5 / v5.5	SRM v6
Average number of years between events with...	5 or more fatalities	1.4	2.4	3.8	5.3	5.4
	10 or more fatalities	3.1	5.6	7.9	9.1	15.3

- For each consequence level, the expected time interval between events has increased since version 1 of the SRM was published, indicating that the likelihood of multi-fatality accidents is decreasing.
- This reflects the industry's success in tackling train accident risk, taking into account recent system improvements such as TPWS, Mark I removal and improvements in track quality following the Hatfield train accident.

Data sources: ORR for historic data; SMIS for recent statistics.

Causes of historic train accidents

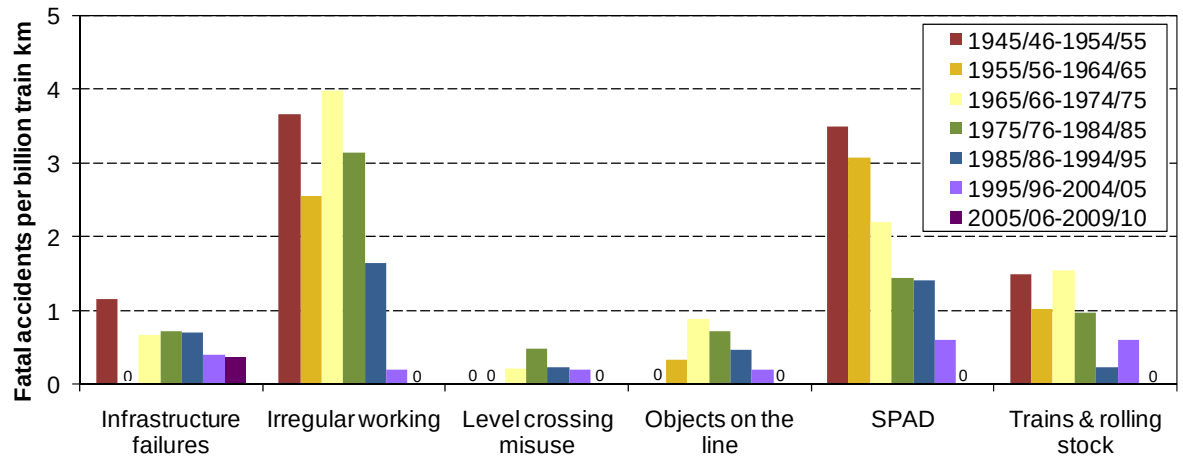
There have been eight train accidents in which 25 or more people died since 1945/46. Three of these were caused by a SPAD.

Table 19. Historic train accidents

Year	Location	Nature and cause of accident	Fatalities		
			Passengers	Workforce	Public
Train accidents with 25 or more fatalities since 1945/46					
1945/46	Bourne End	Derailment due to speeding on a crossover	41	2	0
1947/48	South Croydon	Collision between trains following signaller error	31	1	0
1947/48	Goswick	Derailment due to speeding on a crossover	27	1	0
1952/53	Harrow and Wealdstone	Collision between trains following a SPAD (three trains involved)	108	4	0
1957/58	Lewisham	Collision between trains following a SPAD (subsequent bridge collapse)	89	1	0
1967/68	Hither Green	Derailment caused by a broken rail	49	0	0
1988/89	Clapham Junction	Collision between trains caused by a signal fault (three trains involved)	34	1	0
1999/00	Ladbroke Grove	Collision between trains following a SPAD	29	2	0
Train accidents with passenger or workforce fatalities since 2001/02					
2002/03	Purley	Passenger train fire caused by vandalism	0	1	0
2002/03	Potters Bar	Derailment due to points failure	6	0	1
2003/04	Ancaster	Collision involving on-track plant in a possession due to irregular working	0	1	0
2004/05	Ufton	Derailment following collision with road vehicle parked on crossing (suicide)	5	1	[1]
2006/07	Grayrigg	Derailment due to points failure	1	0	0

Historically, SPADs and irregular working (a category that covers a wide range of workforce errors and misjudgements) have accounted for most fatal accidents.

Chart 102. Trends in train accidents with passenger or workforce fatalities by cause



- There has been a substantial reduction in the frequency of fatal train accidents caused by factors that are largely within the industry's control, namely infrastructure failures, irregular working, SPADs, and train and rolling stock failures.
- The trend is more obscure for causes over which the industry can exert some influence, but which are often not under its direct control: level crossing misuse and objects on the line. These causes now account for a higher proportion of train accident risk than was historically the case.

Data source: ORR for historic data; SMIS for recent data.

8.4.1 Potentially higher-risk train accidents in 2009/10

Table 20 and Table 21 list the 42 PHRTAs that occurred in 2009/10.

The events coloured red indicate the incidents that the Rail Accident Investigation Branch (RAIB) is investigating, or for which it has published a report. For more information about how the industry learns from accidents and incidents, see the *Learning from Operational Experience Annual Report 2009*, which is available from the RSSB website.

Table 20. Passenger train PHRTAs

Derailments (excluding level crossings)				8
Date	**Location**	**Territory**	**Train Operator**	**Description**
22/05/2009	Windsor and Eton Riverside	South East	South West Trains	Derailed at low speed on ground frame points.
01/06/2009	Cummersdale	London North Western	Northern Rail	Derailed by its leading bogie on a track buckle.
11/06/2009	Olive Mount Jcn	London North Western	Northern Rail	Derailed after running over a part of its own engine, which had detached.
11/10/2009	Windsor and Eton Riverside	South East	First GB Railfreight	Derailed at low speed arriving into platform.
28/11/2009	Gillingham Tunnel	South East	South West Trains	Struck a landslip and derailed at one end of the tunnel.
19/12/2009	Thetford	South East	National Express East Anglia	Derailed at low speed as it was being shunted across a junction.
22/01/2010	Dingwall	Scotland	First ScotRail	Derailed on points at the station after passing a signal at danger.
20/02/2010	East Langton	London North Eastern	East Midlands Trains	Drivetrain failure led to wheel disintegration and derailment.
Collisions between passenger trains				**4**
Date	**Location**	**Territory**	**Train Operator**	**Description**
12/06/2009	Liverpool Street	South East	National Express East Anglia	Low speed collision with the rear unit of a stationary train in the platform.
03/10/2009	Darlington	London North Eastern	Northern Rail	Low speed collision with a train in the platform after a category A SPAD at the midplatform signal.
27/10/2009	Kentish Town Junction	London North Eastern	East Midlands Trains	Low speed collision with an engineer's trolley that had been incorrectly placed on the down fast line.
04/01/2010	Exeter St Davids	Western	First Great Western	Low speed collision with a stationary train in the platform.
Buffer stop collisions				**0**
Collisions with road vehicles				**14**
Struck road vehicles on level crossings (see Road Rail Interface chapter)				**12**
Struck road vehicle at other than level crossing (excluding derailments)				**2**
Total passenger train PHRTAs				**26**

The derailment at Windsor and Eton Riverside on 11 October was an 'enthusiasts special', comprising heritage stock attached to a GB Railfreight locomotive.

Table 21. Non-passenger train PHRTAs

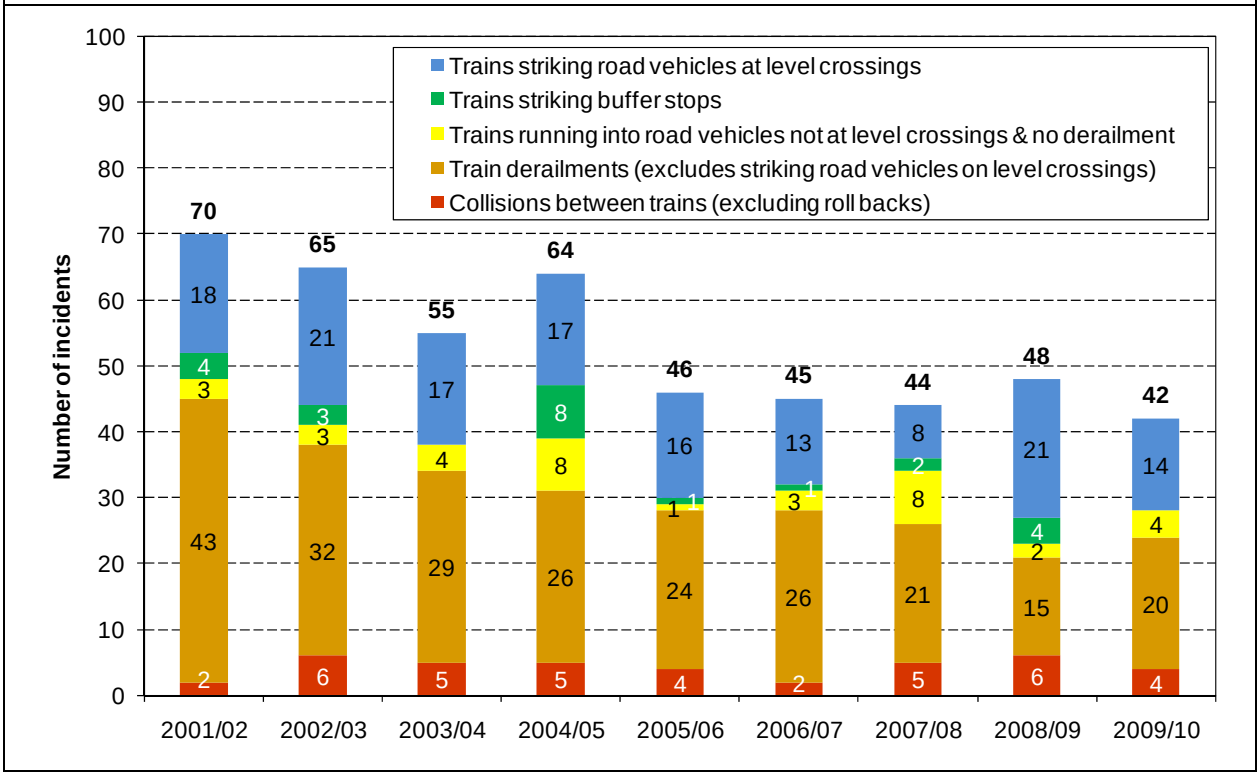
Derailments (excluding level crossings)					12
Date	**Location**	**Territory**	**Train Operator**	**Train Type**	**Description**
01/05/2009	Sudforth Lane LC	London North Eastern	Freightliner	Freight	Derailed on points.
16/06/2009	Derby London Road Jcn	London North Eastern	Serco Rail Operations	Light locomotive or locomotives	Derailed on points whilst making a movement on a wheel skate.
30/06/2009	Kirkdale	London North Western	Merseyrail	ECS multiple unit	Ran away, leading to category D SPAD and derailment.
26/07/2009	Marshgate Jcn	London North Eastern	First GB Railfreight	Freight	Empty wagon ran away during a shunt move. Category D SPAD and derailment.
08/08/2009	Rhymney	Western	Arriva Trains Wales	ECS multiple unit	Derailed on points.
09/08/2009	Bescot	London North Western	DB Schenker	Freight	Derailed over points which were incorrectly set.
25/08/2009	Wigan North Western	London North Western	DB Schenker	Freight	Derailed whilst passing a platform.
12/11/2009	Derby Road	South East	Freightliner	Freight	Derailed after striking a road vehicle (see the Road-Rail Interface chapter)
27/11/2009	Darlington	London North Eastern	Northern Rail	ECS multiple unit	Passed signal at danger and became derailed on points.
04/01/2010	Carrbridge	Scotland	DB Schenker	Freight	Passed signal at danger because of ineffective brakes due to the cold/snowy conditions and derailed on trap points.
07/01/2010	Yate	Western	DB Schenker	Freight	Derailed on points.
22/02/2010	Millbrook (Hants)	South East	DB Schenker	Freight	Derailed by one wheel near points.
Collisions between non-passenger trains					**0**
Buffer stop collisions					**0**
Collisions with road vehicles					**4**
Struck road vehicle on level crossings (see Road-Rail Interface chapter)					**2**
Struck road vehicle other than at level crossing (excluding derailments)					**2**
Total Non-passenger PHRTAs					**16**

- There were 26 passenger train and 16 non-passenger train PHRTAs in 2009/10. Of the non-passenger train PHRTAs, 10 involved freight trains, four involved empty coaching stock, and two involved light locomotives.
- Nine of the PHRTAs were subject to a RAIB investigation: one collision, six derailments and two collisions at level crossings (the incidents at Halkirk and Moreton-on-Lugg).
- RAIB also launched investigations into two other train accidents on the main line in 2009/10, as well as two incidents that had the potential to cause a train accident:
  - Three passenger trains on the West Coast main line were struck by open container doors on a freight train on 4 July 2009. Criminal activity is suspected.
  - A railway bridge was found to have failed near Feltham on 14 November 2009.
  - A freight train SPAD at Carstairs resulted in a ‘near miss’ with two passenger trains on 22 December 2009.
  - A passenger train collided with a length of rail that was being dragged by a road-rail machine at Washwood Heath on 6 March 2010.

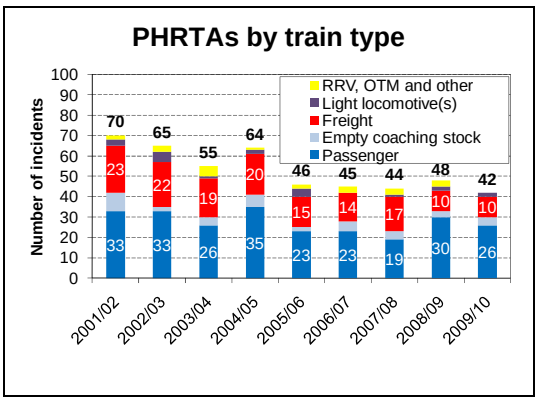
8.5 Trends in potentially higher-risk train accidents

The risk from PHRTAs equates to around 7.2 FWI per year. While PHRTAs comprise the types of train accident that have the greatest potential to result in casualties, the majority result in no injury.

Chart 103. Trends in the numbers of PHRTAs



- The number of PHRTAs in 2009/10 was the lowest recorded for any financial year. Numbers have been fairly steady over the past five years after a period of improvement in the early part of the decade that occurred, in part, as a result of a fall in the number of freight train derailments.
- There were 20 derailments in 2009/10, one of which was the result of running into a road vehicle (not at a level crossing).
- There were a further 18 collisions with road vehicles (14 at level crossings) that did not cause a derailment.
- There were four low-speed collisions between trains, all involving passenger services.
- In the last two years, the number of freight train PHRTAs has been at an historic low. The number of passenger train PHRTAs fluctuates from year to year, although there is some evidence for a slight fall in rates over the past decade, particularly if traffic growth is taken into account.

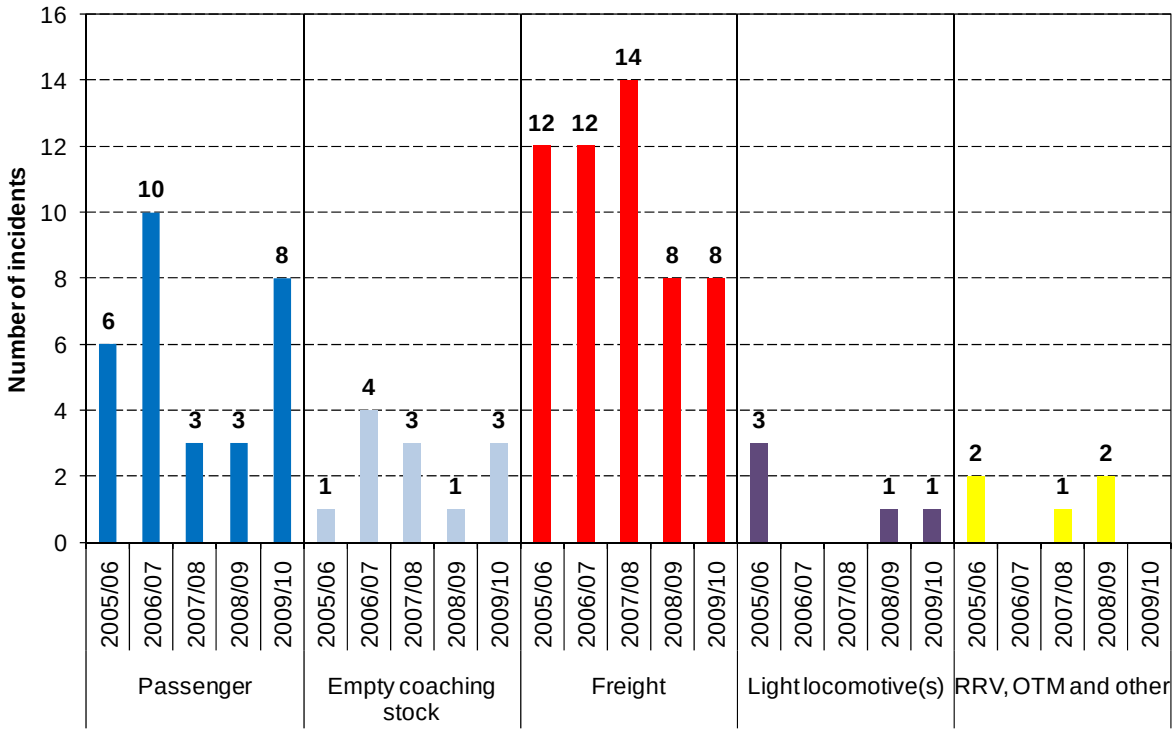


8.5.1 Derailments

The risk from derailments is estimated by SRMv6 to be 2.5 FWI per year. There have been two fatal train derailments since 2001/02 (at Potters Bar and Grayrigg); both were caused by points failure.[43]

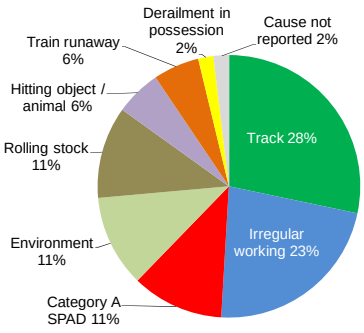
There were 20 derailments in 2009/10, which is more than the previous year but still low by historical standards.

Chart 104. Trends in derailments by train type over the last five years



- There was an increase in passenger train derailments in 2009/10. The incidents had a range of causes, including rolling stock failure, a landslip and track problems.
- Freight train derailments remained at an historic low in 2009/10.
- Over the last five years, track faults and irregular working have been the main causes of derailment.
- Two derailments in 2009/10 were the result of runaways. In one case, empty coaching stock ran away from a depot and derailed, obstructing the running line. In the other, a freight wagon ran away during a shunt move and derailed on trap points.

Causes of train derailment (2005/06–2009/10)

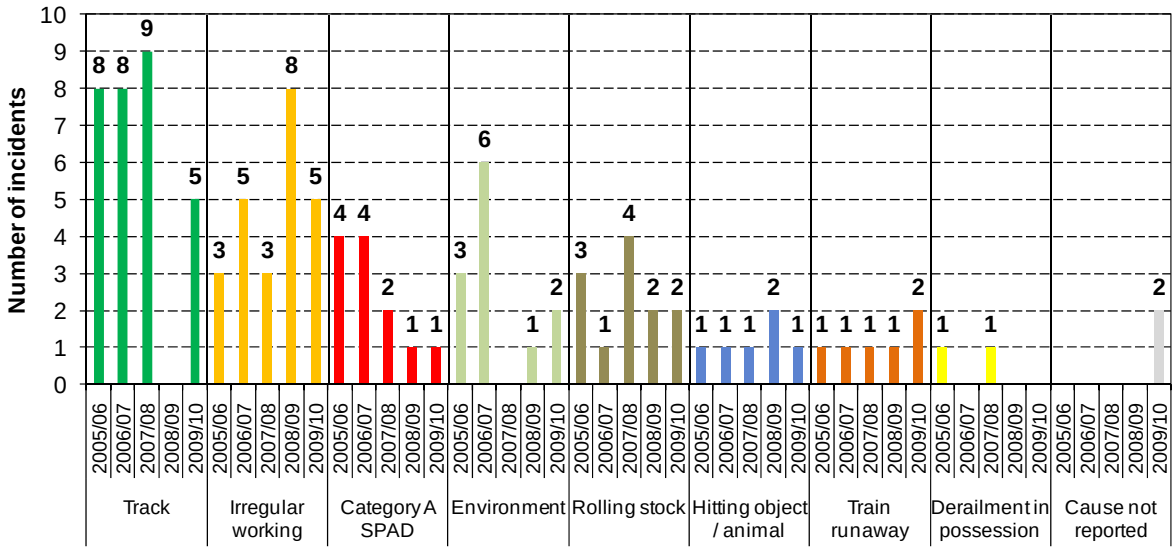


[43] The accident at Ufton, in which the train derailed, does not feature in the analysis in the *Derailments* section because it is classed – in accordance with its initiating event – as a collision with a road vehicle at a level crossing. The risk estimate presented at the top of the page similarly excludes the risk from derailments following collisions with road vehicles at level crossings, or following collisions between trains.

Causes of derailments

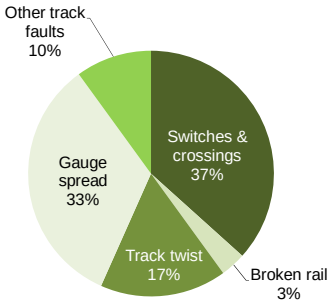
Chart 105 shows the primary causes assigned to train derailments. On investigation, train accidents are generally found to have numerous causal factors and it is not always straightforward to pick out a single one. Nevertheless, this basic approach can be useful for identifying general trends.

Chart 105. Trends in derailments by cause

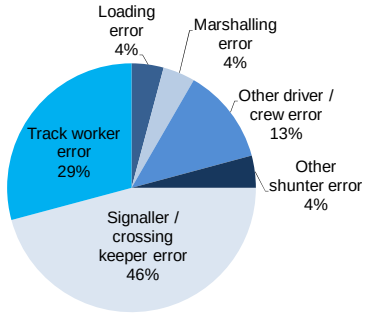


- A wide range of causes contributes to derailment risk. For two of the derailments in 2009/10, the cause had not been established at the time of going to print.
- The number of track-related derailments has fallen over recent years. There were five track-related derailments last year compared with none in 2008/09, but the number was still lower than previous years.
- Around one-third of track-related derailments occur at switches and crossings. This can be due to points moving under the train (as a result of equipment failure), points in the wrong position and not detected, or other failures.
- The number of derailments attributed to irregular working shows no clear trend.
- The most common causes of irregular working-related derailments are signaller error (for example, authorising movements over points that have not been correctly set or moving points underneath the train) and track worker error (typically during installation).

Track-related derailments (2005/06–2009/10)



Irregular working-related derailments (2005/06–2009/10)



Causes of derailments (RAIB reports)

Professor James Reason's 'Swiss cheese' model describes how accidents usually occur when several lines of defence fail simultaneously and the holes in the metaphorical slices of cheese align. For this reason, investigations into accidents tend to identify multiple causes. For example, the immediate cause of the derailment at Cummersdale on 1 June was a track buckle, but the RAIB investigation identified 10 causal factors ranging from track maintenance issues to signaller-driver communication.

RAIB classifies accident causes according to the *railway area* in which the failure arose. For example, *infrastructure* covers the track, power supply, earthworks and other structures (but not signalling and telecommunications); *operations* covers train preparation, despatch, driving and management, as well as the protection of workers.

- RSSB has developed an Incident Causal Classification System, based on the RAIB classification scheme, to analyse incident reports. This covers RAIB reports as well as formal inquiries, local investigations, and reports from other countries and industries.
- The mini chart shows that, out of 46 RAIB investigations into main line derailments, 34 identified a causal factor (or factors) related to *infrastructure*. Of these, 10 identified that *operations* also played a role in the accident; in seven of these events other causes were identified too (for example relating to rolling stock, signalling or third party actions).

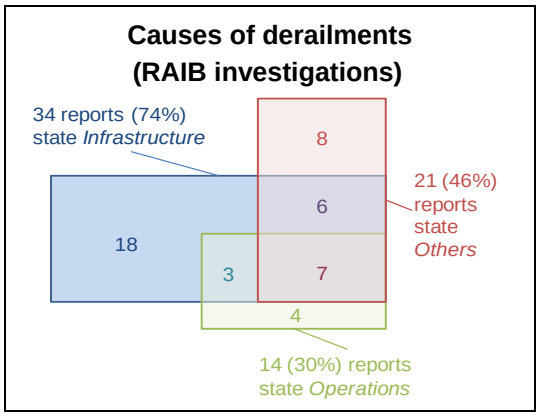
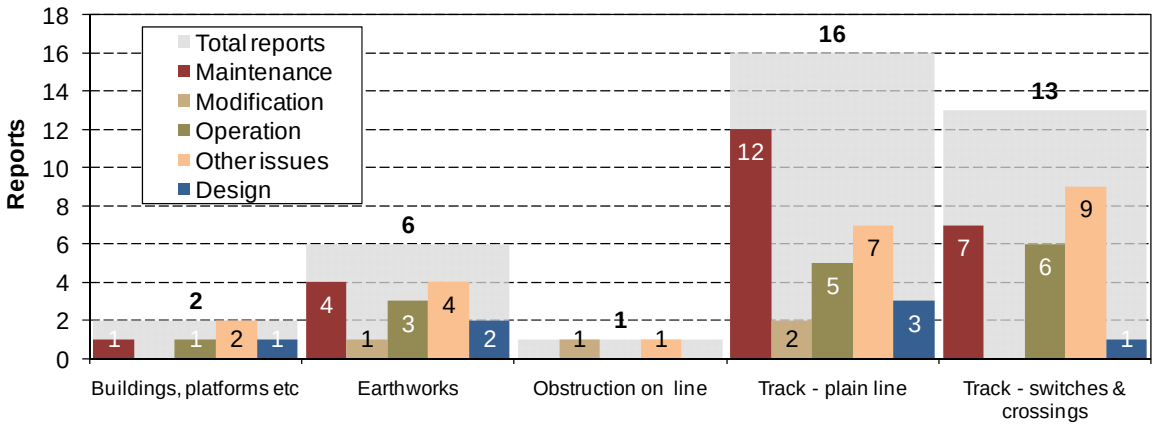


Chart 106 shows in more detail the causes identified in the 34 reports that cited *infrastructure* as a factor. Maintenance issues were identified most frequently. For example, 12 of the 16 reports relating to plain line track problems identified maintenance as a causal factor.

Chart 106. Causes of infrastructure-related derailments (RAIB investigations)



For more information about the Incident Causal Classification System, see the *Learning from Operational Experience Annual Report 2009*, which is available from the RSSB website, or contact enquiries@rssb.co.uk.

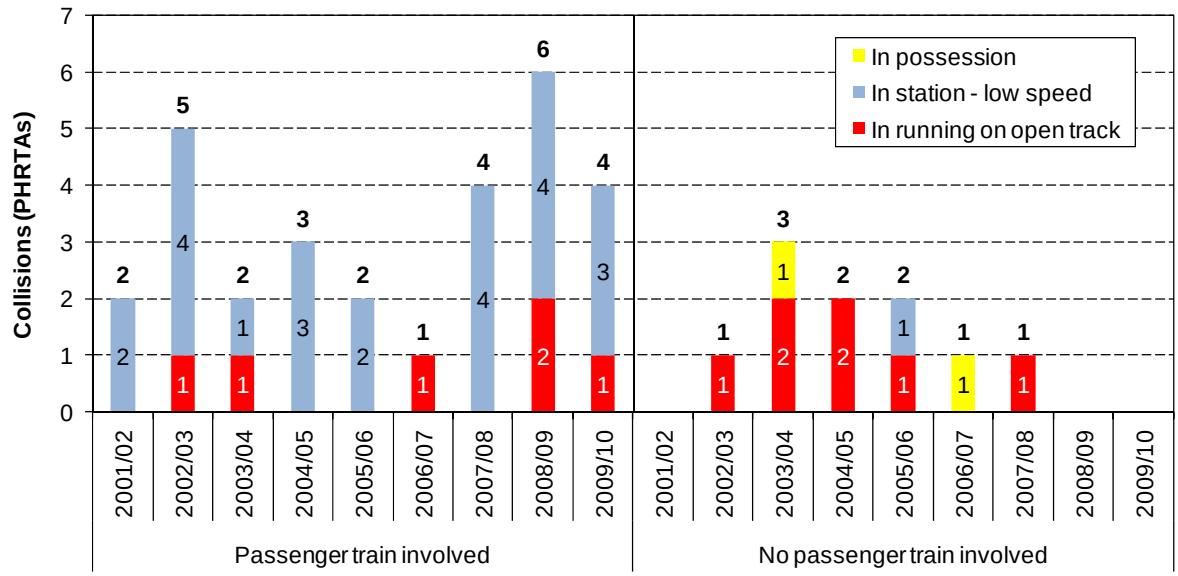
The charts on this page are based on all of the 46 RAIB investigations into derailments on the main line railway published before the end of December 2009.

8.5.2 Collisions between trains

The risk from collisions between trains is estimated by SRMv6 to be 1.2 FWI per year. Roll back and open door collisions (each of which accounts for a risk of less than 0.01 FWI per year) is covered in section 8.6.

A number of collisions between trains are reported each year, but most occur at very low speeds and carry little risk. High-speed collisions between trains accounted for the two worst accidents of the last 40 years, Clapham Junction (1988) and Ladbroke Grove (1999), which each claimed more than 30 lives. The introduction of TPWS in the early part of this decade significantly reduced the risk from collisions caused by SPADs, but there always remains some level of risk from serious accidents.

Chart 107. Trends in collisions between trains by collision type and location



- There were four collisions, all involving passenger trains, in 2009/10. This is fewer than the previous year, but around the average for the period shown on the chart.
- Three collisions occurred at low speed in stations:
  - On 12 June 2009, a collision occurred at very low speed at Liverpool Street station. There was no damage and no reported injuries.
  - On 3 October 2009, a passenger train (Class 142 DMU) passed a signal at danger and collided with the rear of another train in Darlington station. The investigation cited poor rail/wheel adhesion as the cause; railhead contamination had been transferred from a location further along the line. There were several injuries.
  - On 4 January 2010, a passenger train (also a Class 142 DMU) collided with a stationary train in the platform at Exeter St David's. The investigation cited low adhesion in cold and humid conditions as a causal factor, and the lack of a sanding system on the train was a contributory factor. There were several injuries.
- The fourth event was a low-speed collision between a train and an engineer's trolley.
  - On 27 October 2010, a passenger train collided with a trolley that had been incorrectly placed on the down fast line at Kentish Town Junction. The train driver sounded his horn and applied the emergency brake; the work gang moved clear before the collision occurred. There were no reported injuries.

8.5.3 Collisions between trains and road vehicles

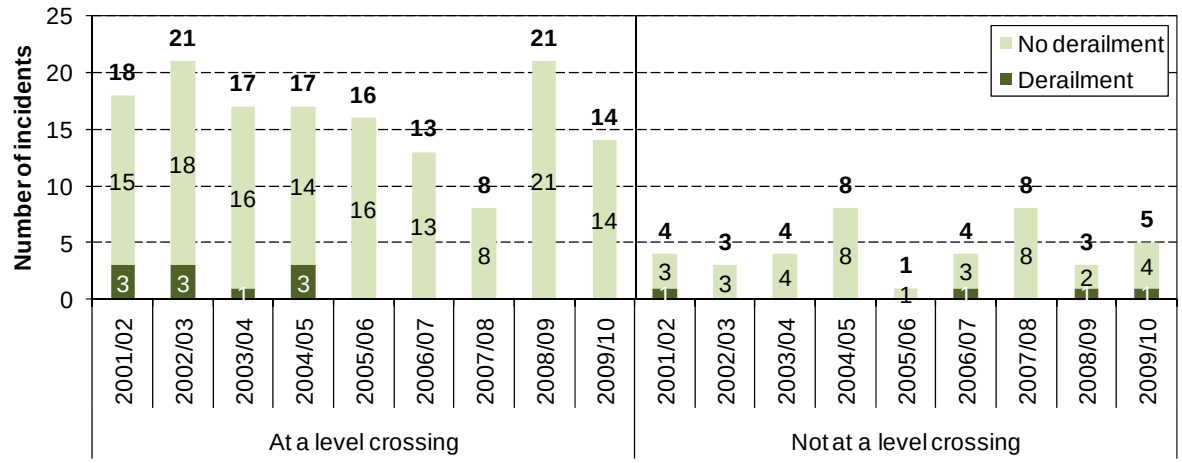
The risk from collisions between trains and road vehicles is estimated by SRMv6 to be 3.3 FWI per year.[44] Accidents at level crossings account for 86% of this. Most of the risk is to road vehicle occupants rather than to people on the train.

Two recent train accidents with passenger fatalities were caused by trains striking road vehicles: one vehicle was on the track after veering off an adjacent road (Great Heck) and the other had been parked on a level crossing by a motorist committing suicide (Ufton).

Seven motorists died in collisions with trains in 2009/10.[45]

- A woman was fatally injured when her car was struck by a light locomotive on a user-worked level crossing at Penrhyndeudraeth on 2 September.
- Three car occupants were killed when their vehicle was struck by a passenger train at Halkirk automatic open level crossing on 29 September.
- In the early hours of 9 December, two quad bikers were killed when a train struck their vehicle between Cardiff and Newport.
- A woman died when her car was struck by a train on the manually controlled barrier crossing at Moreton-on-Lugg, on 16 January. The barriers were raised to road traffic when the collision occurred.

Chart 108. Trends in trains striking road vehicles



- Over the past nine years there have been 145 collisions between trains and road vehicles at level crossings (16.1 per year on average) and 40 collisions at other locations (4.4 per year).
- There are no clear trends in collision rates. The numbers of collisions at and away from level crossings in 2009/10 were fairly typical.
  - One train derailed as the result of a road vehicle incursion during the year. On 12 November 2009, a freight train derailed by one bogie near Derby Road station, when it struck a road vehicle that had left the public highway and crashed through a fence.

For more detailed analysis see Chapter 9, *Risk at the road-rail interface*.

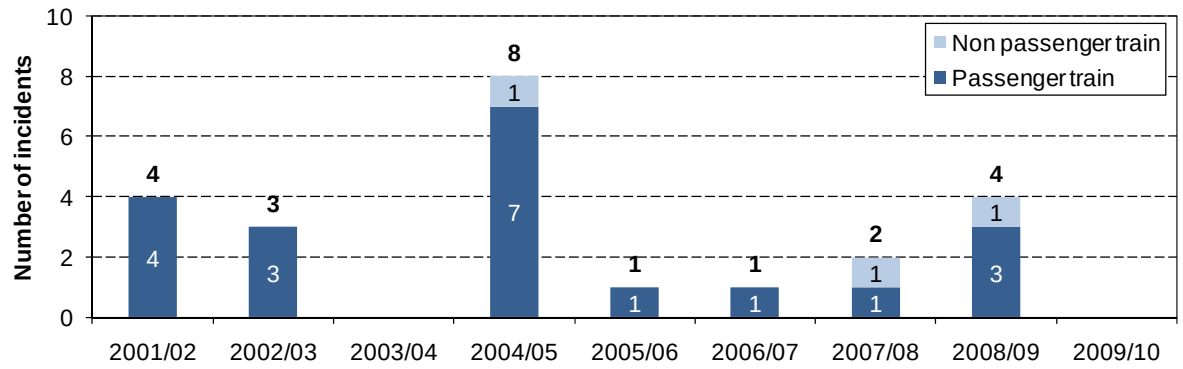
[44] This excludes the risk from derailments that result from trains striking road vehicles at locations other than level crossings (which are covered under the PHRTA *derailment* category).
[45] An additional fatality involving a car occupant on a level crossing is being treated as suspected suicide.

8.5.4 Buffer stop collisions

The risk from buffer stop collisions is estimated by SRMv6 to be 0.1 FWI per year. Most buffer stop collisions occur at very low speeds and carry little risk.

The last fatal buffer stop collision occurred at Cannon Street in 1991. Two passengers on the train died when the service collided with the hydraulic buffers, causing the fifth carriage to partially over-ride the sixth.

Chart 109. Buffer stop collisions



- There were no RIDDOR-reportable buffer stop collisions in 2009/10.
- The main cause of buffer stop collisions is driver error: this usually involves a misjudgement of braking distance, loss of concentration, or error using the couple/uncouple button.

8.5.5 Accidents involving dangerous goods trains

The consequences of a train accident are potentially more severe if dangerous goods are involved. This was illustrated by the freight train derailment at Viareggio station, Italy, on 29 June 2009. Wagons carrying liquefied petroleum gas exploded and caught fire, engulfing the area around the station and killing 32 people.

Britain's most recent RID-reportable[46] incident occurred near Stewarton on 27 January 2009. A train derailed after running into a collapsed bridge, and some of its wagons, which were carrying gas oil, kerosene and diesel, caught fire. Although there were no reported injuries, the accident caused severe environmental damage.

There were no RID-reportable dangerous goods incidents in 2009/10. A freight train carrying dangerous goods was involved in a 'near miss' at Carstairs on 22 December 2009. A derailment at Yate, on 7 January 2010, involved a train carrying diesel fuel; this occurred at very low speed and there was no leakage.

The dangerous goods incidents shown in the *Train Accident Precursors* Key Safety Fact Sheet (see section 8.8) include all safety-related events involving trains carrying dangerous goods, whether or not the goods themselves were compromised. These events often have very minor consequences, but changes in their frequency can indicate a change in the underlying risk.

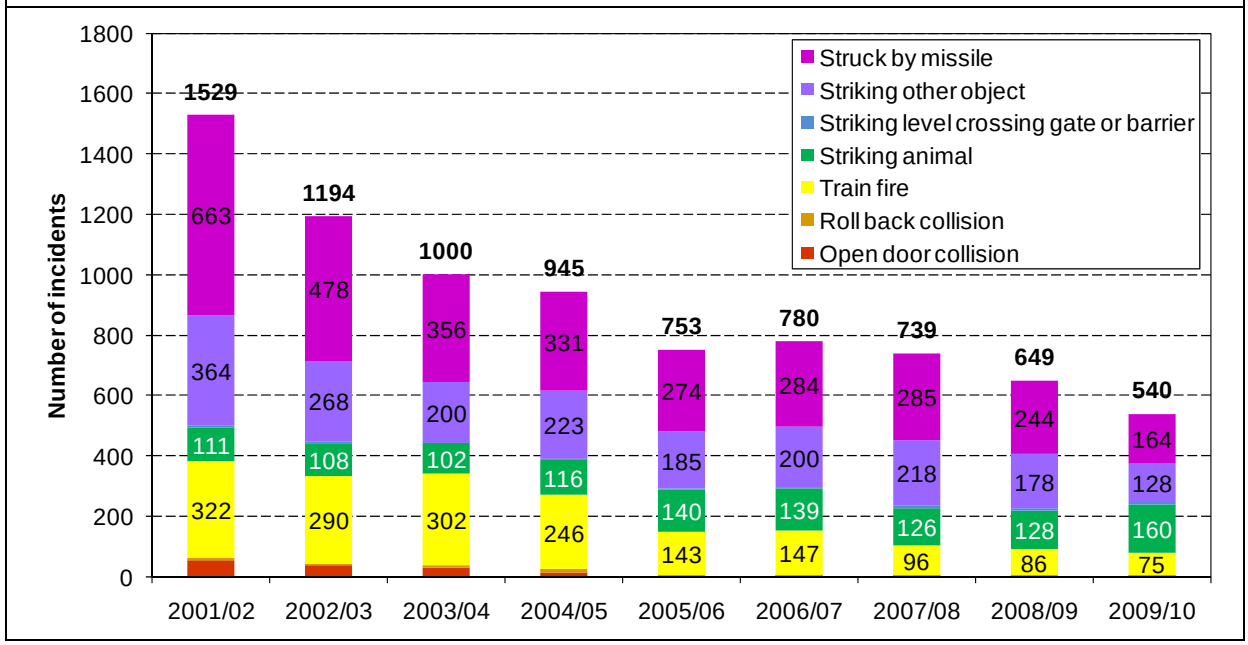
[46] RID refers to the Regulations Concerning the International Carriage of Dangerous Goods by Rail.

8.6 Other train accidents

SRMv6 estimates the risk from types of train accident other than PHRTAs to be relatively low, at 0.5 FWI per year. Train fires and trains struck by missiles each account for around one-third of this.

The most recent fatalities resulting from non-PHRTA train accidents were the result of fires. In 2002, a member of staff at Purley Station died following an asthma attack that was triggered by a train fire and, in 1995, a passenger was killed during the evacuation of a train that had caught fire at Maidenhead.

Chart 110. Trends in number of non-PHRTAs



- There has been a significant reduction in the number of non-PHRTA train accidents since 2001/02, and the current year saw a further drop.
- Reports of trains struck by missiles have fallen by around three-quarters since 2001/02. This reflects a general reduction in vandalism (see Chapter 7 - *Risk to members of the public*) and the laminated glass that is used on modern rolling stock.[47]
  - There were 20 minor injuries as a result of missiles thrown at trains in 2009/10. Some of these events had the potential for serious harm, including one in which a paving slab entered the cab of a freight train after being thrown through the window.
- Open door collisions and train fires have seen the largest percentage decrease since 2001/02. This is due to the phasing out of Mark I stock and the increased use of fire-resistant materials.
  - On 4 July, three passenger trains on the West Coast main line were damaged after being struck by open container doors on a freight train. It is believed the doors had been opened as a result of criminal action when the train was stopped at a junction.
- The only category of non-PHRTA train accident not to show a downward trend is collisions with animals on the line.

[47] Missiles striking trains are reportable under RIDDOR if they result in damage that requires immediate repair.

8.7 Trends in train accident precursors

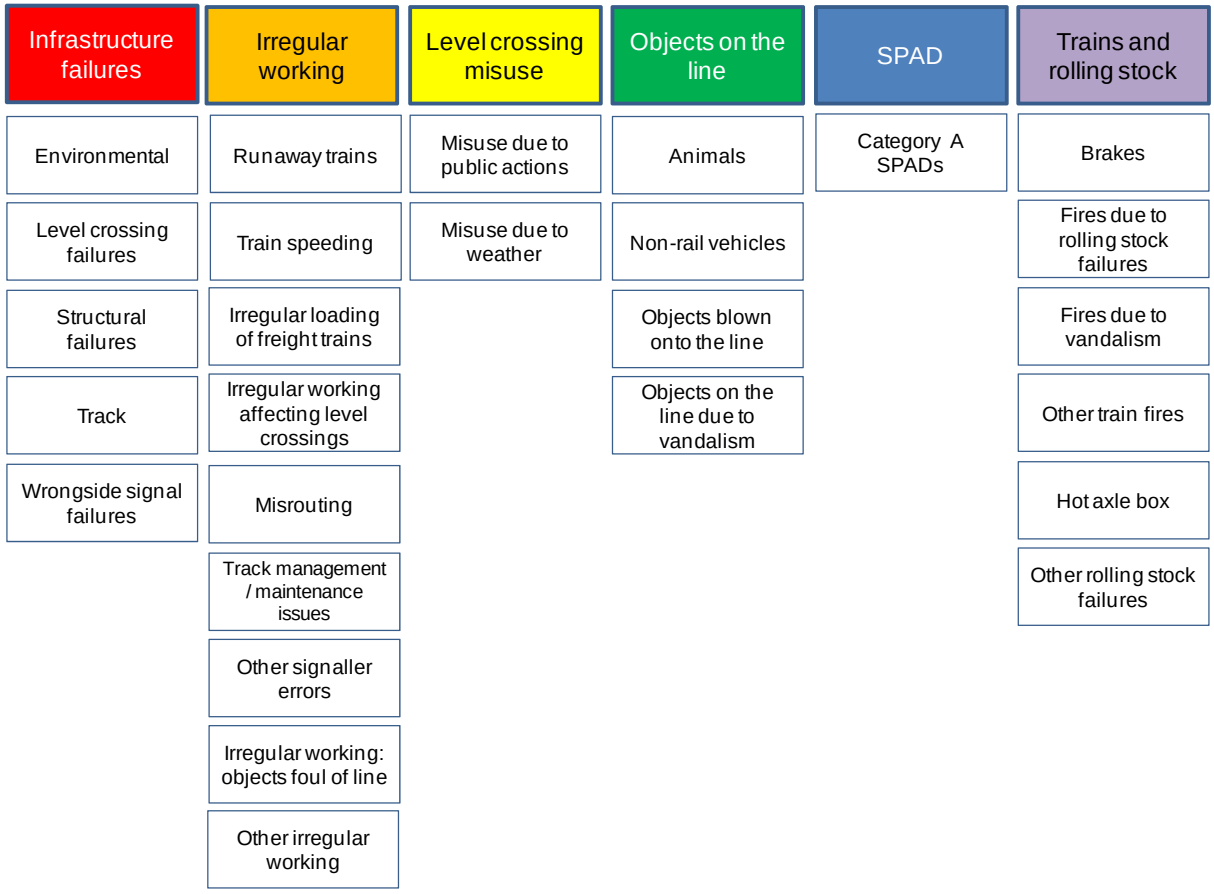
8.7.1 The Precursor Indicator Model

The PIM measures the underlying risk from train accidents by tracking changes in the occurrence of accident precursors. It was first developed in late 1999, and has since been subject to a series of modelling improvements.

Structure

The PIM monitors the risk from train derailments, train collisions, buffer stop collisions, train fires and trains striking road vehicles at level crossings. The precursors covered by the PIM fall into six main groups, encompassing 28 separate subgroups and 46 lower level groups. The irregular working and SPAD components of the PIM model were updated in early 2010 to incorporate risk ranking information.

Figure 1. PIM structure



How the PIM measures changes in train accident risk

The PIM monitors train accident risk to passengers, workforce and members of the public, such as motorists on level crossings. The PIM value is an annual moving average, so it reflects precursors that have occurred during the previous 12 months. It is also normalised by train miles, to account for changes in the level of activity on the railway.

The PIM uses the basic equation

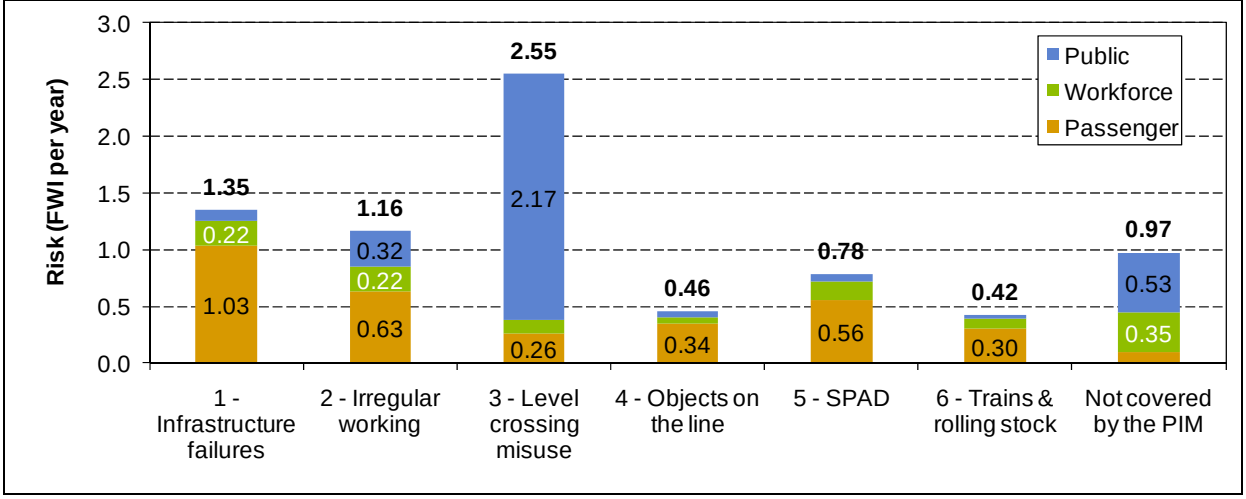
risk = frequency x consequence.

Frequency estimates are based on accident precursor data; consequence estimates are derived from the SRM. The SRM models hazardous events (that is, those that could lead to harm on the railway). Each is broken down into the precursors that could lead to its occurrence. The risk associated with each hazardous event and its precursors is estimated, and the results presented in terms of FWI per year. The SRM provides an estimate of the risk at a particular point in time and is updated periodically. Each month, the number of occurrences of each accident precursor is multiplied by the average consequences per event for that precursor (as estimated by the most recent version of the SRM) to give an estimate of the associated risk to be used in the PIM. The risk from all precursors over the previous 12 months is then summed and normalised per million train miles. The normalised figures are subsequently rebased against the annual average at March 2002. The risk level at the end of March 2002 is taken as the reference level for the PIM and is set at 100.

Train accident risk as measured by the PIM

Chart 111 shows the contribution to train accident risk from each PIM group (based on SRMv6).

Chart 111. Train accident risk by PIM group and person type (SRMv6)

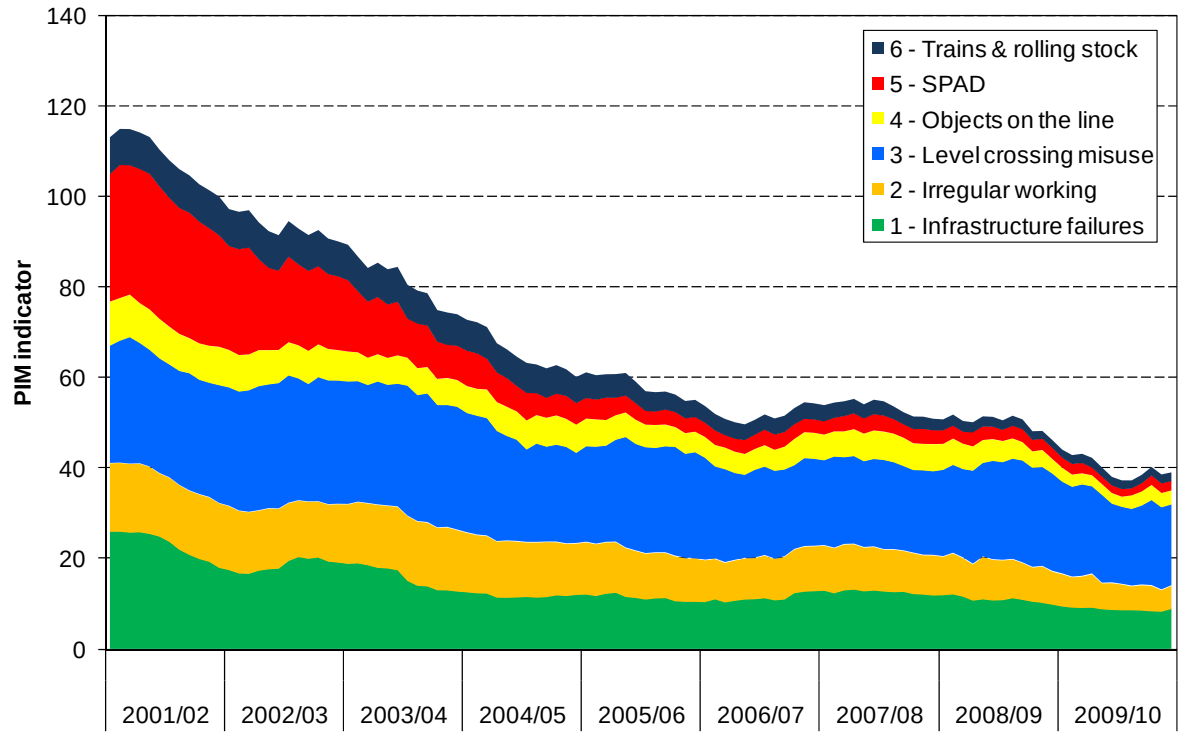


- While level crossing misuse contributes most to overall risk, it has a relatively low impact on passenger and workforce safety.
- The largest contribution to passenger risk comes from infrastructure failures.

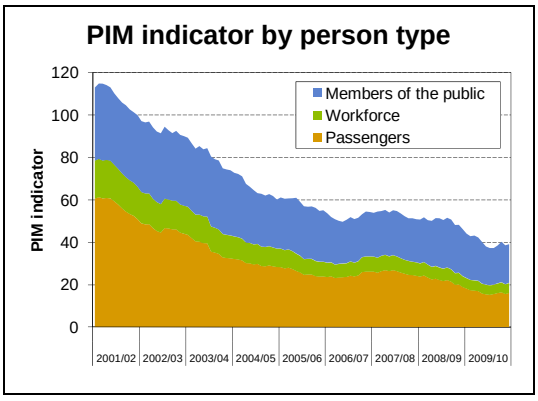
8.7.2 Trends in the PIM indicator

Train accident risk estimates from the SRM will ultimately be used to measure performance against the High Level Output Specification safety metrics (see section 3.2), but the PIM will provide interim information on trends in train accident risk during Control Period 4, which runs from April 2009 to March 2014.

Chart 112. Trends in train accident risk



- There has been an overall reduction in train accident risk as measured by the PIM over the past year.
- The chart shows that a large reduction has occurred in the SPAD group over the past decade; this is largely due to the introduction of TPWS.
- The mini chart shows that the risk to passengers and workforce from train accidents has fallen appreciably since 1999. Much of this results from the reduction in SPAD risk.
- There has been relatively little change in the risk to members of the public from train accidents, which is dominated by the risk from collisions with road vehicles at level crossings. Road user behaviour is the primary cause of such accidents and – being outside the *direct* control of the railway – has proved difficult to reduce.



8.7.3 Trends in the subgroups of the PIM

The PIM precursor groups are used to monitor progress against some of the trajectories set out in the Strategic Safety Plan (see section 3.1).

Table 22. Changes in the PIM indicator by precursor group

	March 2006	March 2007	March 2008	March 2009	March 2010
PIM indicator value	**55.1**	**54.3**	**50.9**	**46.2**	**39.1**
1 - Infrastructure failures	**10.5**	**12.8**	**11.9**	**9.9**	**8.9**
Environmental	1.6	3.0	3.8	2.5	2.5
Level crossing failures	0.3	0.3	0.2	0.2	0.2
Structural failures	1.8	3.5	2.9	1.4	1.0
Track	5.7	5.2	4.0	3.8	3.6
Wrongside signal failures	1.2	0.9	1.0	1.8	1.7
2 - Irregular working	**9.5**	**9.9**	**8.8**	**7.3**	**5.0**
Irregular loading of freight trains	0.0	0.0	0.1	0.2	0.2
IW - affecting level crossing	3.2	3.2	3.2	3.1	1.2
IW - objects foul of the line	0.2	0.2	0.2	0.2	0.0
IW - other	1.9	1.9	1.7	0.8	0.2
IW - other signaller errors	0.3	0.3	0.3	0.2	0.1
IW - routing	0.7	0.7	0.5	0.3	0.3
IW - track issues	1.2	1.2	1.3	1.3	0.2
Runaway trains	1.8	2.2	1.4	1.1	2.5
Train speeding	0.2	0.1	0.2	0.1	0.4
3 - Level crossing misuse	**23.4**	**19.3**	**18.5**	**21.6**	**17.9**
Misuse due to public actions	23.3	19.0	17.3	20.9	17.5
Misuse due to weather	0.1	0.3	1.2	0.6	0.5
4 - Objects on the line	**4.5**	**5.7**	**6.0**	**3.2**	**3.1**
Animals	0.5	0.4	0.3	0.3	0.2
Non-rail vehicles	1.8	2.0	2.0	0.8	0.6
Objects blown onto the line	0.6	2.0	2.1	1.8	2.2
Objects on the line due to vandalism	1.6	1.4	1.7	0.3	0.1
5 - SPAD	**3.3**	**3.0**	**3.1**	**2.5**	**2.1**
Category A SPAD	3.3	3.0	3.1	2.5	2.1
6 - Trains & rolling stock	**3.8**	**3.6**	**2.6**	**1.8**	**1.9**
Brakes	0.3	0.3	0.1	0.0	0.0
Fires due to rolling stock failures	0.8	0.9	0.7	0.6	0.6
Fires due to vandalism	0.6	0.5	0.3	0.2	0.2
Hot axle box	0.2	0.1	0.1	0.0	0.0
Other rolling stock failures	1.9	1.5	1.4	0.7	1.1
Other train fires	0.1	0.1	0.0	0.2	0.1

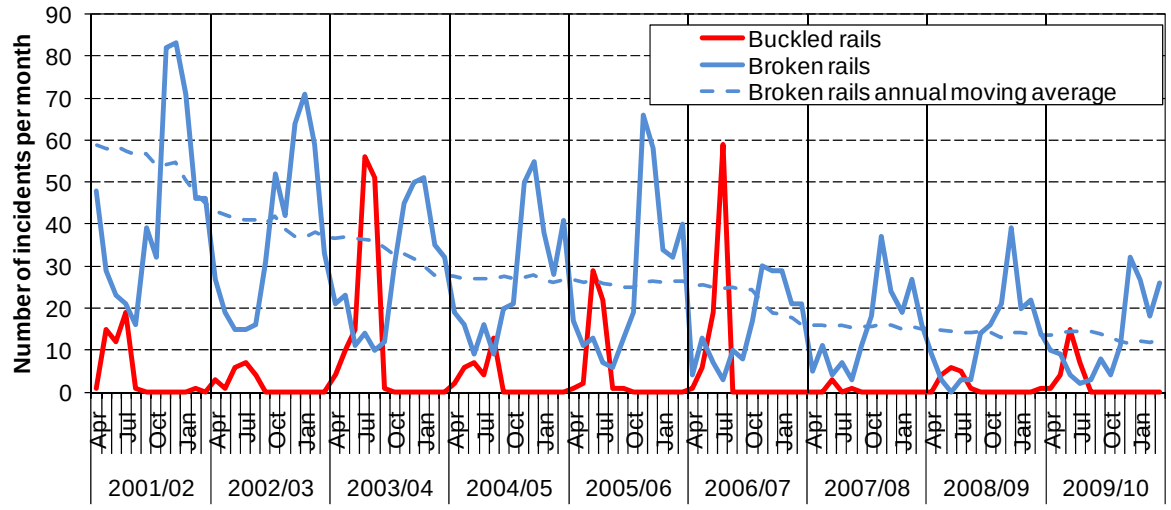
- The overall PIM indicator reduced from 46.2 to 39.1 in 2009/10.
- There were reductions in five of the six PIM groups, the exception being *trains and rolling stock*, which increased slightly, though still remaining well below the levels in earlier years.
- The largest reductions were in *level crossing misuse* and *irregular working*.

Infrastructure failures

The infrastructure failures group of precursors covers track faults, structural failures (such as bridge and tunnel failures), problems due to the environment, and faults with the signalling system and level crossings. Track problems have been associated with two fatal derailments since 2001/02 (Potters Bar and Grayrigg).

The track sub-group of the PIM is informed by three separate measures – broken rails, buckled rails (as shown on Chart 113) and level 2 exceedances (a measure of track faults per mile, shown on the *Precursors* key safety facts table at the end of this chapter).

Chart 113. Trends in track failures



- There has been a significant long-term reduction in the number of broken rails. A step-change occurred after the derailment at Hatfield in October 2000. That accident reinforced rail breaks and track quality as a major safety concern and provoked a nationwide recovery programme to address gauge corner cracking. A taskforce was established to carry out research into metallurgy, wheel–rail interaction, brake and suspension design, and ultrasonic rail flaw detection, and the outputs from this initiative contributed to track quality improvements in subsequent years.[48]
- Rail breaks and track buckles are both highly seasonal. Broken rails are more common during the winter months, and rails are more prone to buckling in high temperatures.

There was one passenger train derailment due to a landslip in 2009/10. On 28 November, a Waterloo–Yeovil Junction service ran through debris at 60mph on the approach to Gillingham Tunnel. The train remained upright and entered the tunnel. Its occupants were safely evacuated with no injuries reported. RAIB is investigating.

RAIB is also investigating a potentially serious bridge failure that occurred during the year. On 14 November, track maintenance staff inspecting a bridge over the river Crane on the London Waterloo–Reading line found that a hole had formed under the track. A section of a brick arch had partially collapsed and ballast had fallen into the river below. The bridge was declared unsafe for the passage of trains and the route remained closed for over a week.

[48] This initiative was also influenced by an investigation into broken rails and Railtrack's management of them that was published in November 2000, one month after the accident, having been commissioned by the Health and Safety Executive and the (then) Rail Regulator in the August of that year.

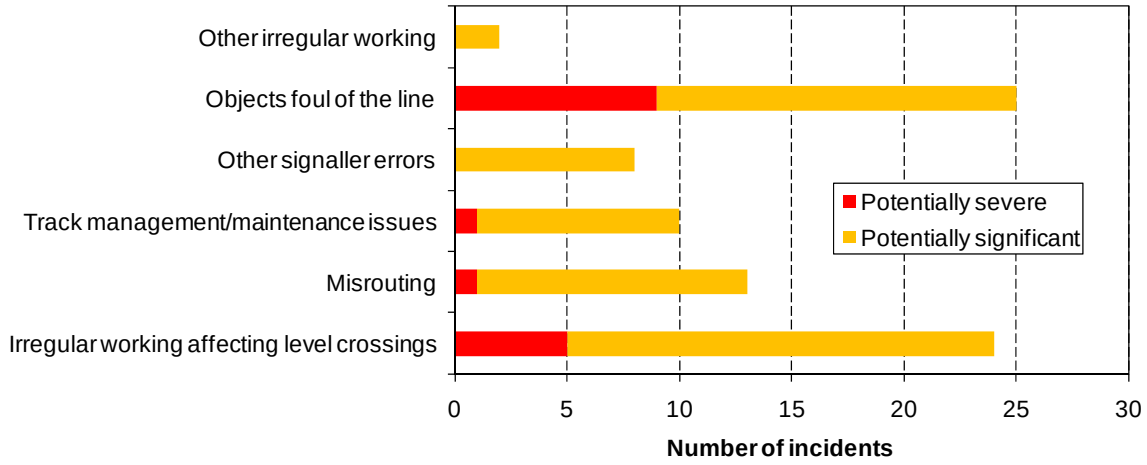
Irregular working

The irregular working precursors cover a wide range of accident causes stemming from workforce error. The PIM incorporates data on runaways, train speeding, incorrect loading of freight, and the diverse set of incidents that is recorded under the SMIS *irregular working* component. Many of the events recorded under this component have no direct causal link to train accidents; for example, irregular working in possessions will most often endanger track workers, but could lead to a derailment if, for example, the track was left in a poor condition. In 2009/10, 6,536 of these irregular working incidents were recorded in SMIS, around 40% of which were relevant to train accident risk.

Network Rail has developed a risk ranking tool to help identify the more serious incidents (that is, those with the greatest potential to lead to injuries). After an initial sift to remove those that carry no risk, the remaining events are risk ranked into one of four categories: negligible risk, low risk, potentially significant or potentially severe. Following trials, regular risk ranking began in April 2008.

In 2009/10, 82 reports of irregular working relevant to train accident risk were ranked as being potentially significant or potentially severe.

Chart 114. Irregular working incidents relevant to train accident risk in 2009/10

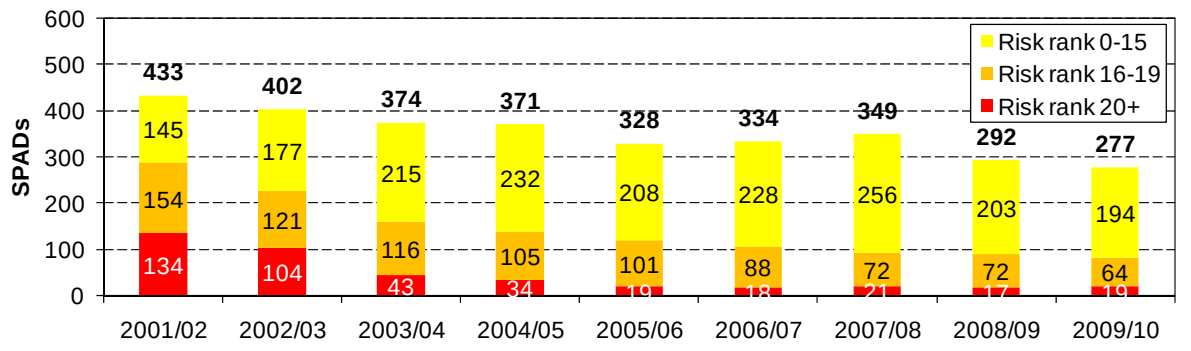


- *Objects foul of the line* accounted for most of the potentially severe events in 2009/10. One incident in this category – a passenger train collision with a length of rail being dragged by a road-rail machine – is subject to a RAIB investigation. Other examples include trains running over incorrectly positioned possession marker boards and detonators and striking vehicles left foul of the line by railway employees.
- The next largest category (in terms of potentially severe and potentially significant events) was *irregular working affecting level crossings*. Examples include users being incorrectly authorised to traverse the crossing or being trapped between crossing barriers, and trains being allowed to pass over crossings that are open to road traffic.
- *Misrouting* accounts for nearly 90% of all train accident-related irregular working incidents, but the great majority are judged to be of negligible risk because the system is designed to fail safe. Examples of misrouting incidents that are categorised as potentially severe or potentially significant include routing trains through worksites, routing trains into occupied platforms, and routing a train into an occupied track section (in the belief that the track circuit had failed).

SPADs

Historically, train accidents resulting from category A SPADs have resulted in high numbers of fatalities and injuries. The last fatal accident from this cause occurred at Ladbroke Grove in 1999; there were 31 fatalities. The industry subsequently focused much effort on reducing the risk from SPADs. An important strand of work was the TPWS fitment programme, which was completed at the end of 2003. This was supplemented by a wide range of other initiatives aimed at improving driver performance and addressing signalling issues.

Chart 115. Trend in the number of SPADs by risk ranking score[49]



- There were 277 SPADs in the year to the end of March, compared to 292 for the corresponding period one year ago. This is the lowest total for a financial year since the systematic recording of SPADs began in 1985.
- There has been a significant reduction in the number of SPADs with a high risk ranking, especially since the introduction of TPWS in 2003/04.

The cold winter of 2009/10 contributed to two incidents that RAIB is investigating:

- On 22 December, a freight train passed two successive signals at danger, at either end of Carstairs station. The actions of the signaller, in operating points to divert the freight train, averted a potential collision with a passenger train.
- On 4 January, a freight train passed AC336 signal at danger at Carrbridge and was derailed on trap points at the north end of the station. The locomotive came to rest down the embankment, with other vehicles fouling the main line.

In both cases, the train's braking performance had been compromised by freezing conditions. On 4 January, Network Rail issued a Communication of Urgent Operating Advice relating to the requirement to carry out frequent brake tests during extreme cold weather.

Two further accidents occurred after passenger train SPADs during the year: a collision at Darlington on 3 October (due to poor adhesion), and a derailment over points at Dingwall on 21 January (after passing a points set indicator that was not illuminated).[50]

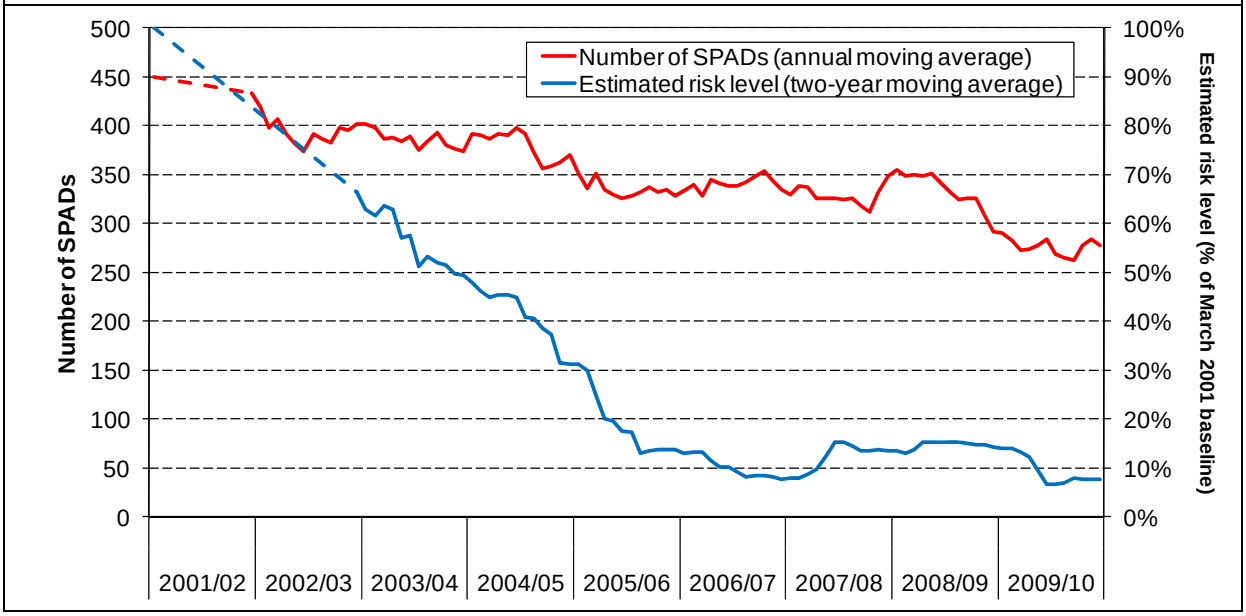
[49] Each SPAD is assessed using the industry's SPAD risk ranking tool and assigned a score of between 0 (very low risk) and 28 (very high risk). An increase of one point corresponds to a doubling of risk. The score reflects the accident potential of each SPAD (for example, how close it came to the potential conflict point) and the potential consequences of the accident if it had occurred (in the case of a collision, this takes into account speed, crashworthiness and passenger loadings).

[50] None of the four incidents described was prevented by TPWS. In three incidents, brake performance was a causal factor and TPWS had no effect in addition to the braking that was already being applied by the driver. In the fourth incident, TPWS was not fitted: it is not routinely fitted at points set indicators because SPADs at these locations will generally be relatively low risk.

SPAD risk

RSSB uses results from the SPAD risk ranking process to assess trends in SPAD risk.

Chart 116. Trend in SPADs and SPAD risk

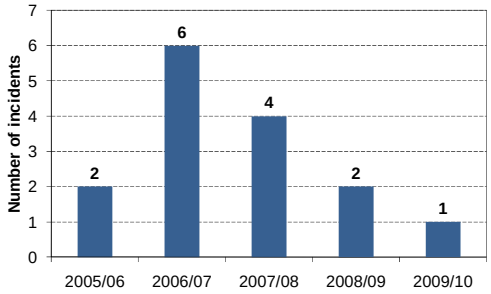


- At the end of the year, the estimated level of SPAD risk was more than 90% lower than it was in March 2001.
- The estimated level of risk fell during the year. This was largely a consequence of two SPADs with a risk ranking score of 26 leaving the two-year average.
- RSSB is developing a new method for estimating SPAD risk, which will be presented to the industry at the *National Operational Risk Conference* in July 2010. Future performance reports will feature risk estimates based on both the new and the existing method. The new method will provide a more stable estimate of underlying risk; the existing method reflects the risk rankings of the SPADs that have occurred.

Since TPWS was introduced, there have been a number of events where the driver has reset the TPWS and continued forward without the signaller's authority. Such events are potentially serious because they negate the safety benefits of TPWS.

- The mini chart shows instances of reset and continue events following a category A SPAD.
- The industry has focussed considerable effort on reducing the risk from TPWS reset and continue in recent years, and the number of events has fallen.
- There was one TPWS 'reset & continue' incident in 2009/10, after a train passed a platform starting signal at danger at Ilford on 30 December. It was the first such incident since October 2008.

TPWS reset and continue after a SPAD



Level crossing misuse

Most of the risk from train accidents at level crossings affects road users whose vehicles are involved in collisions with trains. SRMv6 indicates that more than 90% of the train accident risk at level crossings occurs from the behaviour of the public (rather than workforce errors or equipment failures).

The PIM measure of level crossing misuse fell during 2009/10 due to a reduction in the number of reported near misses between trains and road vehicles. See Chapter 9, *Risk at the road-rail interface*, for more information.

Objects on the line

The main types of event covered by this PIM group are animals on the line, obstructions due to the weather (such as trees that have been blown onto the line) and non-rail vehicles (for example, following a road vehicle incursion). Most of the risk from striking objects on the line is attributable to any subsequent train derailment.

The PIM measure of risk associated with objects on the line was broadly static over 2009/10. The largest contribution to risk comes from objects blown onto the line.

It was noted in Section 8.6 that *striking animals* is one of the few categories of train accident that have seen no sustained reduction over recent years. A noteworthy incident occurred on 15 June 2009, when a passenger needed treatment for bruising and the driver reported shock after a train ran into a herd of cows near Stewarton, killing seven of them. Train occupants are rarely injured when animals are struck. However, in 1984, a collision with a stray cow on the line at Polmont resulted in 13 passenger fatalities.

Trains and rolling stock

Trains and rolling stock defects contribute the smallest amount of train accident risk out of the six groups. Nevertheless, they have the potential to cause serious accidents. For example, the derailment at Viareggio discussed in section 8.5.5 was caused by a failed axle.

Rolling stock failure was a causal factor in two passenger train derailments in 2009/10:

- On 11 June a Class 142 DMU derailed near Olive Mount Junction after running over part of its own engine, which had become detached.
- On 20 February, a seven car Class 222 ‘Meridian’ diesel-electric multiple unit derailed at East Langton. A drive shaft failed, leading to an axle failure and the subsequent collapse of a gear box and disintegration of a wheel. The incident caused major damage to the infrastructure and showered road vehicles with ballast.

The last fatality from a rolling stock defect in Great Britain occurred at Rickerscote in 1996. A freight train derailed because an axle fitted to one of its wagons completely fractured. Its wagons blocked the adjacent line; they were struck by a Post Office train running in the opposite direction. A Royal Mail employee was killed.

The PIM measure of risk associated with trains and rolling stock rose slightly in 2009/10, although it remains low by historical standards.

8.8 Train accident key safety facts[51]

Train accidents	2005/06	2006/07	2007/08	2008/09	2009/10
Fatalities (excluding suicides)	**3**	**5**	**0**	**2**	**7**
Passengers	0	1	0	0	0
Workforce	0	0	0	0	0
Members of the public	3	4	0	2	7
Weighted injuries (excluding sucides)	**0.88**	**4.21**	**0.97**	**0.57**	**1.17**
Passengers	0.38	3.28	0.12	0.03	0.40
Workforce	0.50	0.82	0.63	0.33	0.57
Members of the public	0.00	0.10	0.21	0.21	0.20
Total train accidents	**799**	**825**	**783**	**697**	**582**
PHRTAs	**46**	**45**	**44**	**48**	**42**
Involving passenger trains	23	23	20	30	26
Collisions between trains	2	1	4	6	4
Derailments	6	10	3	3	8
Collisions with road vehicles (not at LC)	1	2	5	0	2
Collisions with road vehicles (at LC)	13	9	7	18	12
Striking buffer stops	1	1	1	3	0
Not involving passenger trains	23	22	24	18	16
Collisions between trains	2	1	1	0	0
Derailments	18	16	18	12	12
Collisions with road vehicles (not at LC)	0	1	3	2	2
Collisions with road vehicles (at LC)	3	4	1	3	2
Striking buffer stops	0	0	1	1	0
Non-PHRTA train accidents	**753**	**780**	**739**	**649**	**540**
Involving passenger trains	621	666	621	552	476
Open door collisions	1	2	3	3	1
Roll back collisions	6	4	3	2	4
Striking animals	120	126	112	116	144
Struck by missiles	208	221	225	198	142
Train fires	127	137	87	75	72
Striking level crossing gates/barriers	2	3	4	6	2
Striking other objects	157	173	187	152	111
Not involving passenger trains	132	114	118	97	64
Open door collisions	0	0	0	0	1
Roll back collisions	0	0	0	0	0
Striking animals	20	13	14	12	16
Struck by missiles	66	63	60	46	22
Train fires	16	10	9	11	3
Striking level crossing gates/barriers	2	1	4	2	5
Striking other objects	28	27	31	26	17
PIM index (at year end)	**55.1**	**54.3**	**50.9**	**46.2**	**39.1**
Infrastructure failures	10.5	12.8	11.9	9.9	8.9
Irregular working	9.5	9.9	8.8	7.3	5.0
Level crossing misuse	23.4	19.3	18.5	21.6	17.9
Objects on the line	4.5	5.7	6.0	3.2	3.1
Signals passed at danger	3.3	3.0	3.1	2.5	2.1
Trains and rolling stock	3.8	3.6	2.6	1.8	1.9

[51] The category *collisions with road vehicles (not at LC)* excludes accidents that result in a derailment; these incidents are included in the *derailments* category.

Precursors	2005/06	2006/07	2007/08	2008/09	2009/10
Infrastructure failures					
Environment: adhesion	193	93	80	137	102
Environment: flooding	42	62	138	108	105
Environment: landslips	15	27	37	31	34
Level crossing failures	2607	2636	2376	2238	2016
Other structural failures	46	80	74	66	51
Track: broken rails	316	192	182	164	154
Track: buckled rails	56	85	4	17	27
Track: level 2 exceedences per mile	0.91	0.80	0.81	0.68	0.72
Wrongside signalling failures	720	589	589	845	811
Irregular working					
Runaway trains	11	13	7	4	9
Train speeding	107	73	113	74	212
Objects foul of the line	-	-	-	113	114
Track management/maintenance issues	-	-	-	142	103
Irregular working affecting level crossings	-	-	-	46	57
Misrouting	-	-	-	2491	2150
Other signaller errors	-	-	-	29	19
Level crossing incidents					
Near misses with road vehicles	189	154	144	170	150
Objects on the line					
Trains striking objects blown onto the line	82	278	237	207	213
Trains striking objects due to vandalism	82	71	46	37	26
Animals on the line (including train strikes)	2721	2390	1923	1857	1300
Road vehicle incursions	66	77	87	66	51
Category A SPADs					
Total number of cat A SPADs	328	334	349	292	277
Risk ranked 20+	19	18	21	17	19
Risk ranked 16+	120	106	93	89	83
Trains and rolling stock					
Brakes	44	49	13	8	5
Hot axle boxes	1101	888	636	730	664
Fires due to rolling stock failures	66	73	58	46	47
Fires due to vandalism	72	65	35	30	21
Other rolling stock failures	114	88	68	30	35
Other train fires	5	10	3	11	5
Dangerous goods incidents					
All incidents involving dangerous goods trains	139	128	164	166	170

9 Risk at the road-rail interface

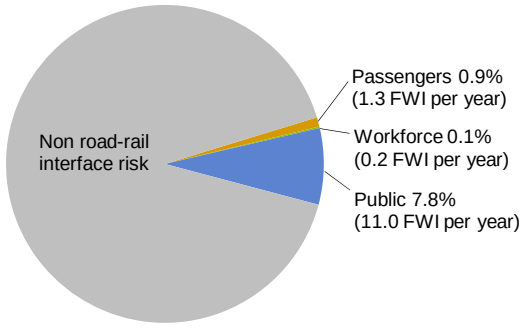
This chapter covers the risk related to level crossings, vehicle incursions onto the railway and bridge strikes. Much of the risk at the road-rail interface is caused by road user behaviour, and most casualties are road vehicle occupants and pedestrians. Network Rail's *Don't run the risk* campaign, which has been running since 2006, is part of a long-term effort to change the attitude and behaviour of level crossing users.

2009/10 Headlines

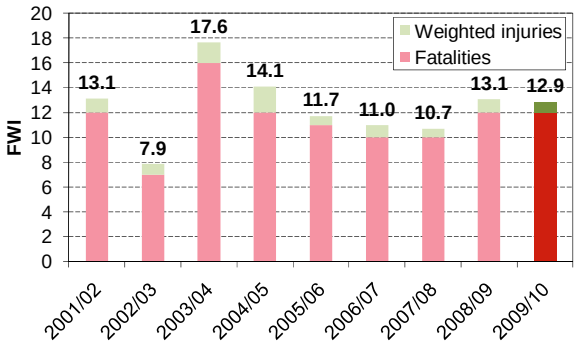
- Excluding suicides, five road vehicle occupants and seven pedestrians/cyclists died in accidents at level crossings in 2009/10. There were seven major injuries and 52 reported minor injuries or cases of shock/trauma. This equated to a total FWI of 12.9, which is broadly similar to the previous year.
- There were 14 collisions between trains and road vehicles at level crossings during the year. This is fewer than the previous year, but broadly in line with the average of around 16 accidents per year since 2001/02.
- Most accidents are caused by user behaviour – misjudgements, errors and wilful misuse. However, the fatal collision at Moreton-on-Lugg in January 2010 occurred when the barriers were raised to road traffic.
- There was a fall in the number of near misses with road vehicles at level crossings.[52] The number of reported near misses with pedestrians and cyclists also fell compared with 2008/09, but remains higher than earlier years.
- Overall, the number of road vehicle incursions onto the railway was fewer than last year. There were five collisions between trains and road vehicles away from level crossings, one of which caused a derailment.
- Two members of the public died as a result of a deliberate vehicle incursion when a quad bike they were riding along the track was struck by a train.
- There was a reduction in the number of bridge strikes at rail over road bridges.

Road-rail interface safety at a glance

Road-rail interface risk in context (SRMv6)



Trends in level crossing safety



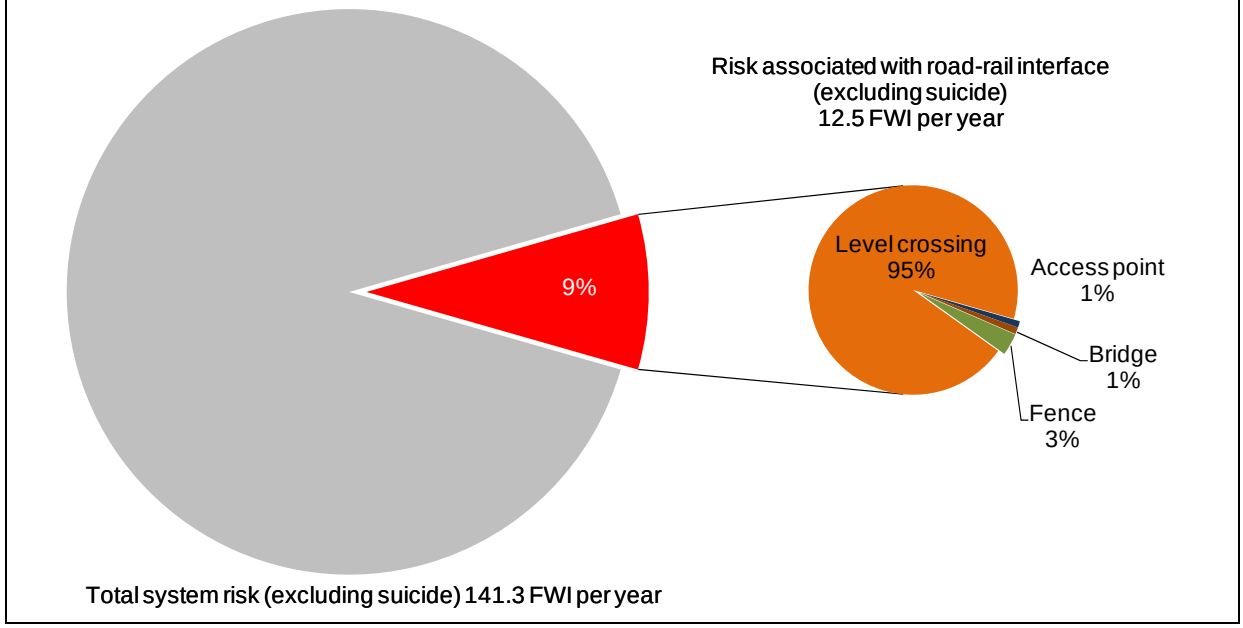
[52] The term *road vehicle* is used in this report to describe a range of vehicles, including farm machinery and off-road vehicles such as quad bikes (but not pedal cyclists, who are grouped with *pedestrians*).

9.1 Risk at the road-rail interface

SRMv6 estimates the overall risk at the road-rail interface to be 12.5 FWI per year[53], which is 9% of the total risk (excluding suicide).

Most of this (11.0 FWI per year) affects members of the public, predominantly level crossing users. The risk to passengers is 1.3 FWI per year, but 0.9 FWI per year of this is to pedestrians on station foot crossings.[54] The risk to train occupants from collisions with vehicles and from bridge strikes amounts to around 0.6 FWI per year.

Chart 117. Risk at road-rail interface by site type (SRMv6)



- Most road-rail interface risk (around 95%) occurs at level crossings. Level crossings are an open interface with the rail, so there is a greater opportunity for misuse to occur.
- Most of the remaining risk (3%) arises from incursions via fences.
- Bridge strikes account for just over 0.1 FWI (around 1% of the risk at the road-rail interface). This includes the risk from rail-over-road bridges becoming displaced or collapsing as a result of a bridge strike, and from debris or road vehicles on the line under road-over-rail bridges.

A considerable amount of research has been undertaken on road-rail interface safety, covering station and footpath crossings, as well as road crossings. This is summarised in *A guide to RSSB research in Road-Rail Interface Safety*, published in October 2009. A more detailed analysis of safety at the road-rail interface, along with information on industry initiatives and collaborations, can be found in the *Road-Rail Interface Special Topic Report*, published in April 2010. Both publications are available from the RSSB website.

[53] In the case of vehicle incursions, this estimate excludes injuries sustained by road vehicle occupants as a result of any initial crash onto the railway, but includes injuries sustained if their vehicle is subsequently struck by a train.
[54] People on station level crossings are classified as passengers if they are in the station in connection with a rail journey they are making.

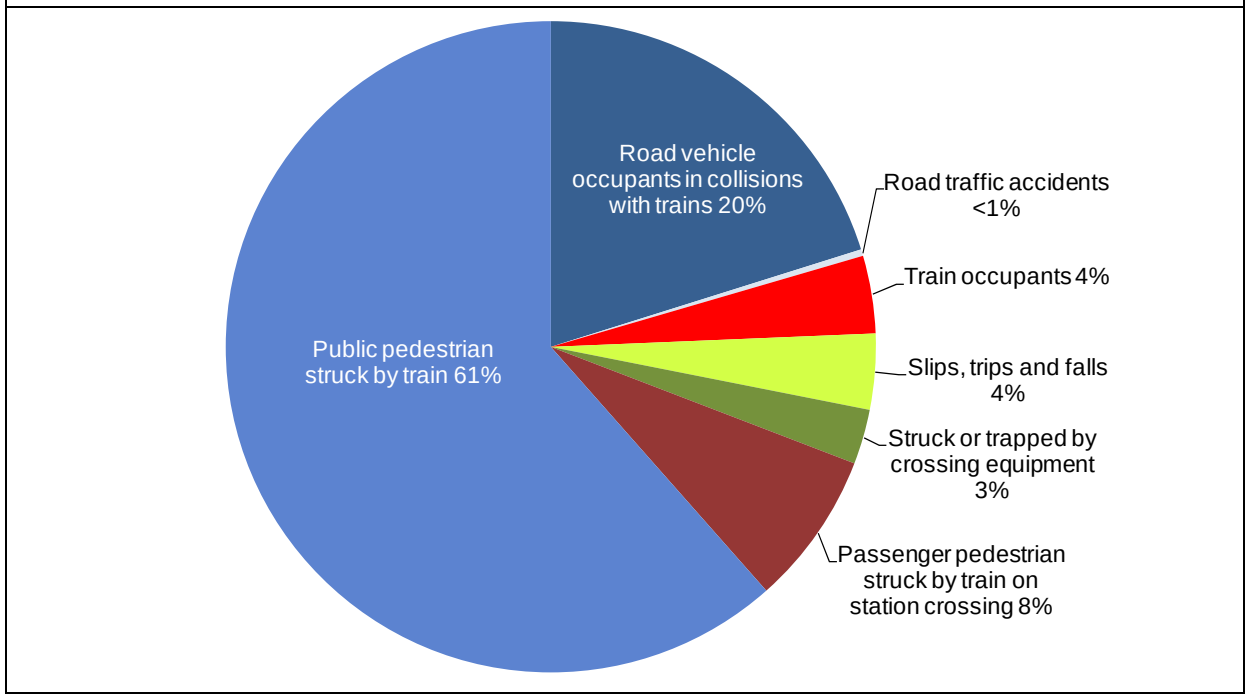
9.2 Risk at level crossings

9.2.1 Level crossing risk by cause and user type

SRMv6 estimates the risk at level crossings to be 11.8 FWI per year.

If injuries to road vehicle occupants are included, collisions at level crossings are the largest single cause of train accident risk (see Chapter 8, *Risk from Train Accidents*). However, level crossing safety in the UK compares favourably with that in other European countries. The UK has the lowest National Reference Value (NRV) for level crossing safety of all EU member states. The NRV measures fatalities and weighted serious injuries at level crossings per billion train kilometres, and was based on four years' performance data. See section 3.3 for more information about NRVs.

Chart 118. Level crossing risk by event and user type, from SRMv6 (11.8 FWI/year)



- Most of the risk at level crossings is to pedestrians.
- Most pedestrian risk involves members of the public being struck by a train (61%) followed by passengers being struck on station crossings (8%).
- Approximately 4% of the risk at level crossings is to passengers and members of the workforce on board the train.
- Slips, trips and falls on level crossings and accidents in which people are struck by level crossing equipment account for around 7% of the risk.

9.2.2 Types of crossing

Different types of level crossings offer different protection to users. There are two broad groups:

- **Active crossings** – where the road vehicle or pedestrian is warned of the approach of a train through closure of gates or barriers and/or by warning lights and/or alarms.
- **Passive crossings** – where no warning of a train's approach is given other than by the train driver who may use the train horn. The onus is on the road user or pedestrian to determine whether or not it is safe to cross the line. Instructions for proper use must be provided at each location, along with other appropriate signage.

Table 23. Level crossing categories by class and type

Crossing type				Number
Passive		UWC-T	User-worked crossing with telephone	1667
		UWC	User-worked crossing	883
		OC	Open crossing	55
		FP	Footpath crossing	2462
Active	Manual	MCG	Manually controlled gate	183
		MCB	Manually controlled barrier	234
		MCB-CCTV	MCB monitored by closed-circuit television	391
	Automatic	AHB	Automatic half-barrier	453
		ABCL	Automatic barrier locally monitored	52
		AOCL/R	Automatic open crossing locally or remotely monitored	116
		UWC-MWL	User-worked crossing with miniature warning lights	96

- Generally, automatic barrier and manually controlled crossings (including those monitored by CCTV) are installed on public roads with high levels of traffic.
- Automatic half barrier crossings, which cause less disruption to road traffic for each train traverse, also tend to be heavily used and have a relatively high average risk per crossing. Automatic open crossings, which have lights but no barriers, also have a relatively high average risk from collisions with road vehicles.
- Passive crossings for road vehicles are generally used in rural areas. These crossings tend to be either on private roads, for example to provide access between a farm and fields, or on roads that provide access to a farm, which can be used by invitees (for example, people making deliveries). In general, user worked crossings tend to be comparatively high risk relative to the volume of traffic passing over them.
- Crossings that are not designed for vehicles are grouped under the single category of *footpath crossings* for the purposes of this report because detailed information about them is not well captured in incident reports. Around 5% have automatic protection in the form of miniature warning or stop lights, and the category also includes bridleway crossings and barrow crossings.

Further information on the level crossing population of Great Britain, along with an illustrated guide to the different level crossing types, may be found in Appendix 4.

Data source: Network Rail level crossing census (as at 31 December 2009). The table shows open active level crossings. Level crossings that have been temporarily closed, are no longer used, or are on mothballed lines have been omitted.

9.2.3 Fatalities and injuries in 2009/10

Fatalities

Excluding suicides and suspected suicides, five road vehicle occupants and seven pedestrians/cyclists died as a result of accidents at level crossings during the year. These included a two-year-old boy. Details of the incidents are shown in Table 24 and Table 25.

Table 24. Pedestrian and cyclist fatalities at level crossings in 2009/10

Date	Location	Territory	LC type	Description
02/04/2009	Peth Lane	London North Eastern	UWC-T	A pedestrian was struck on the footpath crossing. The 17-year-old male was using the crossing whilst listening to an MP3 player
03/04/2009	Eyton	Western	AHB	A cyclist was struck on the level crossing whilst attempting to zig-zag around the lowered barriers.
06/05/2009	Fairfield	Western	footpath	A woman walking two dogs was struck by a train at the level crossing.
23/05/2009	Trowbridge	Western	UWC-T	A member of the public was struck by a train at the level crossing.
07/09/2009	Fox Covert	London North Eastern	footpath	A two-year-old boy was struck by a passenger train on the footpath level crossing. The driver stated that the child had run onto the crossing as the train approached. The driver applied an emergency brake, but could not avoid the impact
02/11/2009	Attenborough Nature Reserve	London North Eastern	footpath	A pedestrian was struck and fatally wounded on the level crossing.
26/01/2010	Ufton	Western	AHB	A pedestrian was struck on the level crossing.

Injuries

There were seven major injuries to level crossing users during 2009/10.

- Three pedestrians were struck by trains, in one case after slipping on the crossing.
- Two road vehicle occupants received major injuries in collisions with trains on level crossings (see Table 25).
- An eighty-year-old came off his cycle on a level crossing and suffered a broken leg and head injuries.
- A sixteen-year-old hiker slipped on the timbers at a level crossing while taking a photograph (she had set the self-timer and was hurrying to get in the picture). She came into contact with the third rail and sustained burns to her back.

There were 32 reported minor injuries (from collisions with road vehicles, slips, trips and falls on crossings and accidents involving the level crossing equipment). In addition, there were 20 reported cases of shock or trauma, predominantly to train drivers involved in accidents.

A potentially serious incident occurred on Victory AHB crossing on 19 December, when a crossing user's wheelchair became stuck in a pothole. The person managed to get out of the wheelchair and clear of the line before the chair was struck and destroyed by a train. RAIB is investigating.

In another incident, a person in a wheelchair fell backwards on a station barrow crossing, having started to cross after the member of staff assisting him had asked him to wait. The member of staff (who could not lift the chair) contacted the signaller to ensure the line was blocked, and the wheelchair was righted with the assistance of other passengers.

9.2.4 Collisions between trains and road vehicles in 2009/10

There were fourteen collisions between trains and road vehicles at level crossings during the year, resulting in five fatalities to road vehicle occupants (three of which occurred in one incident). Collisions resulting in non-suicide fatalities are shown in red. Unless otherwise stated, the crossing was working correctly at the time of the accident.

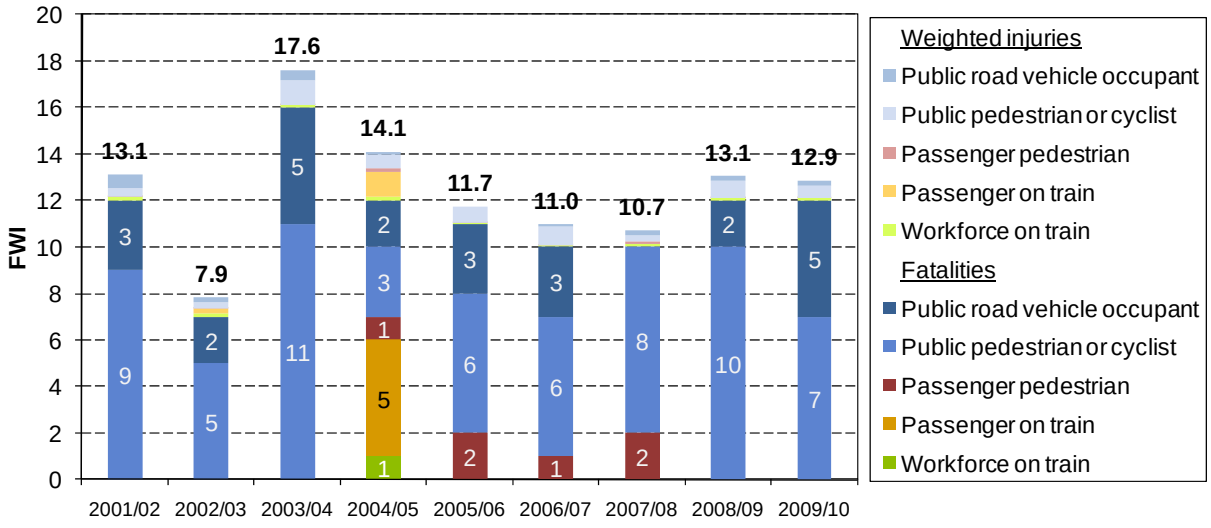
Table 25. Collisions between trains and road vehicles at level crossings in 2009/10

Date	Location	Territory	Type	Description
14/05/2009	Fairbourne	Western	AOCL	A passenger train struck a car that had jumped the lights at the crossing. (See also the event on 27 June, below).
06/06/2009	Welland Bank	London North Eastern	UWC-T	A passenger train travelling at low speed (5mph) clipped an abandoned car at the level crossing.
27/06/2009	Fairbourne	Western	AOCL	A passenger train struck a car and pushed it onto the station platform. The car driver was airlifted to hospital and the train driver was badly shaken, having been involved in a similar incident at the same crossing whilst working the same service on 14 May 2009.
07/08/2009	Helmsdale	Scotland	AOCL	A passenger train struck the rear of a dustcart. Its driver did not see the traffic lights change, having parked very close to them to load a bin, and did not hear the alarm because of the noise from his vehicle.
13/08/2009	Norton-on-Tees South	London North Eastern	UWC	A freight train struck a car at a level crossing. The car driver suffered shock.
02/09/2009	Penrhyndeudraeth	Western	UWC-T	A light locomotive struck a road vehicle on the crossing. The driver of the car - a regular user of the crossing - was fatally injured. The crossing telephone had not been used and the train was an unscheduled service.
04/09/2009	New Barn Crossing	South East	UWC	A passenger train struck a tractor. The tractor driver, who had pulled onto the crossing without looking, saw the train and started to reverse but was struck a glancing blow. The train driver suffered shock and a minor whiplash injury.
29/09/2009	Halkirk	Scotland	AOCL	A passenger train struck a car at the level crossing. All three vehicle occupants received fatal injuries. RAIB is investigating the accident.
23/11/2009	Waterbeach	South East	UWC	A passenger train struck a tractor a glancing blow. The tractor driver had driven onto the crossing as the train approached and was unable to reverse off in time.
10/12/2009	Tunstead Market St	South East	AHB	A passenger train struck a car at the level crossing after the car had zig-zagged around the barrier. The car came to rest in a nearby field, with the driver suffering severe leg injuries.
05/01/2010	Hagg Lane	London North Eastern	AHB	A passenger train struck a road vehicle, which had difficulty braking in snowy conditions. The driver of the train observed the car on the crossing and was able to reduce the speed to around 10mph on impact.
09/01/2010	Hoy	Scotland	AOCL	A transit van struck the side of a passenger train on the crossing. The road vehicle occupant suffered minor injuries and two workforce members suffered from shock.
16/01/2010	Moreton-on-Lugg	Western	MCB	A passenger train struck two cars on the level crossing. One road vehicle occupant was fatally injured and another sustained major injuries. The barriers were raised as the train approached the crossing and initial indications are that workforce error contributed to the accident. RAIB is investigating the accident.
06/03/2010	Waterloo (Wokingham)	South East	AHB	A passenger train struck a road vehicle at the level crossing. The road vehicle occupant was fatally injured and is currently recorded a suspected suicide.

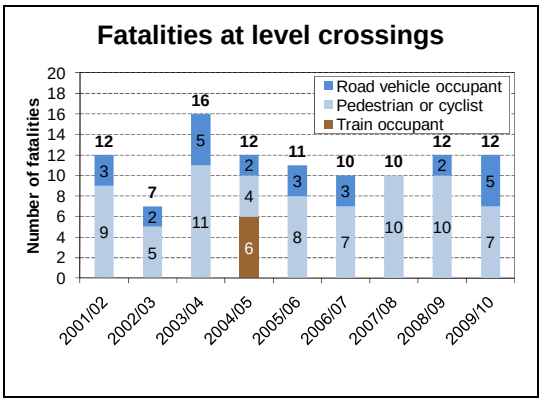
9.2.5 Trends in harm at level crossings

Most of the harm at level crossings arises from pedestrians, cyclists and road vehicles being struck by trains. Some people are also injured each year as a result of being hit by or colliding with crossing barriers, and from slips, trips and falls.

Chart 119. Harm at level crossings (excluding suicides)



- The total level of harm at level crossings in 2009/10 was similar to both the level seen the previous year and to the average over the period shown in the chart.
- The nine years to March 2010 have seen 102 fatalities on level crossings, excluding suicides. This figure comprises 71 pedestrians (including six passengers), 25 road vehicle occupants and the six train occupants who died in the collision at Ufton in 2004.
- At five, the number of road vehicle occupants killed at level crossings in 2009/10 was higher than average. However, three of the fatalities occurred in a single accident, at Halkirk.[55]



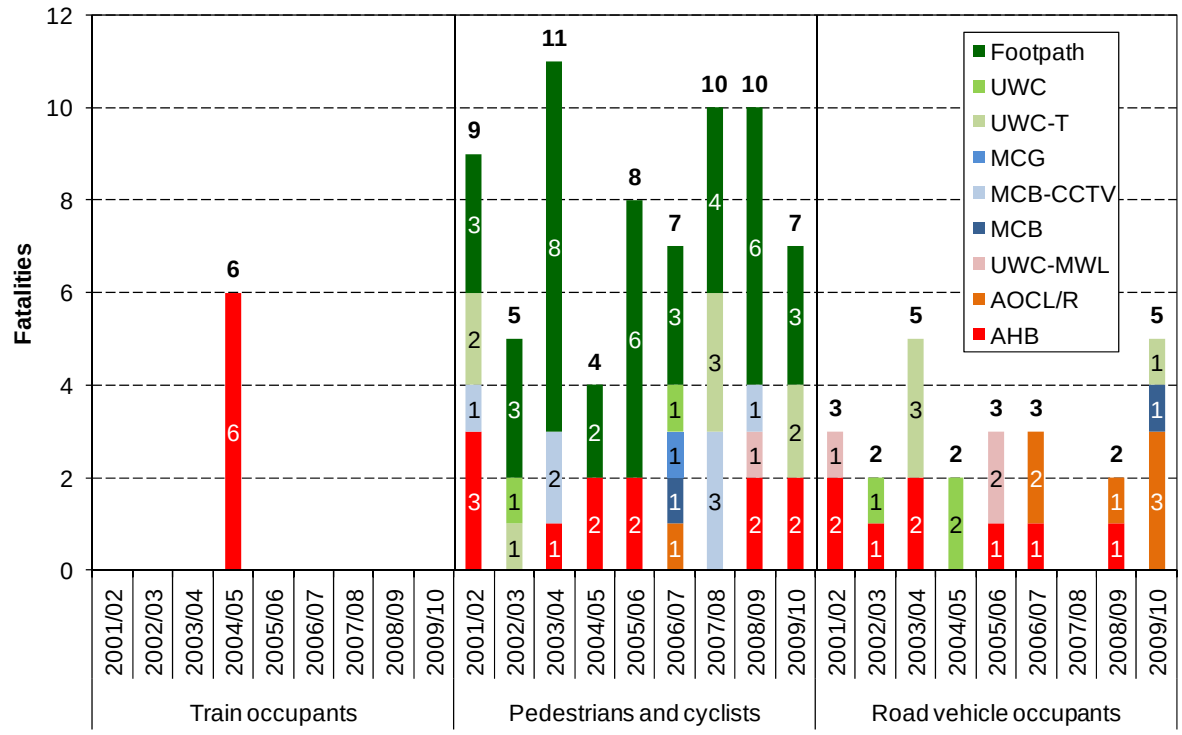
- There is no clear overall trend in the harm at level crossings. Network Rail's *Don't run the risk* campaign aims to reduce the risk at level crossings by effecting a change in people's attitude and behaviour. Campaigns like this, which aim for a cultural shift, tend to have long build times so their effectiveness is most likely to be seen over the long term.

[55] There have been six other accidents since 2001/02 that resulted in multiple fatalities to level crossing users. Three people died in a collision between a train and a minibus at Pools level crossing in July 2003. In each of the other cases (two of which involved road vehicles, and three pedestrians), two people were killed.

9.2.6 Trends in fatalities at level crossings

The last level crossing accident resulting in train occupant fatalities occurred at Ufton in 2004, when a passenger train derailed after striking a car that had been parked on the crossing. In addition to the car driver, who was intending to commit suicide, the driver of the train and five passengers were killed. Prior to this, the last level crossing accidents to result in fatalities to passengers on the train were at Lockington (1986) and Hixon (1968).

Chart 120. Fatalities at level crossings by crossing type (excluding suicides)



- Three of the last four years have seen road vehicle occupant fatalities at automatic open crossings.
- The fatality at the manually controlled barrier crossing at Moreton-on-Lugg was the first road vehicle occupant fatality at a manually controlled crossing for more than a decade.
- Since 2001/02, more than half of pedestrian fatalities have occurred at footpath crossings.

Since April 2001, 10% of railway suicides have taken place at level crossings.

Table 26. Number of suicides and suspected suicides at level crossings

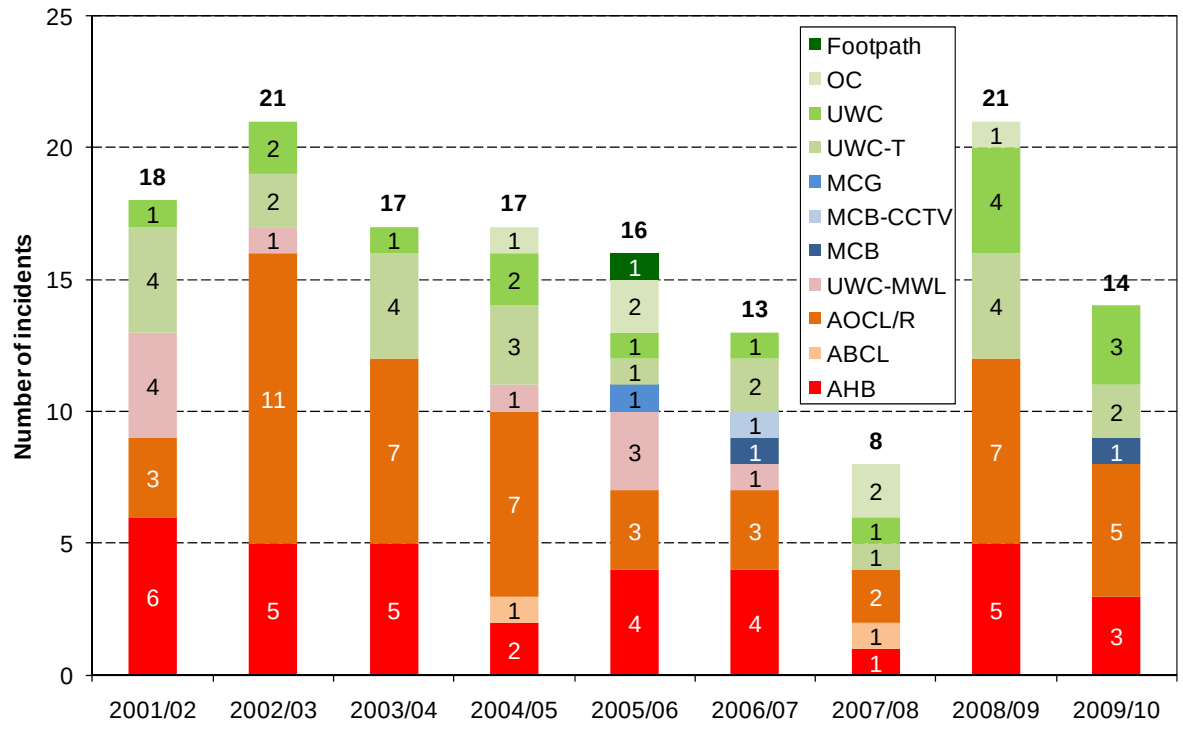
2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
13	17	18	20	27	22	20	22	34

- The number of suicides recorded at level crossings increased in 2009/10. There was a general increase in the number of railway suicides (see section7.6).
- One suspected suicide in 2009/10 was a road vehicle occupant.

9.2.7 Collisions between trains and road vehicles

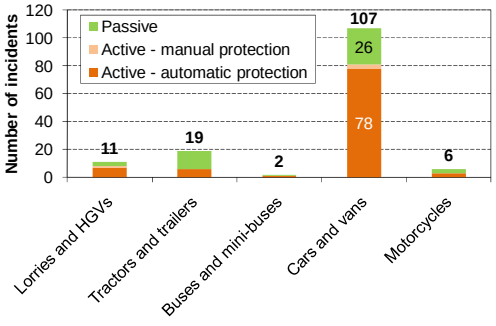
Historically, most collisions have occurred on AHBs, AOCLs and UWCs. The proportion of collisions that result in a fatality varies by crossing type, reflecting factors such as differences in train speed. For example, many AHBs are situated on faster lines and, as a result, collisions with road vehicles are more likely to result in fatalities to road vehicle occupants.

Chart 121. Collisions between trains and road vehicles by crossing type



- In terms of the crossing types involved, the incidents in 2009/10 were fairly typical of other recent years. The exception is the accident at Moreton-on-Lugg. Collisions at manually protected crossings are rare and this accident had very little in common with other collisions at manually protected crossings in recent years.[56]
- Since 2001/02, around one-third of collisions have taken place at automatic open crossings. Because RAIB perceives this to be a high number of incidents in relation to the crossing population, its investigation into the fatal collision at Halkirk is reviewing the more general risk from this type of crossing as well as the specifics of that accident.
- Cars and vans are involved in most collisions at level crossings. The risk to train occupants is greater if a large vehicle, such as a lorry or farm vehicle, is involved.

Road vehicles involved in collisions at level crossings (2001/02–2009/10)



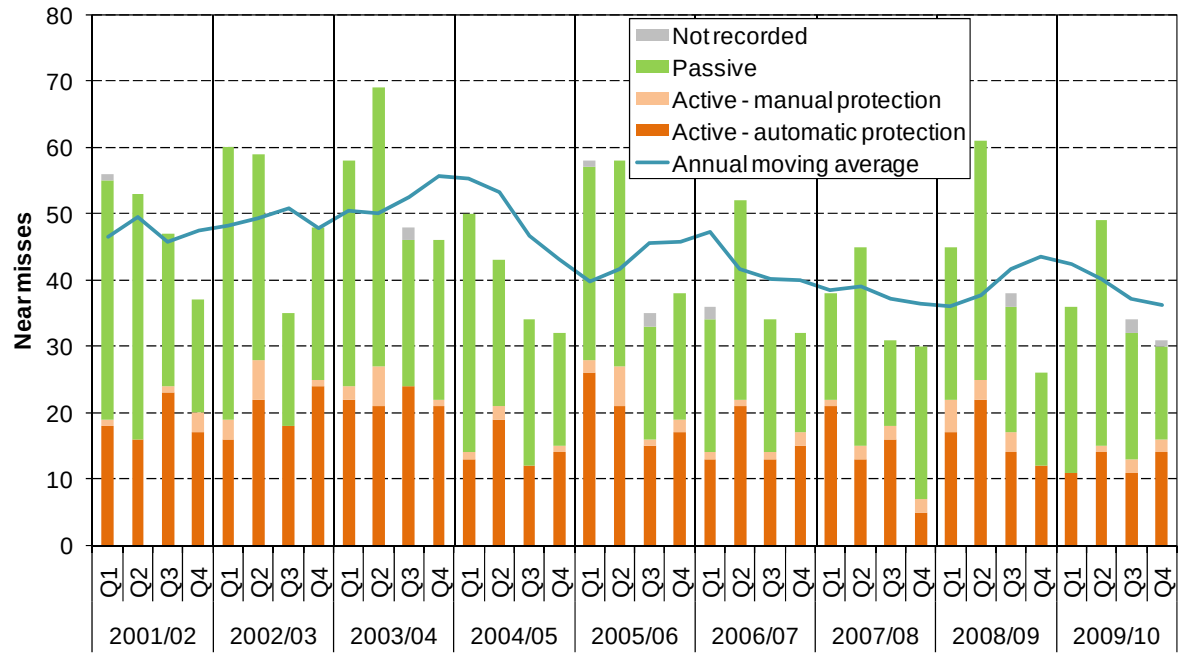
[56] These were caused by an empty car with a faulty handbrake, a collision between a road-rail machine and a contractor's lorry in a possession, and a road vehicle driver crashing through the level crossing barriers.

9.2.8 Near misses with road vehicles and pedestrians

Due to the relatively small number of accidents at level crossings, it is hard to monitor trends and identify patterns from accident data alone. The industry also collects data on near misses. Near misses are typically reported by train drivers who feel that they have had to take action to avoid a collision, or that they came close to striking a road vehicle or pedestrian. Near miss reporting is necessarily subjective, and is likely to be influenced by factors such as the ease of making a report and its perceived effect. It is likely that many near misses go unobserved due to prevailing light and visibility conditions.

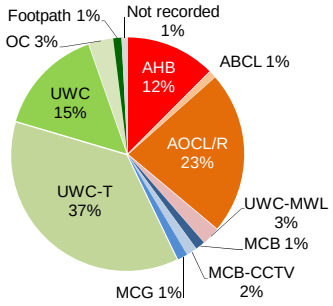
Near misses with road vehicles by crossing type

Chart 122. Trends in reported near misses with road vehicles



- There appears to be a long-term downward trend in near misses with road vehicles. After climbing in 2008/09, the number of near miss reports dropped again this year.
- The majority of near misses occur on user-worked crossings (with and without telephones). It is also estimated that around one in five near misses is with a farm vehicle.
- There is clear seasonality in near miss reporting, with a higher incidence in spring and summer. This may be due to heavier traffic (particularly on farm crossings around the times of haymaking and harvest), and train drivers may be more likely to identify that a near miss has occurred during daylight hours.

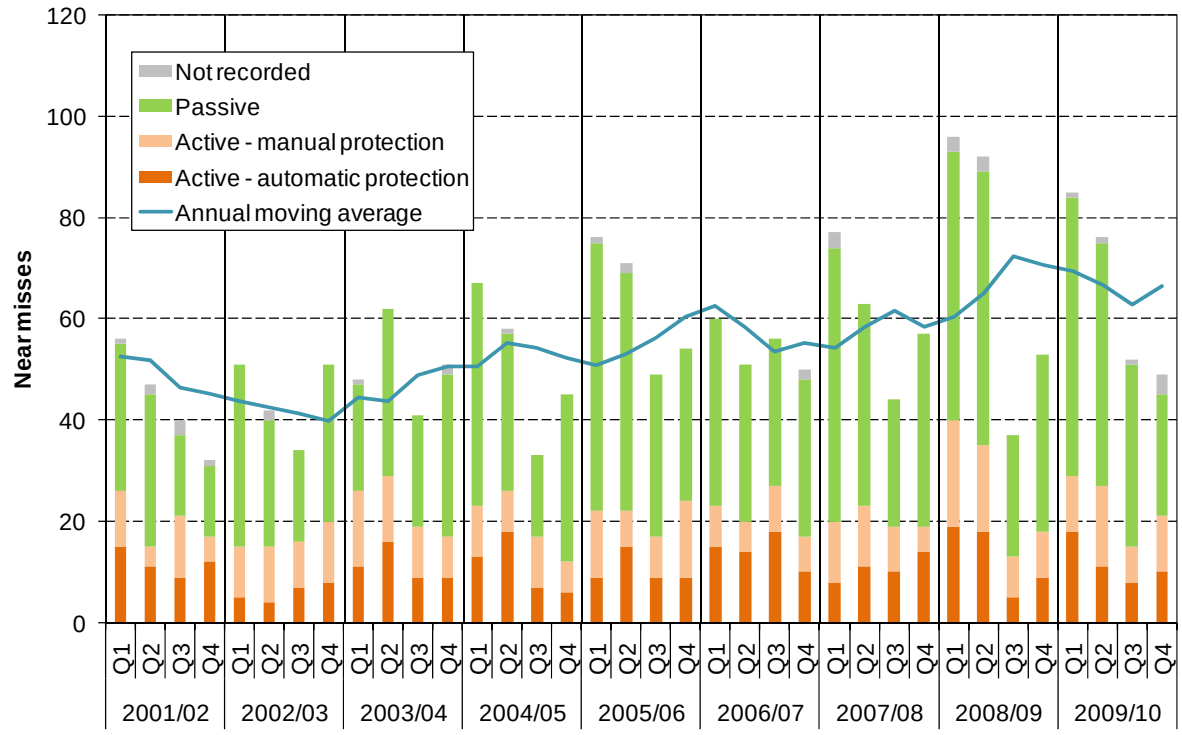
Near misses with road vehicles (2001/02-2009/10)



- Other seasonal factors that affect level crossing risk include ice and snow (which contributed to the accident at Hagg Lane on 5 January) and sunlight, which can make it harder for the motorist to see warning lights.

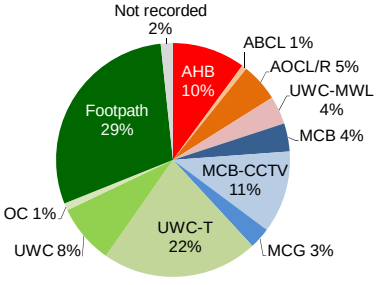
Near misses with pedestrians and cyclists by crossing type

Chart 123. Trends in reported near misses with pedestrians and cyclists



- Although there was a slight fall in near misses with pedestrians and cyclists in 2009/10, the long-term trend has been an upward one.
- As with road vehicle near misses, reporting is highly seasonal. It is likely that there are more pedestrians and cyclists using level crossings during spring and summer when the weather tends to be better.
- Anecdotal evidence, and a qualitative review of accident data, suggests that dog walkers may be particularly vulnerable to accidents at level crossings. For example, the RAIB investigation into the accident at Fairfield footpath crossing on 6 May identified the possibility that the presence and actions of the victim's two dogs may have been contributory factors.
- Auditory distractions, such as MP3 players, can also increase the risk to level crossing users.
- Around one in three reported near misses with pedestrians/cyclists occurs on footpath crossings, compared with around half the fatalities.
- User worked crossings (with and without telephones) account for a significant proportion of near misses with both pedestrians and road vehicle users. Telephones may be provided at crossings where there is a high number of near misses reported or where sighting times are reduced.

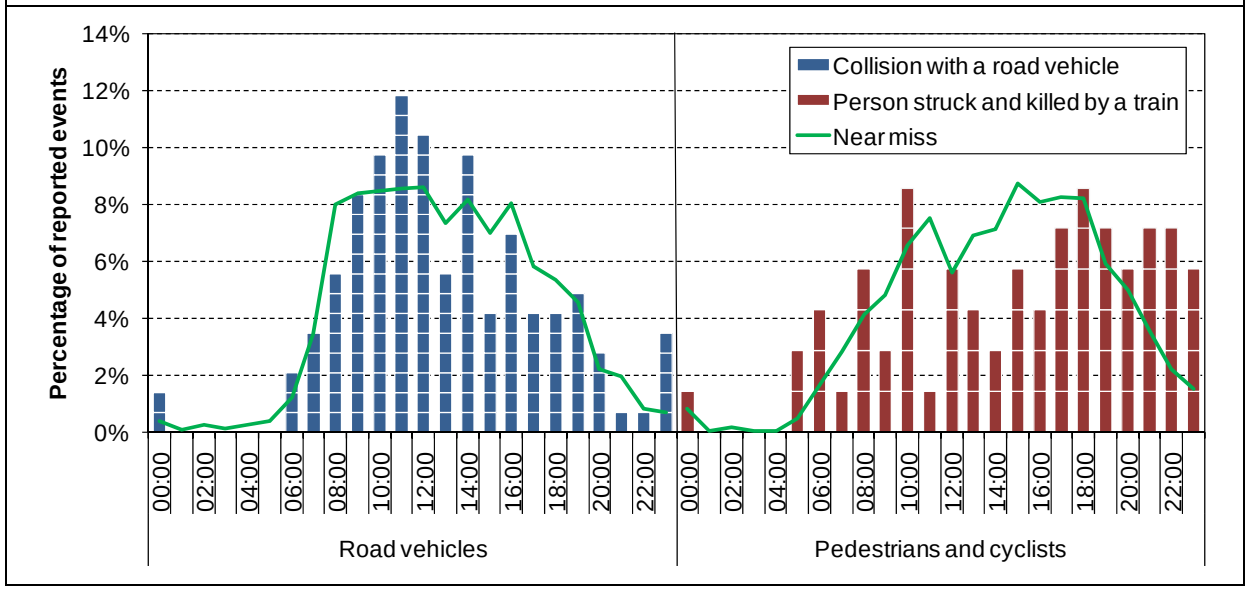
Near misses with pedestrians and cyclists 2001/02-2009/10



Near misses by time of day

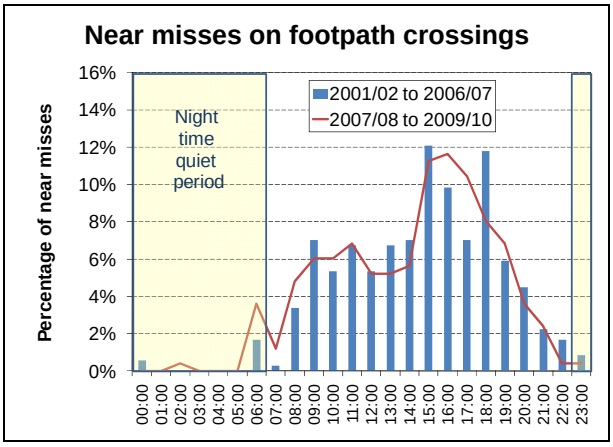
Chart 124 shows the proportion of accidents and near misses at level crossings reported in each hour of the day over the period 2001/02 to 2009/10.

Chart 124. Accidents and near misses by time of day (2001/02 to 2009/10)



- Accidents and reported near misses tend to occur at similar times of the day.
- The main exception to this is that a higher proportion of pedestrian/cyclist fatalities occur in the late evening (9pm to 1am) than would be anticipated from near miss reporting. One explanation for this is that many near misses go unseen (and therefore unreported) during hours of darkness. There may also be an effect from alcohol impairing people's ability to use crossings safely.
- Accidents and near misses with road vehicles tend to peak in the late morning, but remain at a fairly steady rate between 8am and 5pm. Accidents and near misses with pedestrians tend to peak a little later in the day.

In April 2007 a night time 'quiet' period, between 23:00 and 07:00 was introduced. Between these hours train drivers are no longer required to routinely sound their horns at whistle boards approaching crossings.

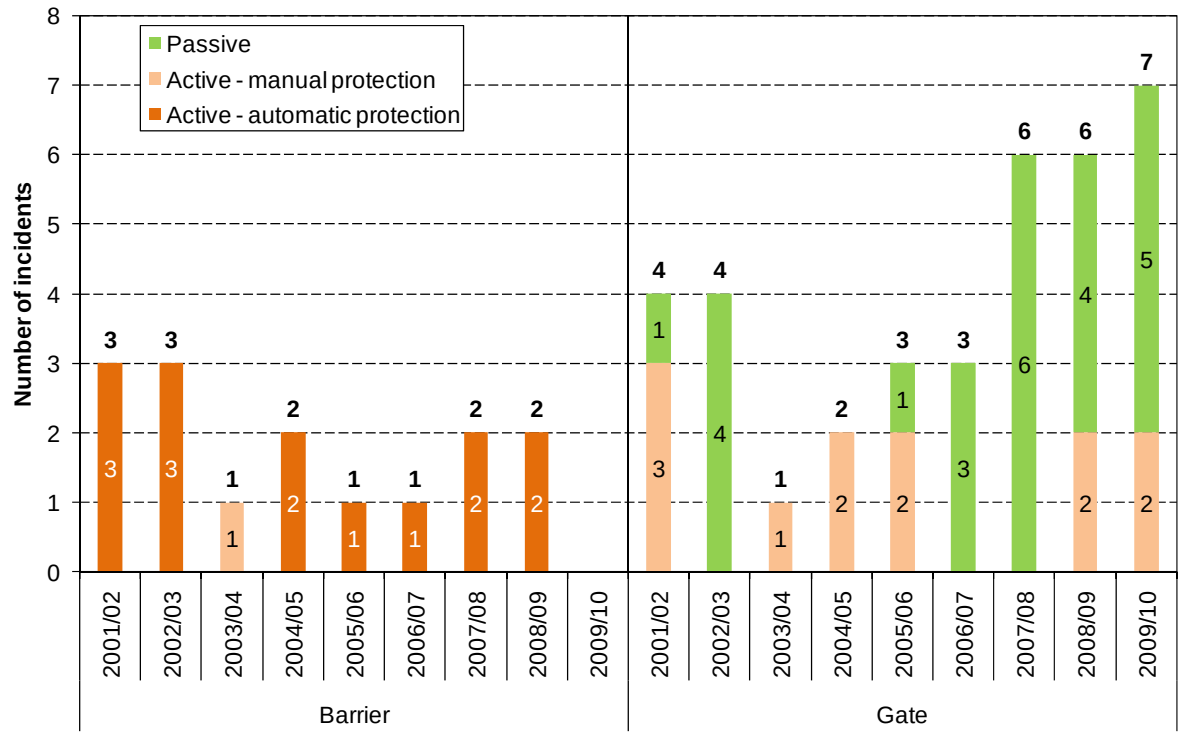


- The fatality at Trowbridge level crossing on 23 May 2009 was the first to occur at a crossing with a whistle board during the quiet period. The accident occurred at around 06:30.
- The mini chart shows near misses at footpath crossings by time of day both before and after the quiet period was introduced.
- There is little evidence that a higher proportion of near misses are occurring during the quiet period. There has been a small rise in the proportion of near misses recorded between 06:00 and 07:00, but there is too little data to draw firm conclusions.

9.2.9 Trains striking level crossing gates or barriers

In general, trains only strike barriers when a previous incident, such as a road traffic accident, has caused the barrier to be foul of the line immediately prior to the train's arrival. Crossing gates may be struck when high winds cause them to blow open, either due to defective clasps, or users failing to close or secure them properly after passing.

Chart 125. Trains striking gates or barriers at level crossings



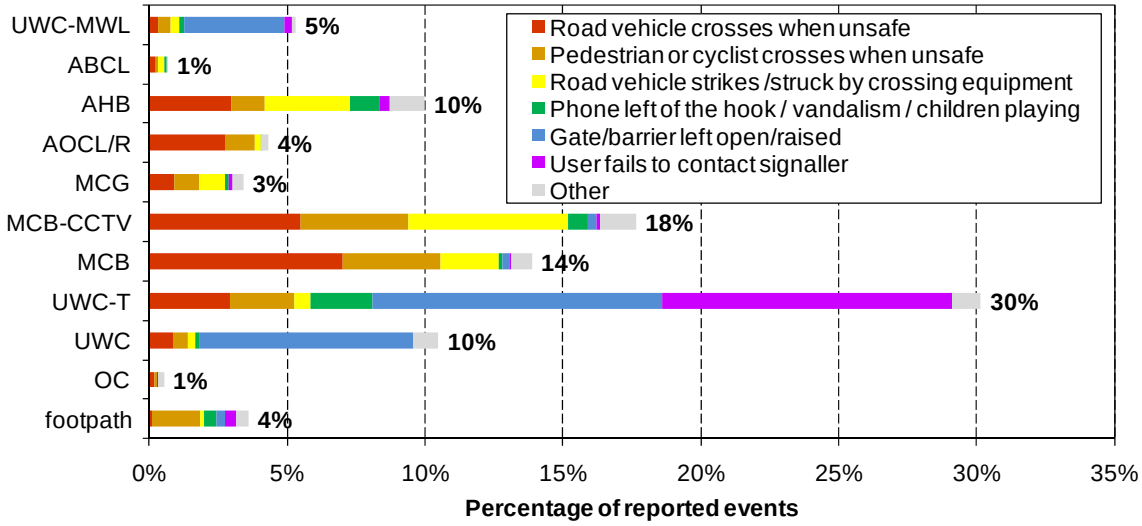
- There were seven instances of trains striking level crossing gates in 2009/10, and no instances of trains striking barriers.
- An accident at Stow Park level crossing (a manually controlled gated crossing) on 20 February 2010 resulted in part of the gate passing through the headlight of the leading unit and into the cab, causing minor injuries to the driver.
  - The signaller had cleared the signal for a train to proceed over the crossing but the gate locking mechanism failed, allowing it to come open. RAIB is investigating the incident and will publish a bulletin to highlight any lessons. A similar incident had occurred on the same crossing in April 2009.

9.2.10 Factors affecting the risk at level crossings

User behaviour

Most accidents involving trains at level crossings are caused by errors or, sometimes, deliberate violations by crossing users. Level crossing misuse refers to a variety of situations in which crossing users attempt to traverse a crossing when it is unsafe to do so, or otherwise fail to use it correctly. Misuse is thought to be considerably under-reported, particularly at crossings that are not monitored. In the light of these difficulties, overall patterns are more significant than absolute numbers.

Chart 126. Reported level crossing misuse by misuse category (2001/02 – 2009/10)



- User-worked crossings with telephones appear to be the most misused crossing type, with around 30% of all reported incidents of misuse. The majority of the misuse at this type of crossing is the user leaving the gates open or failing to contact the signaller either before using the crossing or once they are clear of the crossing.
- Approximately one-third of misuse is reported at manually protected crossings. This is likely to reflect the fact that violations at these crossings are more likely to be observed (and therefore reported) by railway personnel.

Railway crime

Crime at level crossings is a serious issue, which has the potential to cost lives, as well as cause delays and cost to the industry. Usually, these incidents involve members of the public defacing signs or causing damage to gates, barriers, telephones and so on.

Table 27. Number of recorded instances of interference with crossing equipment

2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
153	126	185	139	68	99	38	40	44

- The number of incidents of reported interference with crossing equipment has remained relatively static, and at an historically low rate, for the past three years. This reflects the general downward trend in railway vandalism (see section 7.5). However, data quality issues mean that the data should be interpreted with some caution.

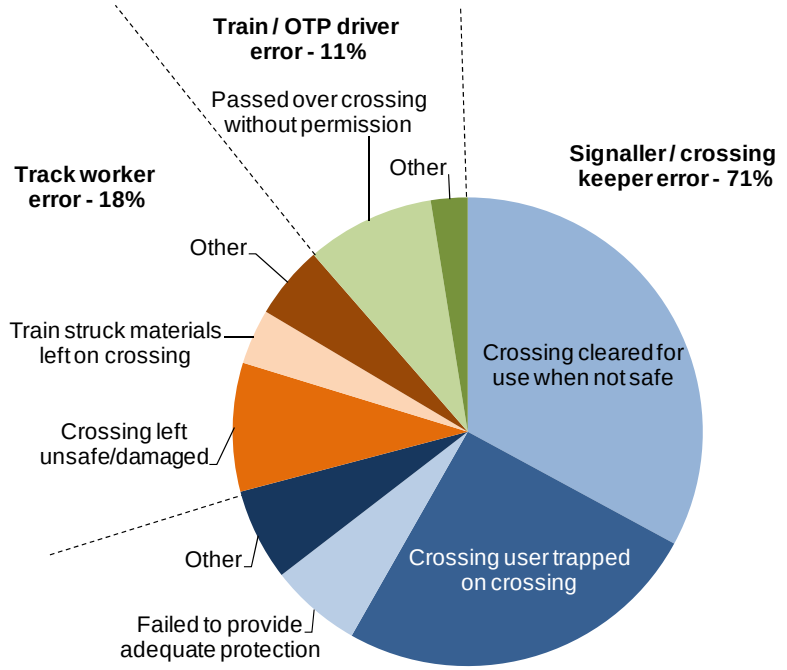
Irregular working at level crossings

SRMv6 estimates that workforce error contributes around 7% of the risk from collisions between trains and road vehicles at level crossings.

The fatal collision at Moreton-on-Lugg on 16 January 2010 occurred when the crossing barriers were raised to road traffic. The investigation is ongoing, but it appears that human error may have contributed to the accident.

Chart 127 shows the breakdown of workforce errors affecting level crossings that were reported under the *irregular working* component in SMIS in 2009/10.

Chart 127. Workforce errors affecting level crossings in 2009/10



- The most frequently reported irregular working incidents were of signallers authorising a user to cross when it was not safe to do so and trapping pedestrians or road vehicles between the barriers on CCTV-monitored level crossings.

Equipment failure

Equipment failure can range from minor component defects to more serious disruptions caused by power cuts and technical faults. Damage to equipment is also caused by vandals, thieves, road traffic accidents and the weather (particularly wind, floods and lightning).

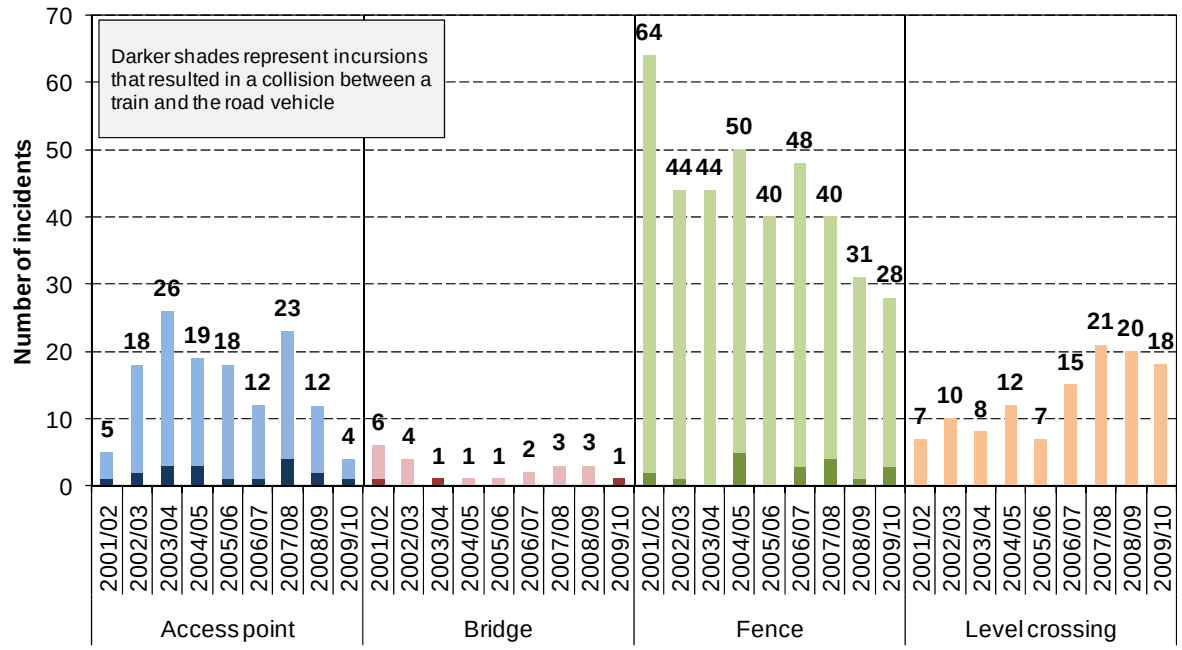
Equipment failure accounts for a small proportion of the risk at level crossings, the risk being mitigated by the fact that equipment is designed to 'fail safe'. For example, if the equipment fails at an automatic level crossing, the warning lights operate and the barriers lower.

- The number of reported level crossing equipment failures has increased dramatically over the past few years. It is believed that this is due to better reporting and the introduction of dedicated level crossing inspection and maintenance teams, and does not reflect a genuine increase in equipment failure rates.

9.3 Vehicle incursions

The accident at Great Heck in February 2001 occurred when a road vehicle towing a trailer came off the M62 motorway near a road-over-rail bridge and ran down the embankment onto the East Coast Main Line. The vehicle was struck by a high speed passenger train, which derailed and collided with a freight train travelling in the opposite direction. Ten people on board the trains, including four rail workers, died.

Chart 128. Vehicle incursions by entry point



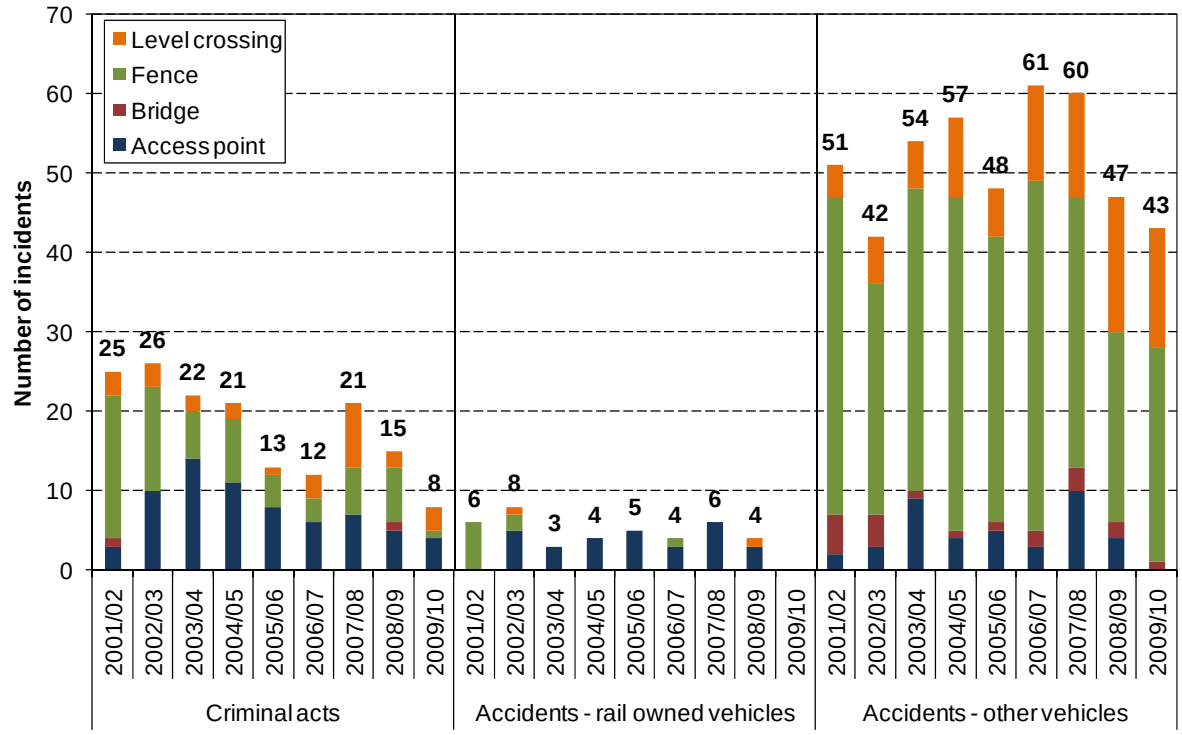
- There were 51 road vehicle incursions in 2009/10. Most of these accessed the track via fences or level crossings.[57]
- Network Rail has a process in place to identify high risk sites that are adjacent to the railway. In 2009/10, the Department for Transport and the Scottish Executive wrote to local highway authorities responsible for sites with the highest ranking scores where remediation was unfinished, seeking a timetable for completion.
- Five of the incursions in 2009/10 resulted in collisions between road vehicles and trains. One of these caused the train to derail.
  - On 12 November 2009, a freight train derailed by one bogie near Derby Road station, when it struck a road vehicle that had left the public highway and crashed through a fence. There were no reported injuries on the train, but the accident caused extensive damage.
- There were two fatalities as a result of a road vehicle incursion in 2009/10.
  - In the early hours of 9 December, two quad bikers were killed when a train struck their vehicle between Cardiff and Newport.

[57] The *level crossings* category in Chart 128 covers incidents where a road vehicle has left the level crossing and ended up on the track (for example, as a result of a road traffic accident). It does not include collisions between trains and road vehicles on level crossings.

Trends in incursions by cause

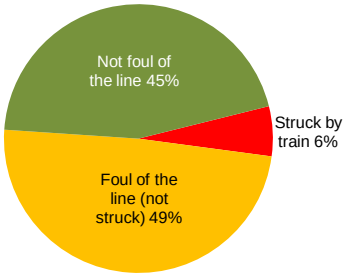
Vehicles can intrude onto the railway as a result of road traffic accidents, deliberate acts of vandalism or trespass and, occasionally, navigational errors. Railway personnel sometimes leave vehicles too close to the line, or not properly secured. There has also been a small number of cases of aircraft crashing onto the railway[58].

Chart 129. Vehicle incursions by cause



- Most incursions are the result of accidents.
  - Four of the incursions at level crossings in 2009/10 were the result of the vehicle skidding onto the line in ice or snow.
- The past two years have seen a reduction in the total number of vehicle incursions. Prior to this, although there was some evidence of a fall in incursions arising from criminal acts, there was no clear overall trend.
- The mini chart shows that around half of all vehicle incursions end up foul of the running line, and around 6% are struck by trains.

Consequence of vehicle incursions



[58] Aircraft incursions are included in Chart 128 under the category *Fence*. There have been seven such incidents since April 2001 (including one involving a hot air balloon and one involving an air ambulance helicopter that was attending a person who had been struck by a train).

9.4 Bridge strikes

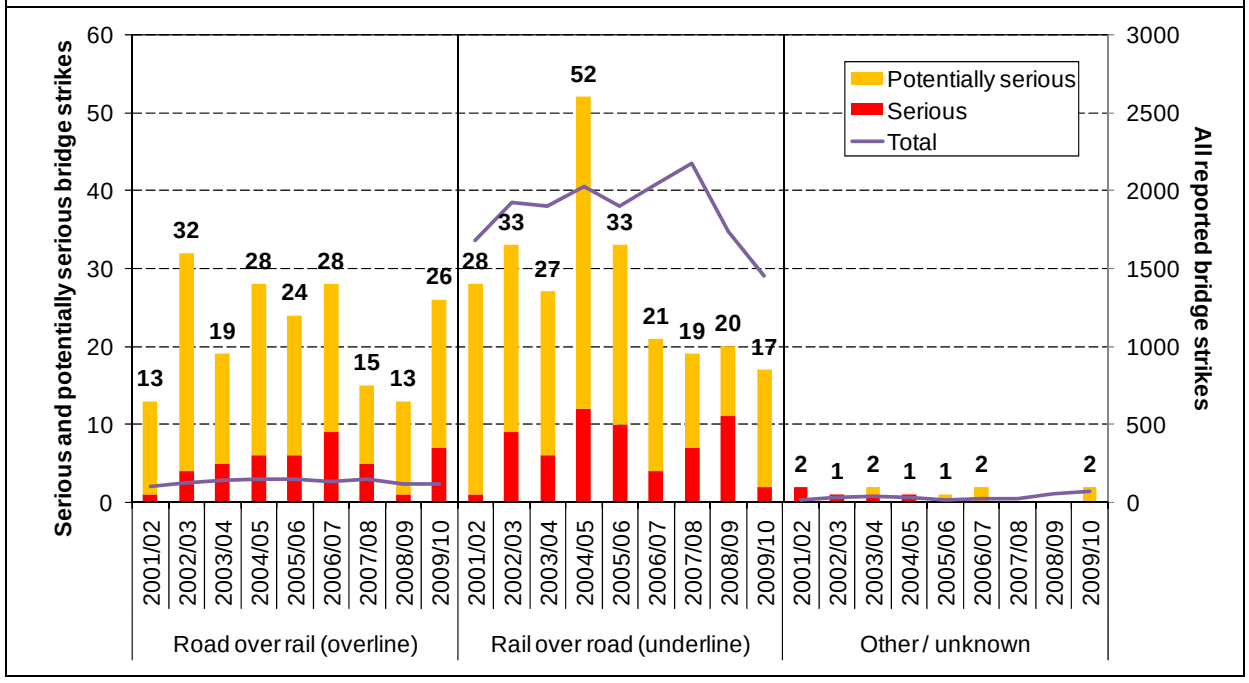
There are more than 30,000 bridges on the rail network in Great Britain. Around 57% are underline (rail-over-road) and 36% are overline (road-over-rail) bridges.[59] Responsibility for controlling the risk from bridge strikes is shared by the railway industry and highways authorities. Overline bridge strikes can result in debris on the line, and underline bridge strikes have the potential to cause track distortion or weaken the bridge structure.

The last recorded case of a bridge strike leading to the displacement and derailment of a train was at Oyne in May 1978. A low-loader carrying construction plant had struck an underline bridge, causing severe distortion to the track.

SRMv6 estimates the risk from train accidents caused by bridge strikes to be less than 0.1 FWI per year. However, the potential for a serious accident remains and, over the five-year period 2005-2009, bridge strikes resulted in more than one million minutes of train delays.

Bridge strikes are classified as serious, potentially serious, or not serious, depending on the extent of the damage to the bridge or track, and the presence and position of fallen debris.

Chart 130. Total number of bridge strikes – all types of bridges



- Most bridge strikes are reported at rail-over-road bridges. Heavy goods vehicles are frequently involved in these incidents.
  - The economic downturn has resulted in a reduction in heavy goods traffic of around 11% from 2007/08 to 2009/10.[60] This is likely to explain some part of the 33% reduction in rail-over-road bridge strikes over the same period.
- A higher proportion of incidents in which a vehicle strikes a road-over-rail bridge are classed as serious, due to the propensity for debris to fall onto the line (and potentially be struck by trains). There were seven such incidents in 2009/10: two resulted in trains running over rubble on the line.

[59] The remainder are viaducts and intersection bridges.
[60] The estimate is based on provisional quarterly vehicle km figures published by the Department for Transport.

9.5 Road-rail interface key safety facts

Road rail interface	2005/06	2006/07	2007/08	2008/09	2009/10
Fatalities at LC (level crossings)	**38**	**32**	**30**	**34**	**46**
Non-suicide	**11**	**10**	**10**	**12**	**12**
Pedestrians	8	7	10	10	7
Passenger on station crossing	2	1	2	0	0
Member of public	6	6	8	10	7
Road vehicle occupants	3	3	0	2	5
Train occupants	0	0	0	0	0
Passenger on train	0	0	0	0	0
Workforce on train	0	0	0	0	0
Suicide and suspected suicide	**27**	**22**	**20**	**22**	**34**
Weighted injuries at LC	**0.73**	**0.97**	**0.70**	**1.06**	**0.85**
Non-suicide	**0.73**	**0.97**	**0.70**	**1.06**	**0.85**
Pedestrians	0.71	0.83	0.38	0.80	0.59
Road vehicle occupants	0.00	0.10	0.21	0.21	0.20
Train occupants	0.02	0.05	0.12	0.05	0.06
Attempted suicide	**0.02**	**0.00**	**0.10**	**0.11**	**0.13**
Collisions with road vehicles at LC	**16**	**13**	**8**	**21**	**14**
Resulting in derailment	0	0	0	0	0
Collisions with gates or barriers at LC	**4**	**4**	**8**	**8**	**7**
Gates	3	3	6	6	7
Barriers	1	1	2	2	0
Reported near misses	**439**	**371**	**385**	**448**	**412**
With pedestrians	250	217	241	278	262
With road vehicles	189	154	144	170	150
Reported incidents of crossing misuse	**5200**	**5384**	**4818**	**5418**	**4776**
With pedestrians	4032	4253	3762	4368	3669
With road vehicles	1168	1131	1056	1050	1107
Vehicle incursions	**66**	**77**	**87**	**66**	**51**
Via fences	40	48	40	31	28
Via bridges	1	2	3	3	1
Via level crossings	7	15	21	20	18
Via access points	18	12	23	12	4
Number foul of the track	31	36	59	34	31
Number struck by trains	1	4	8	3	5
Bridge strikes	**2067**	**2200**	**2351**	**1908**	**1631**
Underline (rail over road)	1902	2042	2176	1736	1450
Serious	10	4	7	11	2
Overline (road over rail)	148	132	149	119	113
Serious	6	9	5	1	7
Other	17	26	26	53	68
Serious	0	0	0	0	0

Pedestrians and road vehicle drivers who commit suicide at level crossings are not included in the statistics.

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10 Data quality

10.1 SMIS

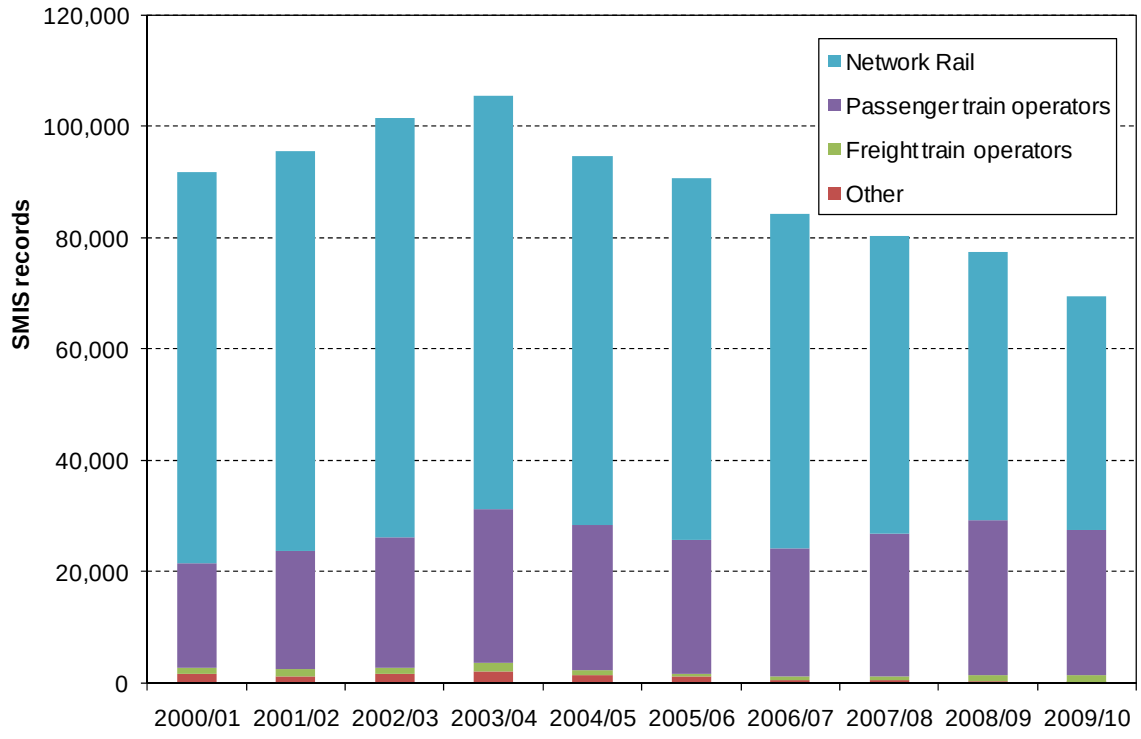
The analysis in this report is reliant on the quality of the data. The majority of the analysis is based on data from the industry's Safety Management Information System (SMIS). To ensure that the conclusions are meaningful, a great deal of effort is put into ensuring that the data is of the highest possible quality. The work carried out by RSSB relating to SMIS is governed by the SMIS Programme Board, which includes representatives of Network Rail, train operators and the Infrastructure Safety Liaison Group.

SMIS came into force in late 1998, and was designed to capture all elements of a safety-related event. Legislation, in the shape of RIDDOR 1995, helped decide the scope of events that were to be reported into SMIS. But, as well as ensuring that the RIDDOR-reportable injuries and accidents could be recorded, the scope was widened to collect all physical injuries and cases of shock, non RIDDOR-reportable train accidents and a number of precursor events.

The industry structure is such that rules are needed to allocate inputting responsibility. A Railway Group Standard (GE/RT8047) details what is required to be input, by whom. The fourth edition went live in February 2009 and can be read at: http://www.rgsonline.co.uk.

In 2009/10 about 75,000 incidents were reported into the SMIS system, mostly by Network Rail, as shown in Chart 131.

Chart 131. Number of SMIS records per year



10.1.1 Data quality issues

Under-reporting

Under-reporting is difficult to identify and can have a significant impact. Missing records will not be included in any analysis, and conclusions drawn may well be wrong. Substantial under-reporting will lead to an underestimate of risk. If the level of under-reporting changes over time, any estimates of trends may be misleading. Missing records can occur because of a lack of understanding, training or guidance or a lack of resources. Under-reporting is more of a concern for minor events, and the weighting that is attached to non-reportable minor injuries in part takes account of this.

Timeliness

The group standard requires that events are entered into SMIS within five working days of their occurrence. The consequence of late reporting is that events could be missed from analysis. Late reporting is often down to problems with a reporting process, though most of the late reporting in SMIS is due to passengers making reports to train operators some time after the event.

Duplicates

The same event entered by two different organisations (or even the same organisation twice) can be hard to detect without manual review and can lead to an overestimate of risk. If the level of duplication changes over time, any estimates of trends may be misleading. Reviews of injury data show the duplicate rate to be around about 1–2%.

Wrong reporting

In SMIS, wrong reporting generally refers to the mis-categorisation of events. SMIS mainly uses drop-down fields alongside a free form narrative to record event details. These types of errors can occur in any of the fields from person type to cause to whether an event is RIDDOR-reportable. Additionally, wrong reporting can refer to a lack of sufficient information to drill down to causes.

Without access to the original record, the types of checks that can be carried out are limited to consistency checking – i.e. checking that the coded fields tie in with the narrative description, and that different parts of the event describe the event in the same way.

Incomplete information

To carry out benchmarking, the organisation responsible for a person's safety (workforce or passenger) and, in many cases, the type of train involved are essential. RSSB alerts event owners to records that don't have such information via the indicator report (see below), and the significance of this issue is reducing.

10.1.2 Data quality improvement measures

Daily checks

In SMIS, the event types that have regular checks are limited to fatalities, injuries, category A signals passed at danger and train collisions, derailments, train fires, buffer stop collisions, level crossing accidents and structural failures.

With regard to fatalities and SPADs, Network Rail's daily control log is used to provide an under-reporting check. For fatalities, information from BTP is also collected and cross-referenced against the SMIS entry. New and amended information is fed back to the SMIS event owner.

Every injury entered into SMIS (about 20,000 per year) is manually reviewed and categorised by RSSB in line with the Safety Risk Model. The review is a check for consistency between the coded fields and the narrative, with a high emphasis placed on the person type and injury degree. Each month, these checks are also independently reviewed.

The SRM coding and RSSB views of the injury degree and person type are then electronically transferred back into SMIS each month (about 7-8 weeks after the end of the month being reviewed) and an alert is generated for any record where there is a change in the injury degree or person type relative to that entered by the responsible company. The event owner can then either update the SMIS record or add a comment which is then reviewed by RSSB until an agreed view is reached.

Pre-publication checks

As part of the process of generating an ASPR or a SRM, the information in SMIS is thoroughly reviewed. This allows a review of similar injuries to be carried out, providing a context that is not possible when reviewing individual records on a daily basis. Changes made as part of this process are transferred to SMIS as part of the next data transfer.

Health checks

To help promote the importance of data quality and to encourage issues to be tackled, the SMIS programme board initiated a programme of data quality health checks in 2008, which involves an annual visit to each of the reporting organisations to discuss what the Railway Group Standard requires (eg timescales, scope, reviewing) to review data, to gather feedback on how processes can be improved, and to explain how the data quality ranking score is calculated.

Data quality indicators

To assist with the review and provide information to support the health check process, a data quality report is automatically generated in SMIS and sent to each organisation. It uses charts that show an organisation's reporting error rate and the national error rate and a series of lists of events that require action. It looks at timeliness, incomplete information and wrong reporting.

Log checks

To supplement the health checks and data quality indicators, there is a weekly review of Network Rail's daily control log. This involves using software to compare the events in the control log with those in SMIS. Those not found in SMIS are notified to the event owner who will either enter it or explain why the event is not SMIS reportable.

Data quality ranking

At the end of 2009 each organisation's SMIS data quality was ranked. This score was based on four factors: timeliness, under-reporting, response to actions and quality of input. The ranking allows each organisation to clearly see where their weaknesses lie and provides the

ability to compare each organisation and to measure the total quality. Companies will be re-measured at the end of 2010 against the same criteria. Each company is advised of its performance and the national benchmark, and the SMIS programme board review the overall results.

Definitions

During 2009, the definition and guidance document defining the most commonly used terms within the Safety Management Information System, safety performance analysis and reporting and risk profiling was reviewed and updated. The latest version can be found here: http://www.rssb.co.uk/publications/guidance.asp.

In addition to this, RSSB is currently defining every hazardous event and precursor used in the SRM. This work will be finished in line with SRM version 7, when the definitions will be made available to the industry.

Coroners' verdicts

For coding fatalities, one of the key pieces of information is the coroner's verdict. Twice a year RSSB follows up any missing verdicts by writing to each coroner.

Summary of how improvement measures address quality issues

To minimise the number of data quality errors and their effects, there are a number of data quality control measures. Table 28 shows the issue that each measure is tackling. Each issue and measure is then discussed in detail.

Table 28. Data quality issues and control measures

	Data quality issue				
Data quality improvement measure	Under-reporting	Timeliness	Duplicates	Wrong reporting	Incomplete information
Daily checks			✓	✓	✓
Pre-publication checks	✓			✓	✓
Health checks	✓	✓	✓	✓	✓
Data quality indicators	✓	✓	✓	✓	✓
Log checks	✓				
Data quality ranking	✓	✓	✓	✓	✓
Definitions	✓			✓	
Coroners' verdicts					✓

10.1.3 Effects of improvement measures

In late 2009, an automated daily check of data quality was initiated. This measures the error rate in a number of measures for each SMIS organisation and nationally. From this we can monitor changes in data quality. It shows improvement in each category:

Table 29. Improvements in SMIS error rates[61]

Category	15/10/2009	31/03/2010
Active records	10.9%	9.0%
Classification questions not answered	0.4%	0.3%
Failure to call and stop shorts with no train	8.0%	5.7%
Injury degree discrepancies	1.3%	0.7%
Injury duplicates	0.3%	0.0%
Injury person type discrepancies	0.4%	0.2%
Irregular working with no activity	15.1%	12.0%
Line type discrepancies	0.5%	0.3%
Missing narratives,locations or descriptions	1.2%	0.8%
Missing train details	1.2%	0.8%
Train type discrepancies	0.9%	0.8%

10.2 Other sources of data

While the majority of the analysis is based on data from SMIS, other data sources have been used. The main ones are outlined below:

BTP CRIME database

The CRIME system is BTP's computerised crime recording system. Its Crime Recording Centre receives reports of crime from all their sources and undertakes appropriate recording of offences and related information. During 2009, an RSSB-led research project[62] (T723 – *Making the most of data associated with railway crime*) looked at the differences between SMIS and CRIME for crime related incidents. In line with the report's recommendations we use SMIS for workforce assaults, trespass and vandalism and CRIME for all other crimes.

Network Rail asset information

Asset information is supplied by Network Rail. This takes the form of failure information (wrongside signal failures and track faults) and normalisation data (level crossing numbers).

Train miles and kilometres

Train mileage is the most commonly used normaliser. It allows the analysis to take into account changes in service (train mileage has increased by over 10% in the last seven years) and provides a method for benchmarking. Typically, this normaliser is used for category A SPADs and train accidents. In the past there have been different systems calculating slightly different mileages. Discussions have been held between Network Rail, ORR and RSSB to ensure all future analysis uses the same base data, and from 2010/11 the train miles figure RSSB use will be generated from the Network Rail's Track Access Billing System. The figures refer to mileage actually run, not timetabled journeys.

[61] 15th October 2009 was the first time the daily check of errors was conducted.
[62] http://www.rssb.co.uk/SiteCollectionDocuments/pdf/reports/research/T723_rpt_final.pdf

Passenger journeys and kilometres

This data is collated for the industry by the ORR and is based on ticket sales recorded in LENNON[63]. Each year this is reconciled with the TOCs so that non LENNON ticket sales can be included. Typical examples of using this normaliser are for boarding and alighting and other passenger movements in stations.

Workforce hours

Both the HLOS safety metric and CSI reporting use workforce hours as a normaliser. Each organisation annually provides RSSB with the number of hours worked by their organisation split across several workforce types. In addition to HLOS and CSI reporting, hours worked are also used for individual risk estimates.

National Travel Survey (NTS)

Each year the Department for Transport conducts the National Travel Survey. The NTS is a household survey which provides information about personal travel within Great Britain and monitors trends in travel behaviour. In this report, some information from the survey is used in the benchmarking chapter.

Station usage

Station usage data is published by the ORR. The data provides estimates by station for number of exits and entries and the number of interchanges made, and is based on ticket sales. This data is useful for normalising station movement injuries, as it can help group similar size stations. The data has some limitations, for example dealing with travel cards, ticketless travel and multiple tickets for one journey.

National Rail Trends

National Rail Trends (NRT), published by the ORR, contains passenger usage and rail performance information. The ASPR uses passenger journey information which is published in the NRT.

National Passenger Survey

Twice a year Passenger Focus collects passenger opinions on 29 specific aspects of service to form the National Passenger Survey (NPS). Personal security data from the NPS is reproduced in the ASPR report. The NPS also provides information on the number of passengers by age and sex, used in the Passengers chapter.

European data

Great British rail industry data tends to be more detailed and accurate than other European reporting. There are also issues surrounding definitions, which are often quite technical and have differing meanings in different countries. For example, the national definition of a fatality varies from country to country. Accurate EU benchmarking is in the early stage of development, and RSSB is participating in the process which is led by the ERA.

[63] LENNON contains two datasets; pre-allocation (sales) and post-allocation (earnings). Passenger usage statistics in National Rail Trends (NRT) are based on the post-allocation dataset. Allocations are created for each ticket group by ORCATS, dependent on sales levels. These allocations are principally used to apportion journeys between TOCs. ORCATS is a mathematical model which uses a similar logic to journey planning systems and identifies passenger 'opportunities to travel' from an origin station to a destination station using timetable information. An opportunity to travel may include one or more changes of train, and one journey is generated for each train used during an opportunity to travel. This results in the number of journeys being inflated by around 5% compared to the pre-allocation dataset that does not assign journeys between TOCs.

10.3 Different definitions of similar terms

Some terms have different meanings in differing contexts. The following table lists the terms and their definitions in Europe, RIDDOR and RSSB.

Table 30. Differing definitions of terms (person types)

Term	ERA Definition	RSSB Definition	RIDDOR definition
Workforce	Any person whose employment is in connection with a railway and is at work at the moment of the accident.	All persons working for the industry on railway operations (either as direct employees or under contract).	RIDDOR distinguishes between employees (all persons working for the industry on railway operations as direct employees) and contractors (all persons working for the industry on railway operations under contract to a railway organisation).
Passenger	Any person, excluding workforce, who makes a trip by rail and who is on-board the train at the time of an accident	A person on railway infrastructure, who either intends to travel, is travelling or has travelled.	A person travelling or intending to travel on a train. This includes before and after travel, but while still on the railway premises, irrespective of whether they have a ticket to travel. It does not include people deliberately avoiding payment of their fare or people who are travelling in a place they are not authorised to do so.
Public	-	Persons other than those who are passengers or members of the workforce.	RIDDOR distinguishes between people on business (those who are not a passenger, employee or contractor but who are justifiably on railway premises on business connected with the railway) and people on property (those who have no business with the railway but become affected by it, eg level crossing or bridge users).
Trespasser	A trespasser is a person who goes where they are never authorised to be.		As RSSB/ERA, and additionally: a person deliberately avoids fare payment; people who have misused level crossings through wilful disobedience; people who enter the railway property from outside, through falls or road traffic accidents.

Table 31. Differing definitions of terms (other)

Term	ERA Definition	RSSB Definition	RIDDOR definition
Train	One or more railway vehicles hauled by one or more locomotives or railcars, or one railcar travelling alone, under a given number or specific designation from an initial fixed point to a terminal fixed point.	Train includes locomotives, tramcars, trolley vehicles and other guided transport vehicles. This also includes the train carriages themselves.	
Fatality	Any injury that causes the victim to die within 30 days of the accident.	Any injury that causes the victim to die within one year of the accident.	
Recordable injury	Any injury that causes a fatality or serious injury (a major injury that requires a stay in hospital of at least 24 hours), and is caused by rolling stock in motion outside of a possession.	Any physical injury to a member of the workforce, passenger or member of the public arising from the operation of the railway.	For people at work: a major injury or a physical injury leading to over three days off work resulting from the operation of the railway. For people not at work: Any physical injury leading to the person being taken from site to hospital, resulting from the operation of the railway

Appendix 1. Key safety facts

Safety overview

Overview	2005/06	2006/07	2007/08	2008/09	2009/10
Fatalities					
Passenger	8	8	7	5	5
Workforce	4	2	2	3	3
Public	52	60	59	59	62
Total	**64**	**70**	**68**	**67**	**70**
Majors					
Passenger	249	246	225	236	238
Workforce	155	128	134	128	118
Public	46	57	48	58	39
Total	**450**	**431**	**407**	**422**	**395**
Minors					
Passenger	4866	4891	5032	5257	5266
Workforce	6695	6216	5681	5488	5305
Public	117	159	141	127	182
Total	**11678**	**11266**	**10854**	**10872**	**10753**
Shock/trauma					
Passenger	254	325	330	263	197
Workforce	1525	1470	1421	1358	1143
Public	8	3	7	7	3
Total	**1787**	**1798**	**1758**	**1628**	**1343**
FWI					
Passenger	42.70	42.42	39.33	38.64	38.92
Workforce	31.73	26.35	25.61	25.92	24.47
Public	56.93	66.09	64.16	65.16	66.30
Total	**131.36**	**134.86**	**129.10**	**129.72**	**129.69**
Non accidental					
Suicides	228	222	205	215	236
FWI	231.27	225.34	207.44	217.98	238.57

Passengers

Passengers	2005/06	2006/07	2007/08	2008/09	2009/10
Fatalities	**8**	**8**	**7**	**5**	**5**
Train accidents	0	1	0	0	0
Slips, trips, and falls	3	2	1	2	1
Platform-train interface	1	3	3	3	4
Assault and abuse	1	1	1	0	0
On-board injuries	0	0	0	0	0
Contact with object or person	0	0	0	0	0
Struck by train on station crossing	2	1	2	0	0
Other type of passenger injury	1	0	0	0	0
Major injuries	**249**	**246**	**225**	**236**	**238**
Train accidents	2	29	0	0	3
Slips, trips, and falls	160	134	142	161	144
Platform-train interface	42	39	41	40	41
Assault and abuse	12	7	10	6	9
On-board injuries	23	30	22	24	32
Contact with object or person	8	7	9	3	8
Struck by train on station crossing	0	0	1	0	0
Other type of passenger injury	2	0	0	2	1
Minor injuries	**4866**	**4891**	**5032**	**5257**	**5266**
RIDDOR reportable	1159	1141	1104	1126	1163
Non-RIDDOR reportable	3707	3750	3928	4131	4103
Incidents of shock	**254**	**325**	**330**	**263**	**197**
Class 1	10	10	13	5	3
Class 2	244	315	317	258	194
Fatalities and Weighted injuries	**42.70**	**42.42**	**39.33**	**38.64**	**38.93**
Train accidents	0.38	4.28	0.12	0.03	0.40
Slips, trips, and falls	24.58	20.78	20.90	23.88	21.08
Platform-train interface	7.10	8.63	8.99	8.99	10.27
Assault and abuse	2.62	2.08	2.29	0.84	1.18
On-board injuries	3.55	4.38	3.38	3.69	4.43
Contact with object or person	1.23	1.22	1.51	0.95	1.45
Struck by train on station crossing	2.00	1.00	2.10	0.00	0.00
Other type of passenger injury	1.24	0.04	0.04	0.26	0.13
Passenger kms (billions)	**43.2**	**46.2**	**49.0**	**50.7**	**51.0**
Passenger journeys (millions)	**1082**	**1151**	**1225**	**1274**	**1227**

BTP Passenger & Public Assaults	2005/06	2006/07	2007/08	2008/09	2009/10
Total	**4063**	**3947**	**3415**	**3427**	**3050**
Actual bodily harm	**1832**	**1624**	**1487**	**1410**	**1140**
Common assaults	**1597**	**1660**	**1383**	**1450**	**1337**
GBH and more serious cases of violence	**170**	**152**	**108**	**175**	**175**
Other violence	**112**	**73**	**51**	**47**	**61**
Racially aggravated harassment	**352**	**438**	**386**	**345**	**337**

Incidents of passenger trespass, suspected and attempted suicide are analysed under public risk and counted in the key safety fact sheet for members of the public.

Workforce

Workforce	2005/06	2006/07	2007/08	2008/09	2009/10
Fatalities	**4**	**2**	**2**	**3**	**3**
Track worker	3	0	2	2	3
Train driver	1	1	0	0	0
Other train crew	0	0	0	0	0
Station staff	0	0	0	0	0
Revenue protection	0	0	0	0	0
Other workforce	0	1	0	1	0
Major injuries	**155**	**128**	**134**	**128**	**118**
Track worker	87	75	71	76	68
Train driver	6	7	18	6	10
Other train crew	35	21	17	20	18
Station staff	14	13	14	9	9
Revenue protection	4	4	2	2	4
Other workforce	9	8	12	15	9
Minor injuries	**6695**	**6216**	**5681**	**5488**	**5305**
RIDDOR-reportable	722	702	559	585	529
Non RIDDOR-reportable	5973	5514	5122	4903	4776
Incidents of shock	**1525**	**1470**	**1421**	**1358**	**1143**
Class 1	280	265	219	234	277
Class 2	1245	1205	1202	1124	866
Total FWI	**31.73**	**26.35**	**25.61**	**25.92**	**24.47**
Track worker	14.24	9.52	10.79	11.22	11.35
Train driver	3.85	3.81	3.83	2.67	2.99
Other train crew	7.66	6.49	5.33	5.64	5.41
Station staff	3.19	3.00	3.04	2.44	2.30
Revenue protection	1.28	1.12	0.95	0.95	1.06
Other workforce	1.51	2.42	1.68	3.01	1.36

Members of the public

Public	2005/06	2006/07	2007/08	2008/09	2009/10
Trespass					
Fatal	40	42	50	44	49
Major	27	35	29	37	19
Minor	32	33	25	21	32
Shock/trauma	0	1	0	1	1
Total trespass FWI	**42.81**	**45.61**	**52.99**	**47.78**	**51.03**
Level crossings					
Fatal	9	9	8	12	12
Major	6	8	4	9	7
Minor	32	34	18	19	23
Shock/trauma	2	0	1	3	1
Total level crossings FWI	**9.00**	**9.00**	**8.00**	**12.00**	**12.00**
Non-trespass non-LX					
Fatal	3	9	1	3	1
Major	13	14	15	12	14
Minor	53	92	98	87	127
Shock/trauma	6	2	6	3	1
Total non-trespass non-LX FWI	**4.45**	**10.59**	**2.73**	**4.41**	**2.63**
Total public accidental FWI					
Fatal	52.00	60.00	59.00	59.00	62.00
Major	4.60	5.70	4.80	5.80	3.90
Minor	0.31	0.39	0.35	0.34	0.39
Shock/trauma	0.02	0.00	0.01	0.02	0.01
Total accidental FWI	**56.93**	**66.09**	**64.16**	**65.16**	**66.30**
Suicide					
Fatal	228	222	205	215	236
Major	32	33	24	29	25
Minor	12	8	8	17	13
Shock/trauma	2	1	0	0	1
Total suicide FWI	**231.27**	**225.34**	**207.44**	**217.98**	**238.57**

This table will also include any incidents of passenger trespass, suspected and attempted suicide.

Train accidents

Train accidents	2005/06	2006/07	2007/08	2008/09	2009/10
Fatalities (excluding suicides)	**3**	**5**	**0**	**2**	**7**
Passengers	0	1	0	0	0
Workforce	0	0	0	0	0
Members of the public	3	4	0	2	7
Weighted injuries (excluding sucides)	**0.88**	**4.21**	**0.97**	**0.57**	**1.17**
Passengers	0.38	3.28	0.12	0.03	0.40
Workforce	0.50	0.82	0.63	0.33	0.57
Members of the public	0.00	0.10	0.21	0.21	0.20
Total train accidents	**799**	**825**	**783**	**697**	**582**
PHRTAs	**46**	**45**	**44**	**48**	**42**
Involving passenger trains	23	23	20	30	26
Collisions between trains	2	1	4	6	4
Derailments	6	10	3	3	8
Collisions with road vehicles (not at LC)	1	2	5	0	2
Collisions with road vehicles (at LC)	13	9	7	18	12
Striking buffer stops	1	1	1	3	0
Not involving passenger trains	23	22	24	18	16
Collisions between trains	2	1	1	0	0
Derailments	18	16	18	12	12
Collisions with road vehicles (not at LC)	0	1	3	2	2
Collisions with road vehicles (at LC)	3	4	1	3	2
Striking buffer stops	0	0	1	1	0
Non-PHRTA train accidents	**753**	**780**	**739**	**649**	**540**
Involving passenger trains	621	666	621	552	476
Open door collisions	1	2	3	3	1
Roll back collisions	6	4	3	2	4
Striking animals	120	126	112	116	144
Struck by missiles	208	221	225	198	142
Train fires	127	137	87	75	72
Striking level crossing gates/barriers	2	3	4	6	2
Striking other objects	157	173	187	152	111
Not involving passenger trains	132	114	118	97	64
Open door collisions	0	0	0	0	1
Roll back collisions	0	0	0	0	0
Striking animals	20	13	14	12	16
Struck by missiles	66	63	60	46	22
Train fires	16	10	9	11	3
Striking level crossing gates/barriers	2	1	4	2	5
Striking other objects	28	27	31	26	17
PIM index (at year end)	**55.1**	**54.3**	**50.9**	**46.2**	**39.1**
Infrastructure failures	10.5	12.8	11.9	9.9	8.9
Irregular working	9.5	9.9	8.8	7.3	5.0
Level crossing misuse	23.4	19.3	18.5	21.6	17.9
Objects on the line	4.5	5.7	6.0	3.2	3.1
Signals passed at danger	3.3	3.0	3.1	2.5	2.1
Trains and rolling stock	3.8	3.6	2.6	1.8	1.9

Derailments following collisions with road vehicles at level crossings are counted under the category *Striking road vehicle at level crossing*. Derailments following collisions with road vehicles at other locations are counted under the category *Derailments*.

Train accident precursors

Precursors	2005/06	2006/07	2007/08	2008/09	2009/10
Infrastructure failures					
Environment: adhesion	193	93	80	137	102
Environment: flooding	42	62	138	108	105
Environment: landslips	15	27	37	31	34
Level crossing failures	2607	2636	2376	2238	2016
Other structural failures	46	80	74	66	51
Track: broken rails	316	192	182	164	154
Track: buckled rails	56	85	4	17	27
Track: level 2 exceedences per mile	0.91	0.80	0.81	0.68	0.72
Wrongside signalling failures	720	589	589	845	811
Irregular working					
Runaway trains	11	13	7	4	9
Train speeding	107	73	113	74	212
Objects foul of the line	0	0	0	113	114
Track management/maintenance issues	0	0	0	142	103
Irregular working affecting level crossings	0	0	0	46	57
Misrouting	0	0	0	2491	2150
Other signaller errors	0	0	0	29	19
Level crossing incidents					
Near misses with road vehicles	189	154	144	170	150
Objects on the line					
Trains striking objects blown onto the line	82	278	237	207	213
Trains striking objects due to vandalism	82	71	46	37	26
Animals on the line (including train strikes)	2721	2390	1923	1857	1300
Road vehicle incursions	66	77	87	66	51
Category A SPADs					
Total number of cat A SPADs	328	334	349	292	277
Risk ranked 20+	19	18	21	17	19
Risk ranked 16+	120	106	93	89	83
Trains and rolling stock					
Brakes	44	49	13	8	5
Hot axle boxes	1101	888	636	730	664
Fires due to rolling stock failures	66	73	58	46	47
Fires due to vandalism	72	65	35	30	21
Other rolling stock failures	114	88	68	30	35
Other train fires	5	10	3	11	5
Dangerous goods incidents					
All incidents involving dangerous goods trains	139	128	164	166	170

Road-rail interface

Road rail interface	2005/06	2006/07	2007/08	2008/09	2009/10
Fatalities at LC (level crossings)	**38**	**32**	**30**	**34**	**46**
Non-suicide	**11**	**10**	**10**	**12**	**12**
Pedestrians	8	7	10	10	7
Passenger on station crossing	2	1	2	0	0
Member of public	6	6	8	10	7
Road vehicle occupants	3	3	0	2	5
Train occupants	0	0	0	0	0
Passenger on train	0	0	0	0	0
Workforce on train	0	0	0	0	0
Suicide and suspected suicide	**27**	**22**	**20**	**22**	**34**
Weighted injuries at LC	**0.73**	**0.97**	**0.70**	**1.06**	**0.85**
Non-suicide	**0.73**	**0.97**	**0.70**	**1.06**	**0.85**
Pedestrians	0.71	0.83	0.38	0.80	0.59
Road vehicle occupants	0.00	0.10	0.21	0.21	0.20
Train occupants	0.02	0.05	0.12	0.05	0.06
Attempted suicide	**0.02**	**0.00**	**0.10**	**0.11**	**0.13**
Collisions with road vehicles at LC	**16**	**13**	**8**	**21**	**14**
Resulting in derailment	0	0	0	0	0
Collisions with gates or barriers at LC	**4**	**4**	**8**	**8**	**7**
Gates	3	3	6	6	7
Barriers	1	1	2	2	0
Reported near misses	**439**	**371**	**385**	**448**	**412**
With pedestrians	250	217	241	278	262
With road vehicles	189	154	144	170	150
Reported incidents of crossing misuse	**5200**	**5384**	**4818**	**5418**	**4776**
With pedestrians	4032	4253	3762	4368	3669
With road vehicles	1168	1131	1056	1050	1107
Vehicle incursions	**66**	**77**	**87**	**66**	**51**
Via fences	40	48	40	31	28
Via bridges	1	2	3	3	1
Via level crossings	7	15	21	20	18
Via access points	18	12	23	12	4
Number foul of the track	31	36	59	34	31
Number struck by trains	1	4	8	3	5
Bridge strikes	**2067**	**2200**	**2351**	**1908**	**1631**
Underline (rail over road)	1902	2042	2176	1736	1450
Serious	10	4	7	11	2
Overline (road over rail)	148	132	149	119	113
Serious	6	9	5	1	7
Other	17	26	26	53	68
Serious	0	0	0	0	0

Appendix 2. Fatalities in 2009/10

Passenger				5
Date	**Location**	**Territory:**	**Station operator**	**Brief description:**
11/11/2009	West Ealing station	Western	First Great Western	A man walking close to the platform edge was killed after he stumbled and was struck by a train arriving at the platform.
21/11/2009	Angmering	South East	Southern	A young woman running alongside her train as it was departing the station, came into contact with the train and fell from the platform.
03/01/2010	Carshalton Beeches	South East	Southern	A man fell from the platform onto the track, and was struck by a through train after being unable to climb back up to the platform. Alcohol was reported as a factor.
30/01/2010	Streatham	South East	Southern	A man sitting on a platform bench, stood up, stumbled and fell from the platform onto the live rail and was electrocuted.
04/02/2010	Liverpool Central	London North Western	Merseyrail	An elderly woman lost her balance on escalator, falling and hitting her head.

Workforce				3
Date	**Location**	**Territory**	**Employer:**	**Description**
02/12/2009	Leeds	London North Eastern	Network Rail	A track worker acting as lookout was struck by a train. He was taken to hospital but later died.
27/01/2010	Forth Bridge, Edinburgh	Scotland	ThyssenKrupp Palmers	A civil maintenance contractor fell from scaffolding on bridge and landed on a scaffold platform below.
28/01/2010	Tay Bridge, Dundee	Scotland	ThyssenKrupp Palmers	A civil maintenance contractor working on a ladder was affected by paint fumes, causing him to fall.

Public (not including suicide or trespass)				62
Level crossing users (road vehicle occupants in italics)				12
Date	**Location**	**Territory**	**LC type**	**Description**
02/04/2009	Peth Lane	London North Eastern	UWC-T	A pedestrian was struck on the footpath crossing. The 17-year-old male was using the crossing whilst listening to an MP3 player.
03/04/2009	Eyton	Western	AHB	A cyclist was struck on the level crossing whilst attempting to zig-zag around the lowered barriers.
06/05/2009	Fairfield	Western	footpath	A woman walking two dogs was struck by a train at the level crossing.
23/05/2009	Trowbridge	Western	UWC-T	A member of public was struck by a train at the level crossing.
02/09/2009	*Penrhyndeud raeth*	*Western*	*UWC-T*	*A light locomotive train struck a road vehicle on the crossing. The driver of the car was fatally injured.*
07/09/2009	Fox Covert	London North Eastern	footpath	A two-year-old boy was struck by a passenger train on the footpath level crossing. The driver stated that the child had run onto the crossing as the train approached. The driver applied an emergency brake, but could not avoid the impact
29/09/2009	*Halkirk*	*Scotland*	*AOCL*	*A passenger train struck a car at the level crossing. Three vehicle occupants received fatal injuries. RAIB is investigating the accident.*
02/11/2009	Attenborough Nature Reserve	London North Eastern	footpath	A pedestrian was struck and fatally wounded on the level crossing.
16/01/2010	*Moreton-on-Lugg*	*Western*	*MCB*	*A passenger train struck two cars on the level crossing. The train driver stated that, on the approach to the crossing, the signal reverted to danger and the barriers rose. One road vehicle occupant was fatally injured; the other sustained major injuries.*
26/01/2010	Ufton	Western	AHB	A pedestrian was struck on the level crossing.
Other locations				1
Date	**Location**	**Territory**	**Description**	
19/02/2010	Gresford Bank	Western	A member of the public walking alongside railway property, fell down the embankment and onto the track. He was struck by a train and suffered leg injuries, passing away later	

Trespass	49
At station	17
On or about the track	32

Suicide	236
Coroner's confirmed verdict	68
Application of Ovenstone criteria	168

Appendix 3. Ovenstone criteria adapted for the railways

Requirement:

Every railway fatality in Great Britain (including Scotland) is classified as:

- A suicide (that is, in accordance with the coroner's verdict – or Scottish equivalent),
- A suspected suicide (using the criteria provided), or
- Accidental.

A suspected/attempted suicide requires objective evidence of suicide (other than a coroner's verdict). It is a managerial assessment, based on applying the Ovenstone criteria adapted for the railways.

Without this positive evidence, the fatality should be deemed accidental. A classification should always be reviewed whenever new evidence comes to light (such as during investigations or at a coroner's inquest).

Whose decision?

The classification is a matter for local railway management judgement, based on all available evidence (for example, eyewitness accounts of the person's behaviour – which may be the train driver's own account – BTP findings or the coroner's findings). The classification is wholly for management statistical purposes and is not:

- Passing judgement on the particulars of any case.
- For use outside the Railway Group.
- For any other purpose.

The criteria for suspected or attempted suicide

Each of the following, on its own, may be treated as sufficient evidence of suspected suicide (unless, of course, positive evidence that the fatality was accidental exists, or the coroner gives an accidental verdict):

- Suicide note.
- Clear statement of suicidal intent to an informant.
- Behaviour demonstrates suicidal intent.
- Previous suicide attempts.
- Prolonged depression.
- Instability; that is, a marked emotional reaction to recent stress or evidence of failure to cope (such as a breakdown).

Appendix 4. Level crossing types

Level crossing population on NRMI (as at 31 December 2009)

	London North East	London North West	Scotland	South East	Western	TOTAL
MCG	112	13	3	37	18	183
MCB	93	28	16	46	51	234
MCB-CCTV	148	49	18	140	36	391
Total active manual	***353***	***90***	***37***	***223***	***105***	***808***
AHB	187	19	28	172	46	452
ABCL	11	3	3	19	16	52
AOCL/R	27	9	24	21	36	117
UWC-MWL	39	10	6	30	11	96
Total active automatic	***264***	***41***	***61***	***242***	***109***	***717***
UWC	296	77	56	234	220	883
UWC-T	395	163	314	302	493	1667
OC	15	7	2	13	18	55
footpath	588	337	78	680	779	2462
Total passive	***1294***	***584***	***450***	***1229***	***1510***	***5067***
TOTAL	**1911**	**715**	**548**	**1694**	**1724**	**6592**

Source: Network Rail. The table excludes disused crossings on mothballed lines and 'sleeping dogs' (see Appendix 6). The category of footpath crossings comprises footpath crossings (86%), bridleway crossings (6%) and station foot and barrow crossings (8%). These are analysed as a single category in the ASPR because the data in SMIS is not always precise enough to differentiate between them. They have been collectively grouped under 'passive' crossings, but in reality some have automatic protection: 2% (including some at stations) have miniature warning lights and 1% are station crossings with white lights. A further 4% are equipped with telephones and around one-third have whistle boards.

ACTIVE CROSSINGS

Manual crossings

Manually controlled gate (MCG) This crossing is equipped with gates, which are manually operated by a signaller or crossing keeper either before the protecting signal can be cleared, or with the permission of the signaller or signalling system. At the majority of these crossings, the normal position of the gates is open to road traffic, but on some quiet roads the gates are maintained 'closed to the road' and opened when required if no train is approaching.

Manually controlled barrier (MCB) MCB crossings are equipped with full barriers, which extend across the whole width of the roadway, and are operated by a signaller or crossing keeper before the protecting signal can be cleared. Road traffic signals and audible warnings for pedestrians are interlocked into the signalling system.

Manually controlled barrier protected by closed circuit television (MCB-CCTV) Similar to MCB crossings, except that a closed circuit television (CCTV) is used to monitor and control the crossing from a remote location.

Automatic crossings

Automatic half-barrier (AHB) AHB crossings are equipped with barriers that only extend across the nearside of the road (so that the exit is left clear if the crossing commences operation when a vehicle is on it). Road traffic signals and audible warnings are activated a set time before the operation of the barriers, which are activated automatically by approaching trains. The barriers rise automatically when the train has passed, unless another train is approaching. Telephones are provided for the public to contact the signaller in case of an emergency or, for example, to ensure it is safe to cross in a long or slow vehicle. These crossings can only be installed where the permissible speed of trains does not exceed 100mph.

Automatic barrier locally monitored (**ABCL**) As far as the road user is concerned, this crossing looks identical to an AHB crossing. The difference is that train drivers must ensure that the crossing is clear before passing over it. Train speed is limited to 55mph or less.

Automatic open crossing remotely monitored (**AOCR**) The AOCR is equipped with road traffic signals and audible warnings only: there are no barriers. It is operated automatically by approaching trains. Telephones are provided for the public to contact the signaller in an emergency. Only one crossing of this type remains on NRMI, at Rosarie in the Scottish Highlands.

Automatic open crossing locally monitored (**AOCL**) Like the AOCR, this crossing is equipped with road traffic signals and audible warnings only and is operated automatically by approaching trains. The only difference is that no telephone is provided for crossing users: train drivers must ensure that the crossing is clear before passing over it and train speed is limited to 55mph or less. If a second train is approaching, the lights continue to flash after the passage of the first train, an additional signal lights up, and the tone of the audible warning changes.

User-worked crossing with miniature warning lights (**UWC-MWL**) This crossing has gates or full lifting barriers, which the user must operate prior to crossing. Red/green miniature warning lights, operated by the approach of trains, inform the user whether it is safe to cross.

PASSIVE CROSSINGS

User-worked crossing (**UWC**) This crossing has gates or, occasionally, full lifting barriers, which the user must operate prior to crossing. The user is responsible for ensuring that it is safe to cross; hence there must be adequate visibility of approaching trains. Once clear, the user is required to close the gate or barriers. These crossings are often found in rural areas, for example providing access between a farm and fields. They often have an identified user, some of whom keep the crossing gates padlocked to prevent unauthorised access.

User-worked crossing with telephone (**UWC-T**) These are similar to the standard user worked crossing, but a telephone is provided. In some circumstances (for example when crossing with livestock or vehicles) the user must contact the signaller for permission to cross, and report back when they are clear of the track. They are provided where visibility of approaching trains is limited, or the user needs to move livestock over the railway on a regular basis.

Open crossing (**OC**) At open crossings, which are sited when the road is quiet and train speeds are low, the interface between road and rail is completely open. Signs warn road users to give way to trains. Road users must therefore have an adequate view of approaching trains. The maximum permissible speed over the crossing is 10mph or the train is required to stop at a stop board before proceeding over.

Footpath crossing These are designed primarily for pedestrians and usually include stiles or wicket gates to restrict access. The crossing user is responsible for making sure that it is safe to cross before doing so. In cases where sufficient sighting time is not available, the railway may provide a 'whistle' board, instructing drivers to sound the horn to warn of their train's approach, or miniature warning lights. A variant is the bridleway crossing, which is usually on a public right of way, although some are private and restricted to authorised users. Some footpath crossings are in stations and these can be protected by a white light generally used by railway staff only (which extinguishes when a train is approaching). All these crossing types, some of which clearly have automatic protection, are analysed as a single group in this report because of concerns over the accuracy of crossing type data in SMIS.

Appendix 5. Accident groups used within ASPR

Accident grouping	Description of the types of event contained within grouping
Train accidents: collisions and derailments	Collisions between trains, buffer stop collisions and derailments (excluding those caused by collisions with road vehicles at level crossings).
Train accidents: collisions with road vehicles at level crossings	Includes derailments.
Train accidents: collisions with objects	Collisions between a train and another object, including road vehicles not at level crossings and trains hit by missiles. Excludes derailments.
Train accidents: other	Train divisions, train fires, train explosions, structural damage affecting trains
Assault and abuse	All types of assault, verbal abuse and threat. Also includes unlawful killing.
Boarding and alighting	Accidents occurring whilst getting on or off trains. Includes falls between train and platform where cause is unknown or 'other' (until PID 6182 is separated in SRMv7).
Contact with object	Any injury involving contact with objects, not covered by another category.
Contact with person	Injuries due to bumping into, or being bumped into by, other people. Excludes assaults.
Falls from height	Generally speaking, falls of more than 2m. Excludes falls down stairs and escalators.
Fires and explosions (not involving trains)	Fires or explosions in stations, lineside or other locations on NRMI.
Lean or fall from train in running	Injuries resulting from accidental falls from trains, or from leaning from trains.
Machinery/tool operation	Injuries from power tools, being trapped in machinery, or track maintenance equipment. Does not include injuries due to arcing. Does not include injuries due to being struck by things thrown up by tools or from carrying tools/equipment.
Manual handling/awkward movement	Strains and sprains due to lifting or moving objects, or awkward movement. Excludes injured due to dropping items being carried, which are classed under contact with objects.
On-train incidents	All injuries on trains, excluding train accidents, assaults, and those occurring during boarding or alighting, or whilst leaning from trains.
Platform edge incidents (not boarding/alighting)	Accidents that involve falls from the platform (with or without trains being present) or contact with trains or traction supplies at the platform edge. Excludes accidents that take place during boarding or alighting.
Road traffic accident	All accidents directly resulting from road traffic accidents, apart from road vehicle incursions not at LX.
Slips, trips, and falls	Generally speaking falls of less than 2m anywhere on NRMI (except on trains), and falls of any height down stairs and escalators.
Struck/crushed by train	All incidents involving pedestrians struck/crushed by trains, excluding trespass, platform edge and boarding and alighting accidents.
Suicide	All injuries arising from suicide, including third party shock and trauma.
Trespass	Injuries resulting from people deliberately going where they are never permitted to go, including those who deliberately jump from trains, platforms, overbridges etc.
Workforce electric shock	Electric shock involving third rail, OHL, or non-traction supply. Includes burns from electrical short circuits. Does not include injuries due to arcing, which are classed under 'other'.
Other	Any other event not covered by another category.

Appendix 6. Definitions

Term	Definition
Accident	In the ASPR, this term refers to an event that causes harm or damage that was not intended by its victims. Suicides are not therefore classed as accidental fatalities. However, injuries sustained as a result of other people's behaviour (for example, from assaults or trains striking objects that have been deliberately placed on the line) are classed as accidental if the injured party did not intend to come to harm. **Train accidents** are accidents occurring to trains and rolling stock. See Chapter 8 (Table 17) for further details. **Individual accidents** are accidents to people on railway premises or on trains, but excluding injuries sustained in train accidents.
Assault	SMIS records incidents in which '*in circumstances related to their work, a member of staff is assaulted, threatened or abused, thereby affecting their safety or welfare.'* BTP records and categorises criminal assaults in accordance with Home Office rules. In the ASPR, BTP crime codes have been grouped into higher level categories.
Child	This term is used in the ASPR to describe a person aged 15 years or below.
Fatalities and weighted injuries (FWI)	An overall measure of safety harm, taking account of injury and fatalities in the following way: One FWI = one fatality = 10 major injuries = 200 RIDDOR-reportable minor injuries or class 1 shock/traumas = 1,000 non RIDDOR-reportable minor injuries or class 2 shock/traumas.
Fatality	Death within one year of the causal accident.
Hazardous event	An event that has the potential to lead directly to death or injury.
Irregular working	Irregularities affecting, or with the potential to affect, the safe operation of trains or the safety and health of persons. The term irregular working applies to a disparate set of human actions involving an infringement of relevant rules, regulations or instructions.
Key Risk Area (KRA)	A concept introduced by the Strategic Safety Plan (see Chapter 3). There are currently 15 KRAs, covering engineering, human error and public behaviour causes of risk. Individually, the KRAs make a significant contribution to the overall safety risk profile of the railway; collectively they represent over 95% of the residual risk on the railway.
Level crossing	The ground-level interface between a road and the railway. The different types of crossing are defined in Appendix 4.
Major injury	An injury to a passenger, staff or member of the public as defined in Schedule 1 to RIDDOR 1995 (including most fractures, amputations, losses of consciousness), or where the injury resulted in hospital attendance for more than 24 hours.
Minor injury	Physical injuries to passengers, staff or members of the public that are not major injuries. For workforce, minor injuries are **RIDDOR-reportable** if they result in greater than three days' lost time. For passengers and members of the public, minor injuries are **RIDDOR-reportable** if the injured person was taken from the accident site direct to the hospital. Other minor injuries are not reportable under RIDDOR.

Term	Definition
Network Rail managed infrastructure (NRMI)	This falls within the boundaries of Network Rail's operational railway and includes the permanent way, land within the lineside fence, and plant used for signalling or exclusively for supplying electricity for operational purposes to the railway. It does not include stations, depots, yards or sidings that are owned by, or leased to, other parties. However, it does include the permanent way at stations and plant within these locations.
Ovenstone criteria	Explicit set of criteria, adapted for the railway, which provides an objective assessment of suicide where a coroner's verdict is not available. The criteria are based on the findings of a 1970 research project into rail suicides and cover aspects such as the presence (or not) of a suicide note, the clear intent to commit suicide, behavioural patterns, previous suicide attempts, prolonged bouts of depression and instability levels. See Appendix 3.
Passenger	A person on railway infrastructure, who either intends to travel, is travelling or has travelled. Note this does not include passengers who are trespassing or who commit suicide – they are included as members of the public.
Passenger train	A train that is in service and available for the use of passengers.
Pedestrian	A person travelling on foot. Note that the category also includes cyclists in Chapter 9 - *Risk at the road-rail interface*.
Potentially higher-risk train accidents (PHRTA)	Accidents that are RIDDOR-reportable and have the potential to result in harm to any or all person types on the railway. They comprise train derailments, train collisions (excluding roll backs), trains striking buffer stops, trains striking road vehicles at level crossings, and trains running into road vehicles not at level crossings (with no derailment).
Precursor	A system failure, sub-system failure, component failure, human error or operational condition which could, individually or in combination with other precursors, result in the occurrence of a hazardous event.
Precursor Indicator Model (PIM)	An RSSB-devised model that measures the underlying risk from train accidents by tracking changes in the occurrence of accident precursors. See section 8.7.1 for further information.
Public (members of)	Persons other than passengers or workforce members (that is, trespassers, persons on business and other persons). Note this includes passengers who are trespassing (when crossing tracks between platforms, for example).
RIDDOR (Reporting of Injuries, Diseases and Dangerous Occurrences Regulations)	RIDDOR 1995 is a set of health and safety regulations that require any major injuries, illnesses or accidents occurring in the workplace to be formally reported to the enforcing authority. It defines major injuries and lists notifiable diseases – many of which can be occupational in origin. It also defines notifiable dangerous occurrences, such as collisions and derailments.
Running line	A line that is ordinarily used for the passage of trains, as shown in Table 'A' of the sectional appendices.
Safety Management Information System (SMIS)	A national database used by railway undertakings and infrastructure managers to record any safety-related events that occur on the railway. SMIS data is accessible to all of the companies who use the system, so that it may be used to analyse risk, predict trends and focus action on major areas of safety concern.

Term	Definition
Safety Risk Model (SRM)	A quantitative representation of the safety risk that can result from the operation and maintenance of the GB rail network. It comprises 125 individual models, each representing a type of hazardous event (defined as an event or incident that has the potential to result in injuries or fatalities).
Shock/trauma	Shock or traumatic stress affecting an employee, passenger or member of the public who has been involved in, or a witness to, an event. **Class 1** refers to shock or traumatic stress related to being involved in or witnessing fatality incidents and train accidents (collisions, derailments and fires). **Class 2** refers to shock or traumatic stress related to all other causes of shock/trauma, such as verbal assaults, witnessing physical assaults, witnessing non-fatal incidents and near misses.
Signal passed at danger (SPAD)	An incident when any part of a train has passed a stop signal at danger without authority or where an in-cab signalled movement authority has been exceeded without authority. A **category A SPAD** is a SPAD that occurs when the stop aspect, end of in-cab signalled movement authority or indication (and any associated preceding cautionary indications) was displayed correctly, in sufficient time for the train to be stopped safely at the signal or end of in-cab movement authority.
SPAD risk ranking tool	A tool that gives a measure of the level of risk from each SPAD. It enables the industry's total SPAD risk to be monitored and can be used to track performance and inform SPAD investigations. The score for each SPAD ranges from zero (no risk) to 28 (a very high risk) and is based on both the potential for the SPAD to lead to an accident and the potential consequences of any accident that did occur. SPADs with risk rankings between 16 and 19 are classified as potentially significant, and those with risk rankings of 20 and above are classified as potentially severe.
Statistical significance	A concept used to determine whether a change in accident statistics implies that the safety of the system has really altered, or whether the change *could* be explained by 'statistical variation'.
Strategic Safety Plan	This is a joint statement by the companies responsible for Britain's mainline rail network setting out an agreed industry approach to managing safety. The 2008-2010 plan was developed by bringing together commitments made by industry companies in their own individual safety plans, thus creating a linkage with the duty holder planning process.
Suicide and suspected suicide	A fatality is classified as a suicide where a coroner's verdict is suicide. It is classified as a suspected suicide where the coroner has yet to return a verdict or returns an open verdict, but where objective evidence of suicide exists based on the application of Ovenstone criteria.
Track worker	A member of workforce whose responsibilities include engineering or technical activities associated with track or civil structures. This includes track maintenance, civil structure inspection, S&T renewal/upgrade, engineering supervision, acting as a controller of site safety (COSS), hand signaller or lookout and machine operation.
Trackside	This is a collective term that refers to the running line, Network Rail managed sidings and depots.
Train	Train includes locomotives, tramcars, trolley vehicles and other guided transport vehicles. This also includes the train carriages themselves.

Term	Definition
Train accident	See *Accident – Train accidents.* **RIDDOR-reportable train accidents** are defined in RIDDOR 1995. To be reportable under RIDDOR, the accident must be on or affect the running line. There are additional criteria for different types of accident, and these can vary depending on whether or not the accident involved a passenger train.
Derailment	*This includes all passenger train derailments, derailments of non-passenger trains on running lines and any derailment in a siding that obstructs the running line. Accidents in which a train derails after a collision with an object on the track (except for another train or a road vehicle at a level crossing) are included in this category, as are accidents in which a train derails and subsequently catches fire or is involved in a collision with another rail vehicle.*
Train fire	*This includes fires, severe electrical arcing or fusing on any passenger train or train conveying dangerous goods, or on a non-passenger train where the fire is extinguished by a fire brigade.*
Train striking road vehicle	*All collisions with road vehicles on level crossings are RIDDOR-reportable. Collisions with road vehicles elsewhere on the running line are reportable if the train is damaged and requires immediate repair, or if there was a possibility of derailment.*
Collision between trains	*This term describes collisions involving two (or more) trains. Accidents in which a collision between trains results in derailment or fire are included in this category.* ***Roll back** collisions occur when a train rolls back (while not under power) into a train on the same line (including one from which it has decoupled).* ***Setting back** collisions occur when a train making a reversing movement under power collides with a train on the same line, usually as part of a decoupling manoeuvre.* ***Shunting movement/coupling collisions** arise when the locomotive or unit causing a collision is engaged in marshalling arrangements. While they characteristically occur at low speed and involve the rolling stock with which the locomotive or unit is to be coupled, accidents may involve a different train that could be travelling more quickly.* ***Coming into station** collisions occur between two trains that are intended to be adjacent to one another (for example, to share a platform) but are not intended to couple up or otherwise touch. Normally, but not always, the collision speed will be low, because one train is stationary and the approaching train will be intending to stop short of the stationary train (rather as for a buffer stop). This operation is known as permissive working.* ***In running (open track)** collisions occur in circumstances where trains are not intended to be in close proximity on the same line. The speed of one or both of the trains involved may be high.* *Collisions **in a possession** occur where there is a complete stoppage of all normal train movements on a running line or siding for engineering purposes. These collisions are only RIDDOR-reportable if they cause injury, or obstruct a running line that is open to traffic.*
Open door collision	*This occurs when a train door swings outward, coming into contact with another train.*
Buffer stop collision	*This occurs when a train strikes buffer stops. Accidents resulting in only superficial damage to the train are not reportable under RIDDOR.*

Term	Definition
Trains running into objects	*This includes trains running into or being struck by objects anywhere on a running line (including level crossings) if the accident had the potential to cause a derailment or results in damage requiring immediate repair.*
Trains striking animals	*This includes all collisions with large-boned animals and flocks of sheep, and collisions with other animals that cause damage requiring immediate repair.*
Trains being struck by missiles	*This includes trains being struck by airborne objects, such as thrown stones, if this results in damage requiring immediate repair.*
Train Protection and Warning System (TPWS)	A safety system that automatically applies the brakes on a train which either passes a signal at danger, or exceeds a given speed when approaching a signal at danger, a permissible speed reduction or the buffer stops in a terminal platform. A **TPWS intervention** is when the system applies the train's brakes without this action having been taken by the driver first. A **TPWS activation** is when the system applies the train's brakes after the driver has already initiated braking. **TPWS reset and continue** incidents occur when the driver has reset the TPWS after an activation (or intervention) and continued forward without the signaller's authority.
Trajectory	A concept developed for the Strategic Safety Plan. There are three aspects to a trajectory: a statement of current safety performance in a particular risk area, details of the actions being taken to address the risk and an estimation of the safety performance improvement that the actions are expected to deliver.
Trespass	Trespass occurs when people go where they are never authorised to be, rather than where they behave inappropriately (either from error or violation) at places where they are allowed to go at certain times and under certain conditions, such as level crossings.
Workforce	Persons working for the industry on railway operations (either as direct employees or under contract).

Appendix 7. Glossary

Acronym	Expansion
ABCL	automatic barrier crossing locally monitored
AHB	automatic half-barrier crossing
AOCL	automatic open crossing, locally monitored
AOCR	automatic open crossing, remotely monitored
ASPR	Annual Safety Performance Report
ATOC	Association of Train Operating Companies
ATP	Automatic Train Protection
BTP	British Transport Police
CCTV	closed-circuit television
CIRAS	Confidential Incident Reporting and Analysis System
COSS	controller of site safety
CP	control period; we are currently in the fourth period, CP4
CSI	common safety indicator
CST	common safety target
DfT	Department for Transport
EC	European Commission
ECS	empty coaching stock
ERA	European Railway Agency
ERTMS	European Rail Traffic Management System
EU	European Union
FOC	freight operating company
FP	footpath level crossing
FWI	fatalities and weighted injuries
FWSI	fatalities and weighted serious injuries
GB	Great Britain
GSM-R	Global System for Mobile communications – Railway
HGV	heavy goods vehicle
HEM	hazardous event movement
HEN	hazardous event non-movement
HET	hazardous event train
HLOS	High Level Output Specification
HSE	Health and Safety Executive
HST	High Speed Train
HSWA	Health and Safety at Work etc Act 1974
KRA	Key Risk Area
LC	level crossing
LNE	London North East
LNW	London North West
LOE	Learning from operational experience
LUL	London Underground Ltd
LX	level crossing
MCB	manually controlled barrier crossing
MCG	manually controlled gate crossing

Acronym	Expansion
MOM	mobile operations manager
MOP	member of the public
MPJ	million passenger journeys
MWL	miniature warning light
NHS	National Health Service
NPS	National Passenger Survey
NR	Network Rail
NRMI	Network Rail managed infrastructure
NRV	national reference values
OC	open crossing
OFG	Operations Focus Group
OHLE	overhead line equipment
ORR	Office of Rail Regulation
PHRTA	potentially higher-risk train accident
PIM	Precursor Indicator Model
PSR	permanent speed restriction
RAIB	Rail Accident Investigation Branch
RGS	Railway Group Standard
RIDDOR	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995
RMMM	rail-mounted maintenance machine
ROGS	Railway and Other Guided Transport Systems (Safety) Regulations 2006
ROSCO	rolling stock leasing company
RPB	Risk Profile Bulletin
RRV	road–rail vehicle
RSD	(European) Railway Safety Directive
RSSB	Rail Safety and Standards Board
S&T	signal and telecommunications
Sc	Scotland
SE	South East
SIC	Systems Interface Committee
SMIS	Safety Management Information System
SPAD	signal passed at danger
SRM	Safety Risk Model
SRP	Sustainable Rail Programme
SRRT	SPAD risk ranking tool
SSP	Strategic Safety Plan
TOC	train operating company
TPWS	train protection and warning system
UWC	user-worked crossing
UWC-T	user-worked crossing with telephone
V/TC&C SIC	Vehicle/Train Control & Communications Systems Interface Committee