Annual Safety Performance Report 2010/11

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This report reviews the rail industry's safety performance over the financial year 2010/11. RSSB reports on a financial year basis for consistency with Control Period 4 (CP4), 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.

As stated in the European Safety Directive, the overarching safety requirement for European railways is to maintain safety and improve it where reasonably practicable. 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 two years 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 Railway Agency, and Britain's railways compare very favourably against the rest of Europe. Rail continues to be one of the safest forms of transport.

2010/11 Headlines

- In 2010/11, there were 1.4 billion passenger journeys (8% increase on 2009/10), 54.5 billion passenger kilometres (6% increase), and 18.3 billion tonne kilometres of freight moved (4% decrease).
- There were no passenger or workforce fatalities in train accidents in 2010/11. This is the fourth year in succession with no such fatalities. There were also no fatalities to members of the public in train accidents.
- There were 18 potentially higher-risk train accidents. This is a significant reduction on the previous year's total of 42, which, at the time, was the lowest number on record. In contrast, the Precursor Indicator Model (PIM), which measures changes in train accident risk based on the occurrence of precursors, stood at 50.4 at the end of the year, compared with 44.0 at the end of 2009/10. At the end of 2010/11, the estimated level of risk from signals passed at danger (SPADs) was higher than the level at the end of 2009/10, but 16% lower than the September 2006 baseline level.
- There were 40 accidental fatalities, 395 major injuries, 11,075 minor injuries and 1,331 cases of shock/trauma. The total level of recorded harm was 100.4 fatalities and weighted injuries (FWI), compared with 130.0 FWI in 2009/10. The main cause of the reduction was a fall in the number of fatalities due to trespass.
- Eight passengers died in separate incidents, all at stations. When non-fatal injuries are also taken into account, the total level of passenger harm was 42.6 FWI; this in an increase of 10% on the 38.7 FWI (five fatalities) recorded for 2009/10. Both the fatality total and the FWI total were the highest since 2006/07. When normalised by passenger journeys, the rate of harm shows a 2% increase compared with 2009/10.
- There was one workforce fatality during 2010/11: an infrastructure worker died as a result of a fall from height. Including non-fatal injuries, the total level of workforce harm was 22.9 FWI. This is a reduction of 8% compared with the 25.0 FWI (three fatalities) recorded in 2009/10. The rate of harm normalised by workforce hours reduced by 10%.
- There were 31 fatalities to members of the public, excluding those due to suicide or suspected suicide. Of the total, 27 were trespassers, and the remaining four were pedestrians at level crossings. Including non-fatal injuries, the total level of public harm was 34.8 FWI, which is 48% lower than the 66.3 FWI recorded for 2009/10. At 208, the number of suicides was close to the average of the previous nine years.

Executive summary

Risk from train accidents

The past four years have seen no fatalities to passengers or workforce from train accidents. The last train accident with an on-board fatality was 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, is the lowest recorded, at 0.5 per year.

The types of train accident with the greatest potential to cause harm are termed 'potentially higher-risk train accidents', or PHRTAs. These account for around 5% of the total number of events that are classed under RIDDOR[1] as train accidents, but contribute around 94% of the train accident risk. Over time, the number of PHRTAs has also shown a decreasing trend; in 2010/11 there were 18 events, compared with 42 in 2009/10. Two PHRTAs resulted in major injury to train occupants in 2010/11. One was a train collision with a road vehicle at a level crossing; the other was the result of a road vehicle incursion following a bridge strike.

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, which compares train accident risk with a March 2002 baseline, now stands at 50.4, compared with 44.0 at the end of 2009/10.

Risk to passengers

Eight passengers died in separate incidents, all at stations. Of the eight, five occurred at the platform-train interface (PTI). Four of these were falls from the platform – in two events the person was electrocuted and in the other two events the person was struck by a train. The other PTI fatality occurred when someone standing too close to the platform edge was struck by a train. Based on RSSB's Safety Risk Model (SRM), the PTI is the greatest source of passenger fatality risk. Most of the fatality risk does not arise from boarding or alighting, but is due to the types of incident seen in 2010/11.

Two passenger fatalities resulted from slips, trips or falls in the station: one on the platform and one on an escalator. In each of the past four years, an escalator fall has resulted in a passenger fatality, and in all four 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 to passengers in 2010/11 was 240, compared with 235 recorded for 2009/10. 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 2010/11 was 42.6 FWI, which is an increase of 10% on the 38.7 FWI recorded for the previous year. The rate of harm normalised by passenger journeys saw a rise of 2%.

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

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 passenger safety in the area of personal security. The number of assaults recorded for 2010/11 was 3277, which is 3% higher than for the previous year. When normalised by passenger journeys, the rate of assaults fell by 4%. BTP data has shown a reducing trend in the normalised rate of assaults since 2005/06. The current likelihood of being assaulted during the average journey is lower than one in 400,000.

Risk to the workforce

One member of the workforce was killed in 2010/11. The accident occurred to an infrastructure worker, who fell from height while engaged on viaduct maintenance work. 'Infrastructure worker' is now being used in safety performance reporting to replace the term 'track worker'. The new term has exactly the same scope, but reflects more accurately the wide range of activities performed by those within the grouping. It encompasses those whose work involves inspecting, maintaining and renewing the track, signalling and telecommunications equipment, and other railway infrastructure, such as earthworks and bridges.

Most workforce fatalities occur to infrastructure workers. Since 2001/02, there have been 37 workforce fatalities, 27 of whom were infrastructure workers. Infrastructure workers also dominate the major injury figure; since 2001/02, 60% of major injuries have occurred to this group.

The total number of workforce major injuries was 122, the same as recorded for 2009/10. Since 2006/07, workforce major injuries have been at a generally lower level than before that date.

In January 2011, RSSB published an independent review of RIDDOR reporting by Network Rail and its contractors. This review found that some 500 to 600 RIDDOR lost time injuries may not have been reported by Network Rail Infrastructure Projects and Maintenance over the five years from 2005/06 to 2009/10. This equates, in FWI terms, to an under-reporting of around 0.5 FWI per year. The SRM estimates of the risk to infrastructure workers has improved during the time of the under-reporting, with a reduction of around 14% in overall FWI. Therefore, although the magnitude of the observed reduction in RIDDOR-reportable injuries is known to be incorrect, it is likely that there has been an actual reduction from the levels seen in 2004/05 and before.

In contrast to passenger assaults, the main reporting mechanism for workforce assaults is SMIS. Workforce assault is an important issue for the industry, and one that has been the focus of efforts to improve 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 2010/11, there were 1.7 FWI (no fatalities) attributed to assault. Assault is of particular concern for those workforce groups that deal directly with passengers and public, such as non-driving train crew, station staff and revenue protection officers.

The overall level of workforce harm recorded in 2010/11 was 22.9 FWI, which is a reduction of 8% compared with the 25.0 FWI recorded for the previous year.

Risk to members of the public

Excluding suicides and suspected suicides, there were 31 fatalities to members of the public in 2010/11, of which 27 were the result of trespass. This is a substantial decrease on the numbers recorded over the past nine years. Since 2001/02, around 76% of trespasser fatalities have been the result of being struck by trains. The majority of the remainder were due to electrocution. A small proportion (8%) have died as a result of train surfing, deliberately exiting trains in running, or falling onto the railway while engaged in prohibited behaviour such as climbing on railway structures.

In 2010/11, there were four level crossing user fatalities, all were pedestrians. There were no public accidental fatalities that did not involve trespass or level crossings.

As well as the accidental public fatalities, there were 208 suicides and suspected suicides; this is very close to the average of 209 for the previous nine-year period.

Risk at the road-rail interface

The total level of harm at level crossings was 5.2 FWI, of which four were the public fatalities mentioned above. There were no passenger or workforce fatalities at level crossings.

Since 2001/02, there has been an average of 15 collisions per year between trains and road vehicles at level crossings. There were five such incidents during 2010/11, which is a ten-year low. One resulted in major injury to train occupants. There is some evidence that the underlying rate of collisions at level crossings has reduced over the past ten years.

Away from level crossings, the other sources of road-rail interface risk are vehicle incursions and bridge strikes. At 60, the number of vehicle incursions onto the railway was an increase of ten on the previous year. At 36, the number of serious or potentially serous bridge strikes was a reduction of nine compared with 2009/10.

Summary

The overriding safety picture at the end of 2010/11 is mixed. While there was a significant reduction in the number of potentially higher-risk train accidents, trends in the occurrence of train accident precursors point towards a more static situation. The overall level of accidental harm showed a considerable reduction of 23%. Workforce safety levels have shown an improvement. For the first time in some years, a notable reduction in public harm has been seen, with the number of fatalities around half of the average of the previous nine years. It remains to be seen whether or not this marks a step-change in public behaviour on the railways. For passengers, the main area of focus is the platform-train interface, where an increasing level of injuries has been seen in recent years. Operations Focus Group is currently targeting this area, with the aim of identifying ways to achieve improvement.

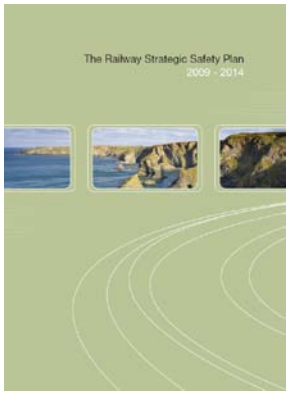
Summary of injuries by person type (excluding suicide and suspected suicide)

	2010/11						2009/10
	Fatal	Major	RIDDOR-reportable minor	Not RIDDOR-reportable minor	Shock & trauma	FWI	FWI
Passenger	8	240	1201	4354	227	42.61	38.67
Workforce	1	122	571	4764	1101	22.94	24.96
Public	31	33	77	108	3	34.80	66.33
Total	40	395	1849	9226	1331	100.4	130.0

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 2010/11 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 2010/11, covering the period 1 April 2010 to 31 March 2011. RSSB reports on a financial year basis 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 industry's 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, while others provide a measure of the underlying risk.

1.3 How the report analyses safety

1.3.1 Person type

The ASPR focuses on the risk to the different types of people who are directly affected by the railway. In the analyses in the report, 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

[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.

analysed as members of the public. 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. 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.

1.3.2 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 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	Shock or trauma resulting from being involved in or witnessing events that have serious potential of a fatal outcome eg train accidents such as collisions and derailments, or personal accidents involving being struck by train.	200
Class 2 shock/trauma	Shock or trauma resulting from other causes, such as verbal abuse and near misses, or personal accidents of a typically non-fatal outcome.	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

[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, *inter alia*, work-related accidents.

area or topic. The SRM is updated periodically, and the SRM information presented in this report is taken from latest update – SRM version 7 – which was published in June 2011.

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. Appendix 6 provides a list of groupings that are commonly used through the report.

1.3.3 Methodology

The majority of ASPR analyses are 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 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 leads an on-going data quality project, which is backed by the SMIS Programme Board and Association of Train Operating Companies (ATOC) Safety Forum. 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. As well as using the information supplied in SMIS, information from BTP, ORR and coroners' reports may be used. For fatalities, RSSB distinguishes 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 – see Appendix 4 for details) as to whether the event is more likely to have been a suicide than an accident. If there is no evidence to the contrary, fatalities are classed 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.

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 2010/11 ASPR was 3 May 2011 for SMIS data.

1.5 RSSB reporting to be used for ORR's National Rail Trends

A noteworthy recent development in the area of safety performance reporting is the ORR's decision to use RSSB statistics as their sole source of published mainline safety data. ORR will reproduce ASPR data in National Rail Trends; a Memorandum of Understanding for the supply of data has been drafted. In the past, differences in statistics published by different railway bodies have been the focus of criticism. These variations have existed for a number of reasons, including differences in scope of reporting and differences in data sources.

1.6 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 SRMv7, together with an overview of performance during 2010/11 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 help companies to assess risk as at more local level.

The risk to passengers, the workforce and members of the public are dealt with separately, in Chapters 5 to 7. Where appropriate, these chapters contain analysis of personal security and station safety.

The risk from train accidents is covered in Chapter 8, while the risk from the road-rail interface is covered in Chapter 9.

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.

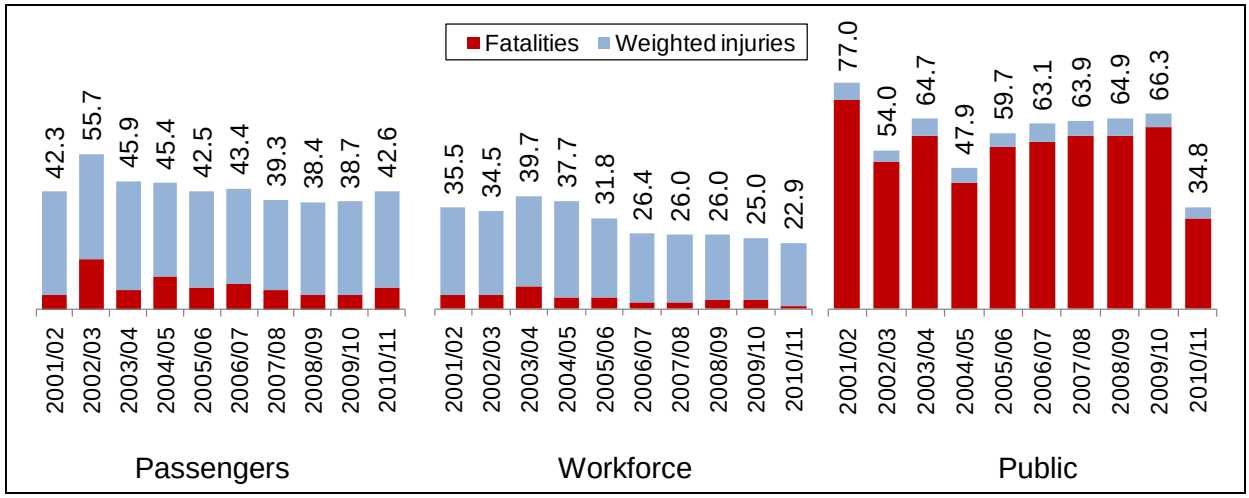
2 Safety overview

As stated in the European Safety Directive, the overarching safety requirement for European railways is to maintain safety and improve it when reasonably practicable. Over the past decade, and against a background of generally increasing rail usage, industry initiatives have brought about improvements in the safety of both passengers and workforce from train accidents and personal accidents.

2010/11 Headlines

- There were no passenger or workforce fatalities in train accidents. This is the fourth year in succession with no such fatalities. There were also no public fatalities in train accidents.
- In total, there were 40 accidental fatalities, 395 major injuries, 11,075 minor injuries and 1,331 cases of shock/trauma. The total level of harm was 100.4 FWI, compared with 130.0 FWI recorded in 2009/10. The main cause of the reduction has been a fall in the number of fatalities to members of the public.
- Of the 40 fatalities, eight were passengers, one was a member of the workforce and the remaining 31 were members of the public, 27 of whom were engaged in acts of trespass.
- Comparing 2010/11 with 2009/10, there has been an increase in passenger FWI of 10%, a fall in workforce FWI of 8% and a fall in public FWI of 48%.
- In addition the injuries above, which were accidental in nature, a further 208 people died as a result of suicide or suspected suicide.
- Based on SRMv7, the FWI risk from all sources (excluding suicide) on the railway is estimated to be 140.9 FWI per year; 37% occurs to passengers, 19% to the workforce, and 44% to members of the public. The fatality risk from all sources (excluding suicide) on the railway is estimated to be 70.7 fatalities per year; 15% occurs to passengers, 6% occurs to the workforce, and 79% occurs to members of the public.
- After a short period where passenger traffic growth slowed down due to the economic situation, 2010/11 saw a return to increasing numbers, with a rise in passenger journeys of 8% compared with 2009/10.

System safety at a glance



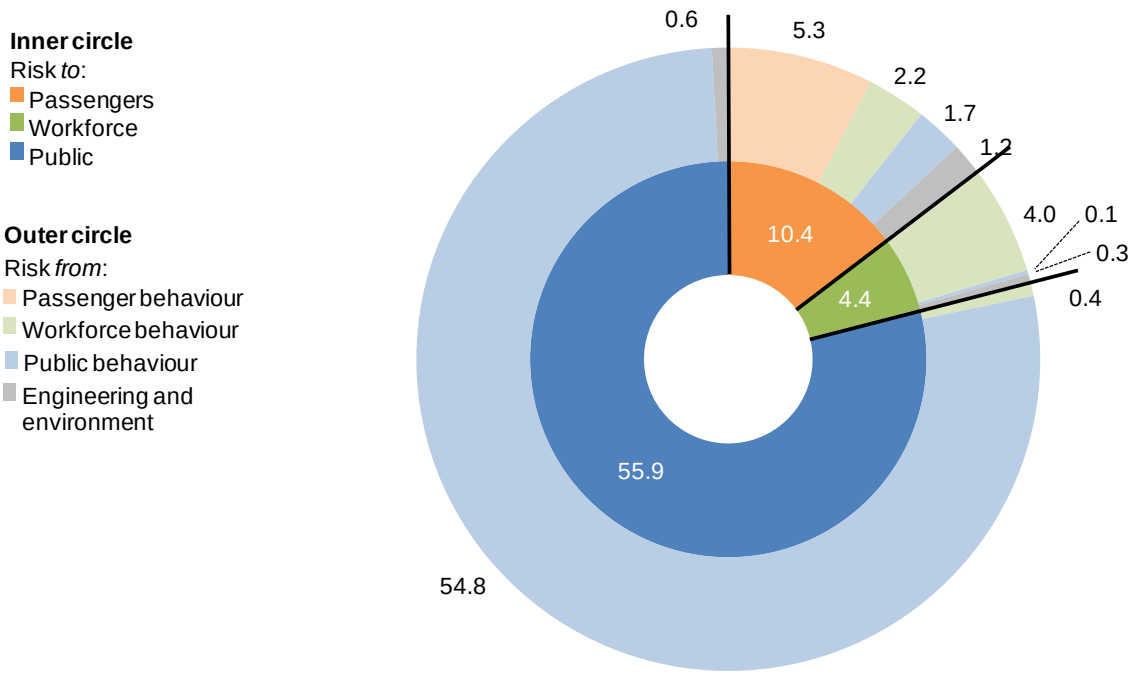
2.1 System risk profile

2.1.1 Fatalities

This section presents the SRMv7 fatality risk profile 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. The chart excludes fatality risk due to suicide or suspected suicide.

The SRM estimates the underlying level of risk based on the occurrence of precursors and potential accident sequences, taking full account of the low-frequency / high-consequence events that are normally not seen in a single year's safety performance.

Chart 1. Fatality risk profile from SRMv7, excluding suicide (70.7 fatalities/year)



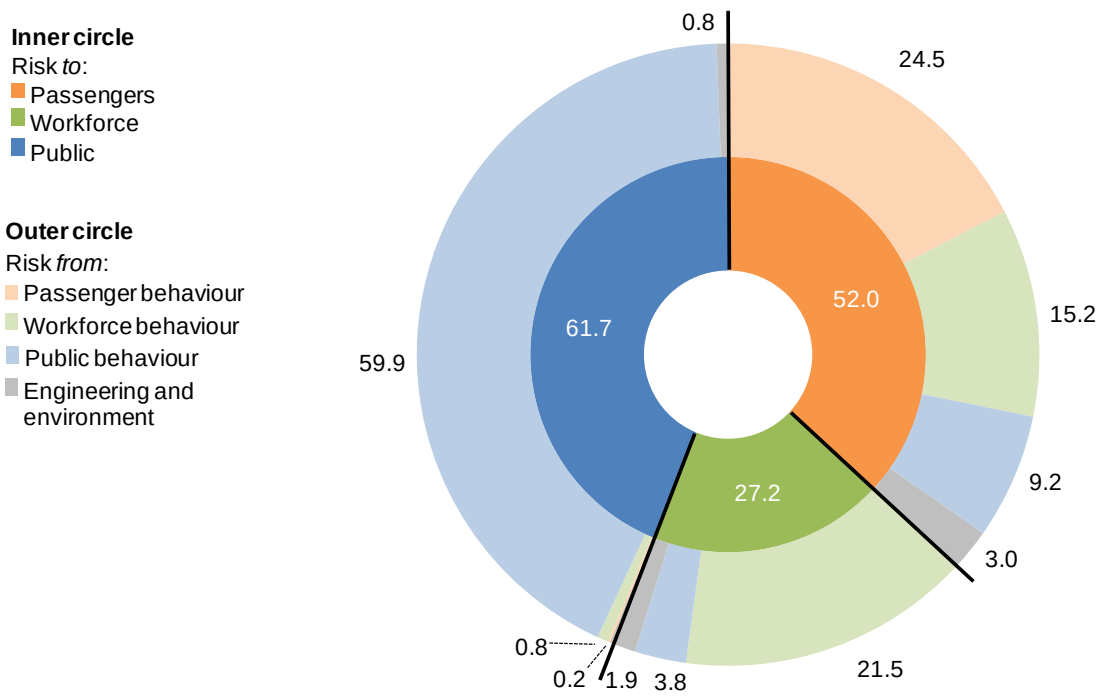
The accidental fatality risk from all sources on the railway is estimated to be 70.7 fatalities per year.

- 15% occurs to passengers, and whereas some of this is caused by passenger behaviour, nearly half is from sources outside their control.
- 6% of the total fatality risk occurs to the workforce. The majority of this is identified as being within the responsibility of the workforce.
- More than three-quarters of fatality risk occurs to members of the public, almost entirely as a result of their own behaviour.

2.1.2 Fatalities and weighted injuries

This section presents SRMv7 risk profile for passengers, the workforce and members of the public, this time based on FWI. Fatalities or injuries to people committing or attempting to commit suicide are not included in the chart, although any injuries or shock/trauma suffered by others in connection with these events is incorporated. To give a complete picture of risk on the railway, the information includes the estimated FWI risk from assaults.[4]

Chart 2. FWI risk profile from SRMv7, excluding suicide (140.9 FWI/year)



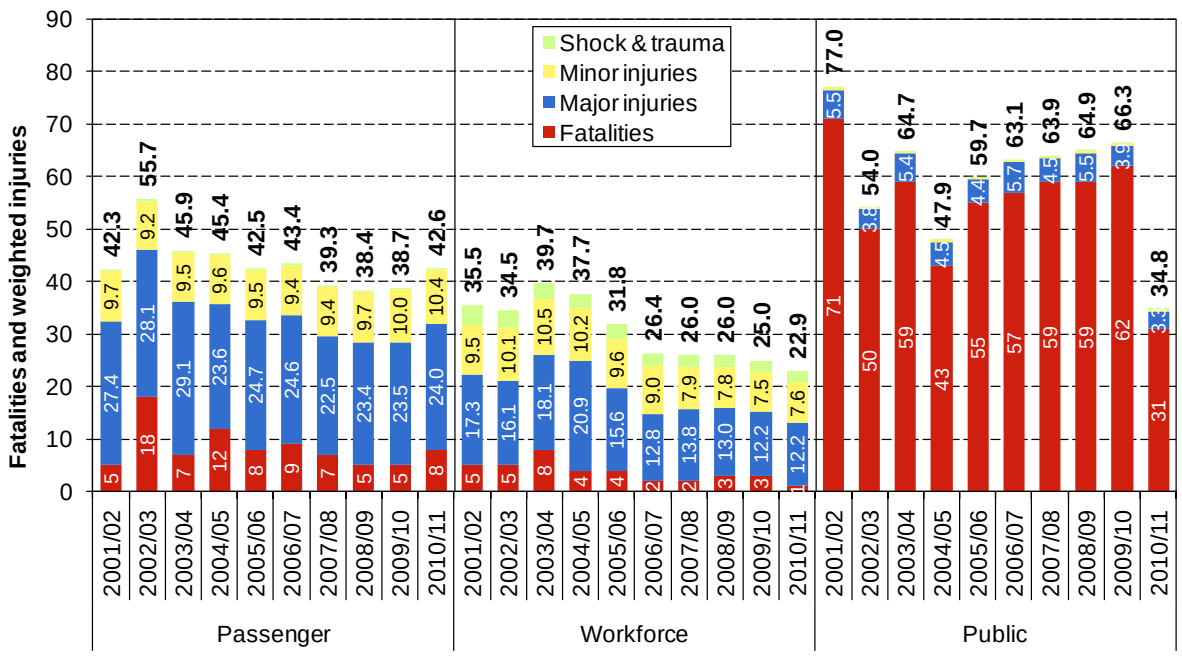
- The accidental FWI risk from all sources on the railway is estimated to be 140.9 FWI per year. FWI risk is split more evenly than fatality risk – 37% occurs to passengers, 19% to the workforce, and 44% to members of the public.
- Nearly half of the risk to passengers arises from passenger behaviour, but a notable proportion falls under the responsibility of the workforce. This is because events like passenger slips, trips and falls are considered to be partly due to workforce station management issues. Of the risk to passengers arising from public behaviour, most is due to assaults[5], with a much smaller proportion arising from road vehicle drivers at level crossings.
- Most of the risk to the workforce arises from the workforce itself. Around 3% is due to assaults from the public (including from passengers), 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] SMIS is not the main means whereby information on non-fatal passenger assaults is recorded: these type of events are recorded by BTP. The SRM estimate for assaults on passengers is therefore based on BTP data.
[5] The 2009–14 SSP assigns all assaults to the *public behaviour* risk area, even if the offender was a passenger.

2.2 Fatalities and injuries in 2010/11

Chart 3 shows the accidental fatalities and weighted injuries that occurred during 2010/11 compared with each year since 2001/02. Injuries due to suicide or suspected suicide are not included.

Chart 3. Accidental fatalities and weighted injuries



- There were no passenger or workforce fatalities in train accidents during 2010/11.
- Forty people died as a result of personal accidents the year. Eight were passengers, one was a member of the workforce and the remaining 31 were members of the public, 27 of whom were engaged in acts of trespass. When non-fatal injuries are taken into account, the total harm occurring during the year was 100.4 FWI.
- The overall harm to passengers has risen compared with recent years. This is due mainly to the higher number of fatalities that have occurred during the year. The overall harm to members of the workforce is at an historic low, as is the overall harm to members of the public.
- In any given year, the observed levels of harm may differ from SRM estimated values. One factor in this is statistical variation of frequently occurring events. 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 on-board injuries. SMIS data does not contain complete information on passenger assault, which is another reason for differences in passenger actual and estimated risk totals.
- A further 208 people died as a result of suicide or suspected suicide.

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	2010/11
Fatality	192	200	189	193	226	225	208	218	233	208
Major injury	37	33	30	23	33	33	27	34	25	36

2.3 Notable safety-related occurrences of 2010/11

This section presents a selection of the safety-related events of 2010/11.

April 2010

Workforce fatality at Stewarton Viaduct

On 13 April, a contractor working for Network Rail was fatally injured after the cherry picker[6], which he was using while engaged on bridge strengthening work, toppled over, causing him to fall around 70ft.

May 2010

Girl struck by train after chasing dog onto line

On 16 May, the driver of a passenger service reported that the train had struck a person on approach to Morley, at Old Gas House footpath crossing. Both lines were blocked. The incident occurred after a 16-year-old female had apparently run after her dog which had strayed onto the line. She was taken to hospital with severe leg injuries, and later died.

Multiple stabbing incident on board train near Woolwich Arsenal

On 28 May, the driver of a passenger service reported that, on investigating the activation of the passenger emergency equipment, he had discovered that four people had been injured in a stabbing incident. The train was made secure, and the area was declared a scene of crime. BTP later reported that the incident had begun as an argument about one person smoking, which escalated into a group of three persons attacking a fourth person, with all sustaining non-life threatening injuries. Arrests were made.

June 2010

Train derailment following collision with boulder on the line[7]

On 6 June, a two-car passenger train derailed on the single line west of Falls of Cruachan station, after striking a large boulder that had fallen onto the line. Passengers were subsequently detrained; no serious injuries reported were reported, although some passengers suffered minor injuries.

The line was blocked for eight days while the train was re-railed and the track repaired.

Girl injured while leaning from train window

On 25 June, a 13-year-old girl, who was leaning out of an open droplight window of a HST train, was struck in the face by lineside vegetation and suffered facial lacerations. The injured girl was treated by doctors who were travelling on the train, and was subsequently taken to hospital for facial surgery to be carried out.

[6] A cherry picker is a type of mobile elevated work platform (MEWP).
[7] Photograph reproduced by permission of ScotRail.

July 2010

Vehicle struck at UWC near Beccles

On 3 July, a passenger service collided with a 4x4 vehicle at Wrights No.19 user worked crossing (UWC), near Beccles. There were no injuries to passengers on board the service and the train did not derail. There were two occupants in the road vehicle, one was a child who suffered head injuries in the incident.

Train collision with fallen tree at Lavington[8]

On 10 July 2010, a passenger train ran into a tree that had fallen onto the track at Lavington. The 90mph collision caused extensive damage to the train cab and the driver suffered a broken wrist.

Train guard hit by train in suspected suicide

On 27 July, the driver of a passenger service reported the train had struck the guard of a second passenger service, which was running on the opposite line. The guard was seen to step from the inward-opening rear crew door of the unit as the trains approached each other, into the path of the oncoming train. Early indications are that the guard committed suicide, although investigations are ongoing.

August 2010

Level crossing collision near Sudbury[9]

On 17 August, a train driver and four passengers received major injuries when a train collided with a tanker on Sewage Works Lane UWC. Each of the other 16 occupants of the train received minor injuries.

Low-speed passenger train derailment at Guildford following SPAD

On 28 August, a passenger train became derailed as the train departed from Guildford station. All lines were initially blocked. Repair to the track was necessary, and the train was later re-railed. The incident was identified as being due to a Category A SPAD.

September 2010

Workforce assault at Topsham

On 4 September, police and an ambulance were summoned to Topsham station, after the guard of passenger service had been assaulted, sustaining bruising to his ribs. Up to 25 people were removed from Topsham station by the Devon & Cornwall Police. A member of the public was arrested and charged.

[8] Photograph reproduced by permission of RAIB: taken from *Rail Accident Report Collision between train 1C84 and a tree at Lavington, Wiltshire*. Report 08/2011. © Crown copyright 2011.
[9] Photograph reproduced by permission of RAIB: taken from http://www.raib.gov.uk/publications/current_investigations_register/100817_Sudbury.cfm . © Crown copyright 2011.

Passenger trespasser electrocuted by OHL at Durham

On 11 September, a person alighting from a train at Durham station threw a shoe onto the roof of the train. He then climbed up to retrieve it, but came into contact with the overhead electricity supply. The man subsequently fell from the train and landed on the track, having suffered critical injuries. He was taken to hospital but later died.

Second stabbing incident on board train near Woolwich Arsenal

On 29 September, civil police were called to attend at Woolwich Arsenal after a passenger service had arrived at the station with two gangs of youths fighting in the rear coach. BTP reported that seven persons had been arrested, with one having suffered knife-related injuries. A number of knives and other bladed weapons were recovered.

October 2010

Near miss with children near Llwynjack Viaduct

On 24 October, the driver of a Shrewsbury–Swansea service reported that, on approaching Llwynjack Viaduct, two children emerged onto the cess and immediately laid down in the four foot in front of the train. The driver was unable to stop and passed over the top of them. He brought the train to a stand after engaging the emergency brake and went back to investigate, but found no trace of the two people.

November 2010

Road vehicle incursion at Oxshott[10]

On 5 November, a cement lorry fell from Warren Lane Bridge at Oxshott onto the sixth and seventh coaches of a eight-car passenger service, resulting in the derailment of the train. Two passengers received major injuries. The lorry driver was also injured, and trapped in the vehicle cab. The bridge had sustained significant damage, and remedial work was required to the track.

December 2010

Member of the workforce trapped by girder at Pouparts Junction

On 27 December, a member of a crane crew, working within a possession at Pouparts Junction, sustained serious injuries to both legs. The man had been engaged in removing the straps from a steel bridge girder on a wagon. The girder rolled before a sling attached to the crane could take the strain and trapped him by his legs, leaving him suspended upside down from the wagon. The injuries resulted in the amputation of both legs.

Derailment in tunnel near Todmorden

On 28 December, a passenger service became derailed in Summit Tunnel, between Littlebrough and Todmorden, after striking a large piece of ice on the track. The derailed train remained upright, but struck the walls of the tunnel, and came to rest within the tunnel itself. No injuries were reported. The ice had apparently fallen from one of the tunnel

[10] Photograph reproduced by permission of RAIB: taken from http://www.raib.gov.uk/publications/current_investigations_register/101105_Oxshott.cfm . © Crown copyright 2011.

ventilation shafts. While waiting to be evacuated, the rear coach of the train was hit by a further fall of ice, from a different ventilation shaft.

January 2011

Fall from bridge at Linton Road – crime suspected

On 23 January, BTP reported that a woman had fallen off a bridge, landing a few feet from the track. The emergency services arrived on site and attended to the casualty, who was removed to hospital suffering from serious injuries. The area was being treated as a secondary crime scene at track level, the main scene being on the bridge, after the Sussex Police had been involved in a domestic dispute an hour earlier involving the woman and a second person.

February 2011

Passenger train derails on landslip near Bankhouse Tunnel[11]

On 5 February, the driver of a passenger service reported that the train had become derailed after running into a landslip. The train was approximately 200 yards on the approach to Bankhouse Tunnel. The train remained upright, and there were no reported major injuries to train occupants. Site inspection revealed that the retaining wall from the road above had given way, with debris falling onto the Down Main line.

March 2011

Train driver prevents suicide at station

On 17 March, the guard of a passenger service reported that the driver had restrained a suicidal person, who was on the track in front of his train at Bridgewater station. Avon & Somerset police arrived on site and the person was apprehended.

Tractor causes line blockage

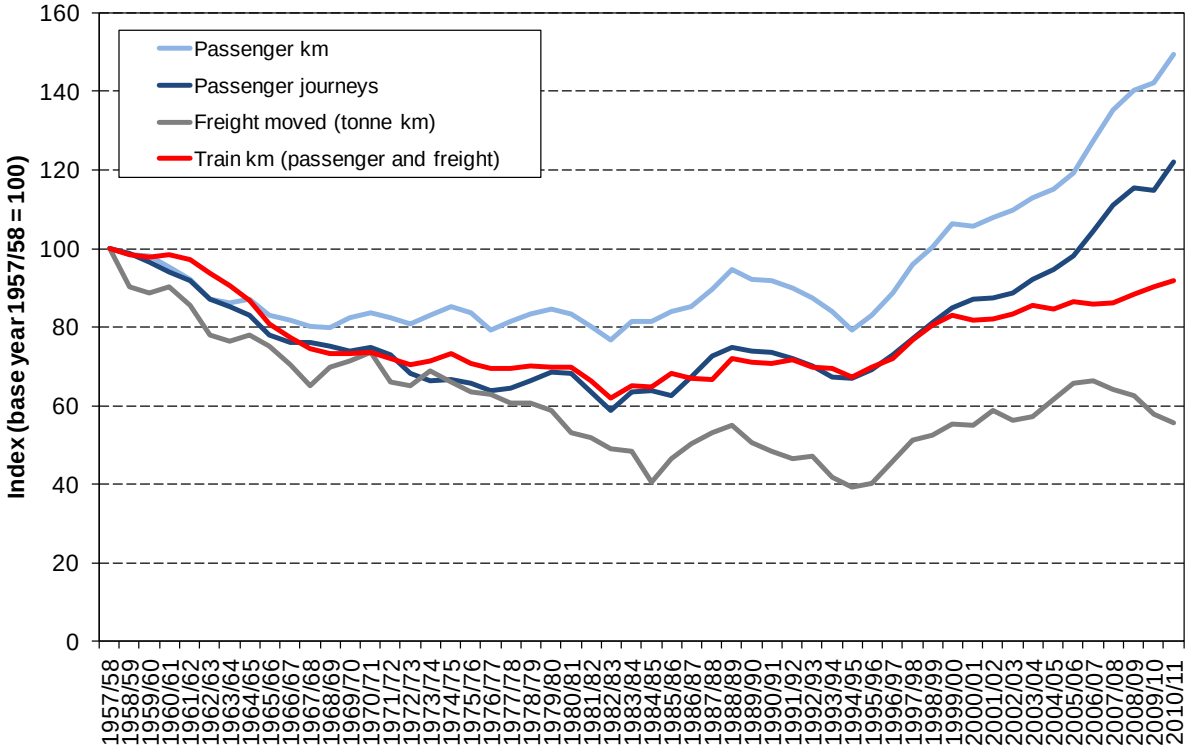
On 29 March, the coupling between a tractor and an effluent trailer parted as the vehicles travelled over Cherry Holt AHB crossing. The crossing was protected by the signaller with staff advised to attend. Track damage was caused by the tow bar between the vehicles, which had sheared away and dropped onto the rail, damaging it and the crossing surface.

[11] Photograph reproduced by permission of RAIB: taken from http://www.raib.gov.uk/publications/current_investigations_register/110205_Dryclough.cfm . © Crown copyright 2011.

2.4 Long-term historical trends

2.4.1 Rail usage

Chart 4. Trends in rail usage

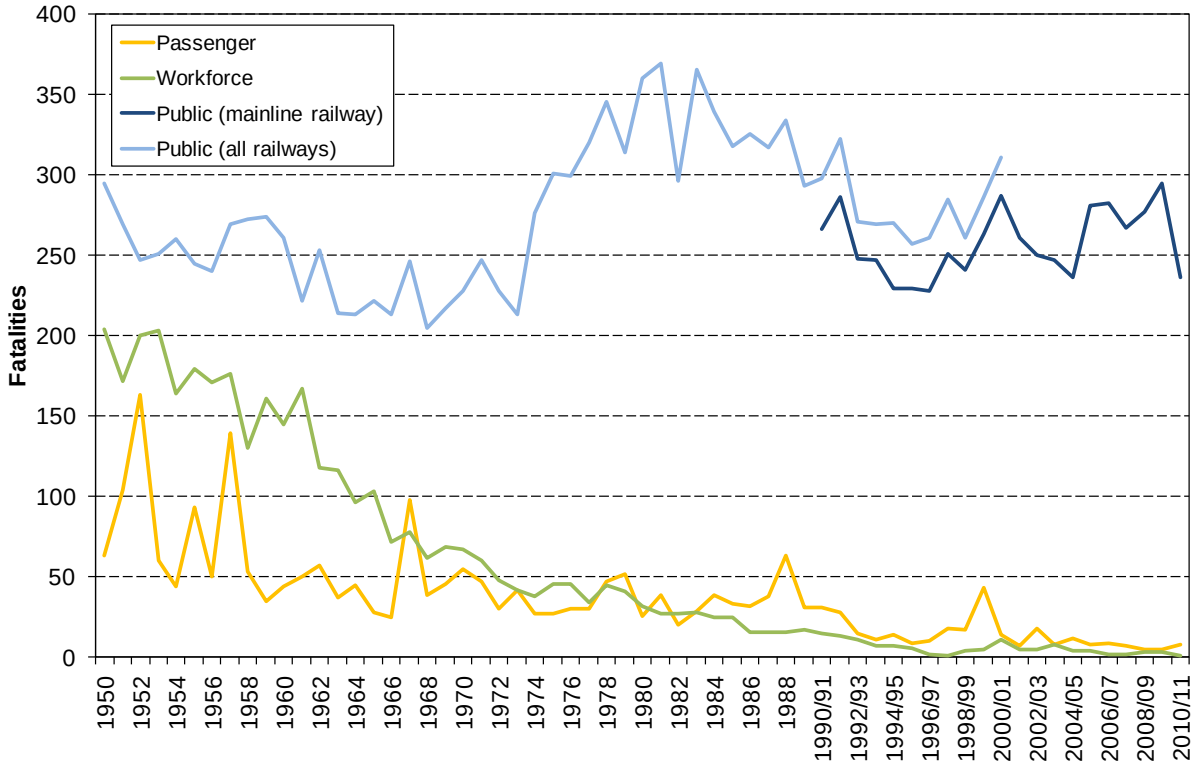


- Between the mid-1950s and early 1980s, passenger kilometres initially fell, and then stagnated, largely as a result of the increasing ownership of road vehicles.
- Since privatisation began in 1994/95, there has been a general growth in passenger kilometres and journeys, reflecting changes in society, transport policy and the economic climate.
- In 2009/10, the economic recession led to a slowing down in the growth in rail usage; passenger journeys showed a small decrease. However, figures for 2010/11 indicate that this has been a temporary effect, with rail passenger usage once again beginning to rise.
- Up until around 2006/07, freight usage showed a similar trend to passenger usage. However, since that time, the trend in freight has been decreasing.

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

2.4.2 Fatalities

Chart 5. Number of fatalities



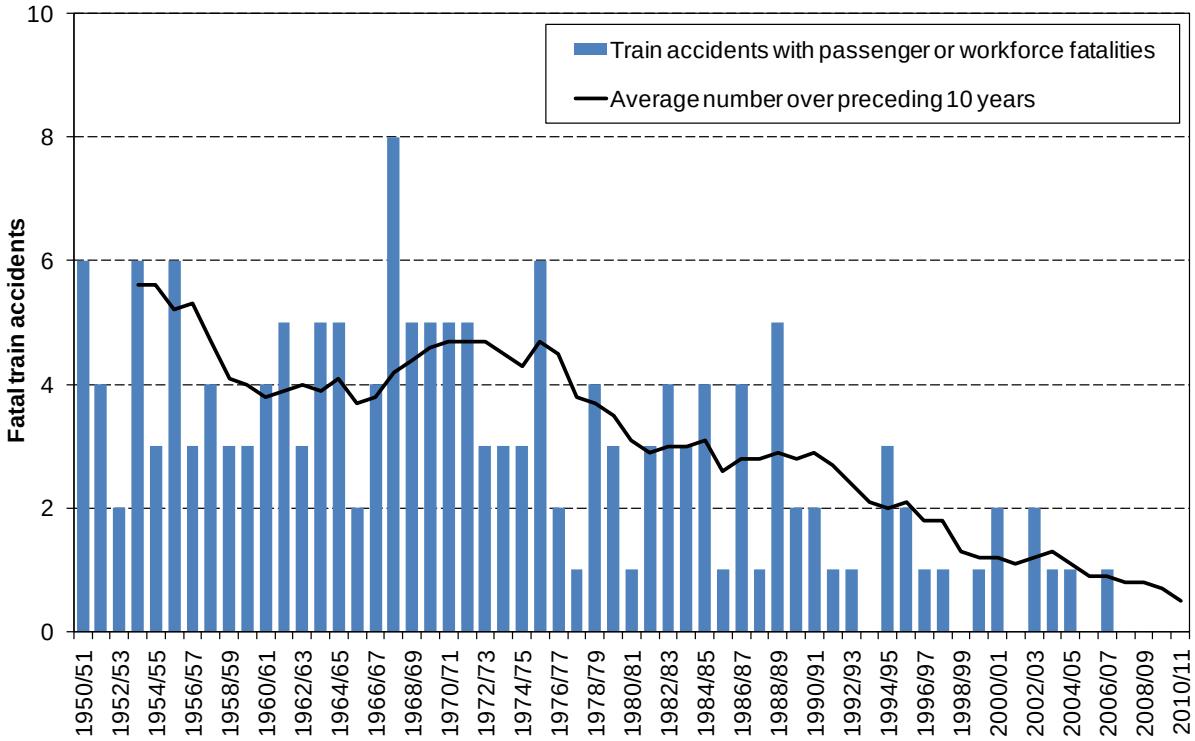
- The trend in fatalities for both passengers and workforce has shown marked long-term improvement.
- The greatest improvement over the past 60 years has been in the number of workforce fatalities, which exceeded 100 per year until the early 1960s.
  - The amount of maintenance work being performed during this time, as well as the more 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.
- The trends in public fatalities (trespass, suicide and suspected suicide) are shown for the whole railway system (ie including London Underground and other non-mainline systems) up to 2001/02 and for the mainline railway only from 1990/91 onwards. The 10-year period of overlap of the two lines indicates that trends have been similar for each.
- In contrast to trends for passengers and workforce, 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.

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.

2.4.3 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



- There were no train accidents resulting in passenger or workforce fatalities during 2010/11. This is the fourth year in succession with no such fatalities; the 10-year rate of fatal train accidents now stands at its lowest ever level.
- Over the last 60 years, the number of train accidents resulting in fatalities to passengers and/or members of the workforce has reduced significantly.
- Based on a ten-year moving average, the current rate of train accidents with passenger or workforce fatalities is 0.5 per year, the lowest ever level.
- The chart does not show train accidents that result solely in fatalities to member of the public, for example as a result of a train collision with a road vehicle.

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

2.5 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 etc Act 1974*, and the collective commitment of the rail industry to put safety first, may be expected to consolidate past user experience of progressive improvement.

2.5.1 Future influences on safety

2010/11 has seen a return to growth in passenger usage of the railway, and the industry continues to prepare for significant growth in the future. The *Rail Technical Strategy*, published in 2007, brings together a long-term vision for the railway in 30 years, with the aim of meeting 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.[12]

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.

The publication of the recent *Value for Money* Study report by Sir Roy McNulty in May 2011 is likely to have a significant influence on both the structure and operation of the rail industry in the future. The remit for the study was "*to identify options for improving value for money … while continuing to expand network capacity as necessary*". Sir Roy concludes that the recommendations in the report, if fully implemented, could achieve the target of a 30% unit cost reduction by 2018/19 based on current estimates of future demand. Such significant cost reductions present challenges to the industry to continue to comply with the European Safety Directive requirement to, at the very least, maintain safety and, in line with technical and scientific progress, improve safety when reasonably practicable.

The challenges and opportunities are:

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

1. If the industry goes through a period of significant organisational change, there will be risks associated with those changes, which will need to be managed. These risks relate to the orderly migration of responsibilities, including achieving clarity as to who does what and with what authority, and ensuring the maintenance and development of competencies where they are needed. Also of importance will be sustaining the morale and focus of the workforce.

2. The opportunity to develop industry systems and processes to support distributed decision making – recognising that network-wide benefits and interoperability demand that some issues are determined centrally, while enabling more localised decisions as to how to deliver the industry's outputs to its customers.

3. The opportunity to identify areas where overly restrictive risk controls are currently being applied which can be relaxed without significantly increasing safety risk.

4. The opportunity to develop the Safety Risk Model to support the new industry structure. While the current Safety Risk Model (SRM) has supported the industry well with understanding and managing risk, an approach which develops the model into more route specific / localised risk modelling would support and facilitate local risk based decision making.

In view of this, RSSB, in conjunction with Network Rail and the train operating companies, is undertaking research project T972 *Piloting a simulation-based risk model for the rail network in Great Britain.* The aim of the project is to investigate the potential for more route-specific / localised risk modelling using simulation-based risk modelling. It will incorporate the existing SRM modelling structures, and obtain inputs directly from industry asset databases including:

- The current timetable and the modelling of the change in risk from timetable change
- Network Rail asset and asset condition databases:
  - Track
  - Signals
  - Structures
- Rolling stock related databases:
  - Rolling stock types
  - Crashworthiness

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 Leadership Group (TLSG), 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 2.5.2.

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

GSM-R allows direct voice 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, the southern end of the East and West Coast Main Lines and North London; 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. ERTMS includes an Automatic Train Protection (ATP) system, reducing the likelihood of train collisions, and continual speed supervision, reducing the risk arising from overspeeding. The national implementation plan (the detail of which is currently under revision) sets out the plan for widespread implementation of ERTMS across much of the GB rail network in the next few decades based on anticipated commercial benefits that ERTMS can bring. The Cambrian Line, which runs from just outside Shrewsbury to Aberystwyth and Pwllheli in Wales, entered service with ERTMS Level 2 earlier in 2011 and work is in progress for fitment on parts of the Thameslink and Great Western routes.

It has been recognised, however, that ERTMS is a long-term project and it will be many years before a substantial proportion of the rail network is covered by the system. In the meantime the industry has recognised the need to maintain, and where reasonably practicable, develop the TPWS to meet the ongoing train protection requirements of the industry. In view of this, at the end of 2009, the RSSB Board approved a long-term strategy for TPWS. Details of the strategy can be found at:

http://www.rssb.co.uk/SAFETY/Pages/TPWSSTRATEGY.aspx.

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.

Network Rail is continuing with its trials at Filey of an obstacle detector system that uses radar to detect objects. This has now been enhanced with an additional low-cost light detection and ranging (LIDAR) system which can check to see if any low-level obstructions such as a child or someone who has fallen down are on the crossing. If this can be developed further to engineering integrity SIL 3 level, it may be able to dispense with the

radar equipment and make substantial cost savings. Once the trials are complete Network Rail plans to upgrade a number of CCTV crossings with the new equipment and functionality.

2.5.2 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 TSLG 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 DfT 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.

TSLG is the industry client group for strategic research, and it has an overview of the work of System Interface Committees that assist the railway industry to manage the relevant 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).

2.5.3 Sustainable Rail Programme

The Sustainable Rail Programme (SRP) supports the industry in addressing the risks and opportunities of sustainable development. Focussed on key strategic issues, such as carbon, and on embedding sustainability at the heart on the industry, key achievements have included:

- The publication of the Rail Industry Sustainable Development Principles
- The development of an agreed framework to manage industry carbon emissions in CP5 and beyond
- Strengthening the coverage of sustainability in franchising

In autumn 2011, the SRP will be launching a self assessment tool, to help organisations from across the rail sector assess and improve their own sustainability performance.

2.6 Safety overview key safety facts

Overview	2006/07	2007/08	2008/09	2009/10	2010/11
Fatalities					
Passenger	9	7	5	5	8
Workforce	2	2	3	3	1
Public	57	59	59	62	31
Total	**68**	**68**	**67**	**70**	**40**
Major injuries					
Passenger	246	225	234	235	240
Workforce	128	138	130	122	122
Public	57	45	55	39	33
Total	**431**	**408**	**419**	**396**	**395**
Minor injuries					
Passenger	4888	5028	5237	5280	5555
Workforce	6202	5663	5455	5305	5335
Public	159	140	126	186	185
Total	**11249**	**10831**	**10818**	**10771**	**11075**
Shock/trauma					
Passenger	322	330	260	205	227
Workforce	1450	1422	1335	1140	1101
Public	3	7	7	3	3
Total	**1775**	**1759**	**1602**	**1348**	**1331**
Fatalities and weighted injuries					
Passenger	43.4	39.3	38.4	38.7	42.6
Workforce	26.4	26.0	26.0	25.0	22.9
Public	63.1	63.9	64.9	66.3	34.8
Total	**132.9**	**129.2**	**129.3**	**130.0**	**100.4**
Suicide and attempted suicide					
Suicides	225	208	218	233	208
FWI	228.4	210.8	221.5	235.6	211.9

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).

2010/11 Headlines

- For 11 of the 15 trajectories set out in the 2009-2014 SSP, risk satisfies the trajectory, with varying levels of stability.
- For four of the 15 SSP trajectories, risk is not within the trajectory. These trajectories relate to train accident risk from rolling stock failure, passenger risk at the platform-train interface, passenger injuries on board trains, and trespass.
- 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 Agency, via the NRVs.

Performance at a glance

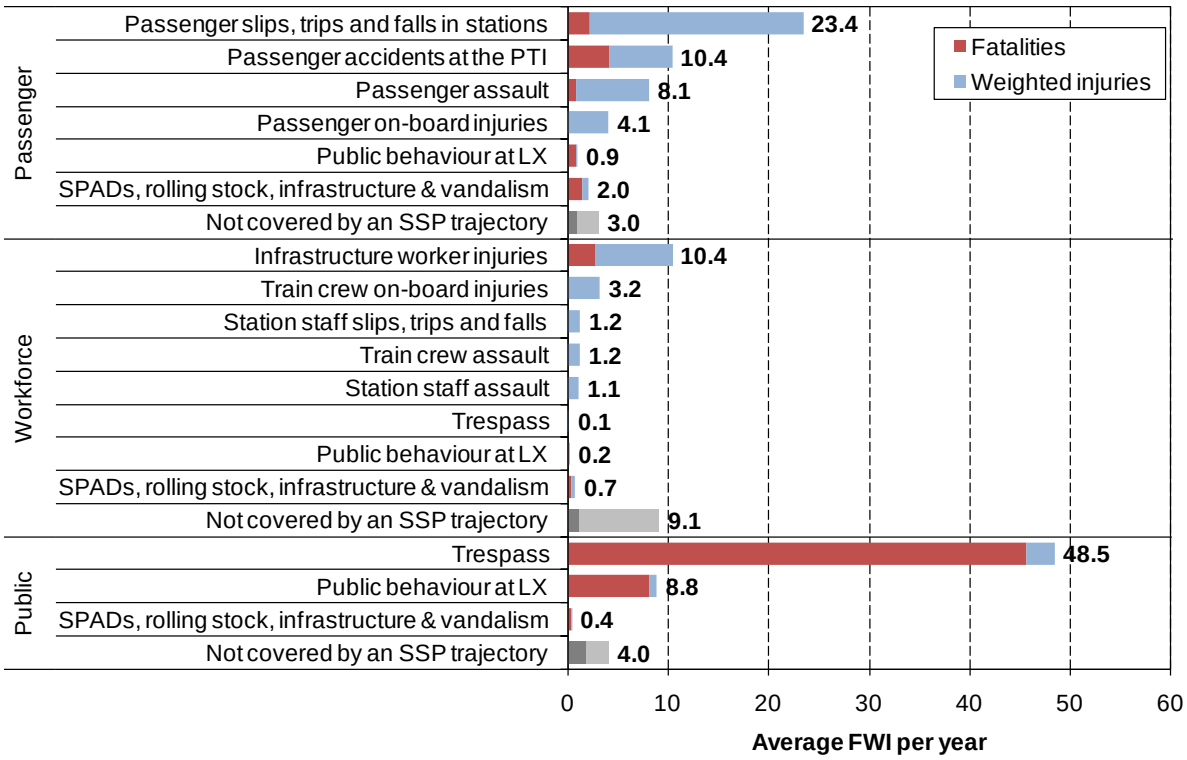
2009 – 2014 Strategic Safety Plan	Passenger slips, trips and falls in stations	Performance currently satisfies trajectories – ie is within or below trajectory range. Stability of performance varies for each trajectory; see charts for details.
	Train crew injuries on board trains	
	SPADs	
	Risk to infrastructure workers	
	Station staff slips, trips and falls	
	Train accidents due to infrastructure failure	
	Assaults on passengers	
	Assaults on train crew	
	Assaults on station staff	
	Public behaviour at level crossings	
	Vandalism	
	Passenger injuries on board trains	Performance currently not within trajectory.
	Passenger accidents at the platform train interface	
	Trespass	
	Train accidents due to rolling stock failure	
High Level Output Specification	Passenger risk	Performance is in line with HLOS 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 Key Risk Areas (KRAs), which together account for 98% of the total FWI risk as measured by SRMv7.

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 SRMv6.5. Fifteen trajectories have been defined in total. Together, they cover 89% of the total FWI risk, and 94% of the fatality risk (excluding suicide and suspected suicide).

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



Source: SRMv7

- The SSP trajectories cover 94% of risk to passengers, 67% of risk to the workforce and 93% of risk to members of the public.
- 45% 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 passenger fatality risk.
- Infrastructure worker injuries are the largest contributor to the workforce risk profile, at 38%.
- Most of the public risk arises from trespass, with a notable amount being due to public behaviour at level crossings.

3.1.1 How progress towards the trajectories is measured

The SRM is being used as the primary means of measuring the performance of the industry against the SSP trajectories over CP4. Full updates of the SRM occur at specific points during CP4. SRMv6 was applied at the beginning of CP4, SRMv7 is being used to assess the change in risk occurring at the end of 2010/11, and SRMv8 will be used at the end of CP4 (March 2014).

In producing SRMv7, some improvements to the modelling of a number of hazardous events and precursors took place. To ensure that comparisons of risk at the end of 2010/11 with risk at the start of CP4 are based only on changes in performance data, and not on changes in modelling approaches, SRMv6 risk estimates were updated to reflect the modelling changes used in SRMv7. The updated SRMv6 has been termed SRMv6.5. Both SRMv7 and SRMv6.5 take into account the additional risk estimated to be due to the under-reporting of RIDDOR-reportable injuries by Network Rail and its contractors, which particularly affects the area of infrastructure worker risk.

All charts in this section show the comparison between SRMv6.5 risk estimates (March 2009) and SRMv7 risk estimates (March 2011).

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.

It should be noted that the statistics in other chapters of the report are not necessarily normalised, and are subject to the effects of statistical variation. Hence it is not always possible to draw a direct comparison between the charts in this section and those in later chapters. Where trajectory charts and performance charts appear to give somewhat different pictures of risk trends in a particular area, an explanation has been given with the trajectory chart.

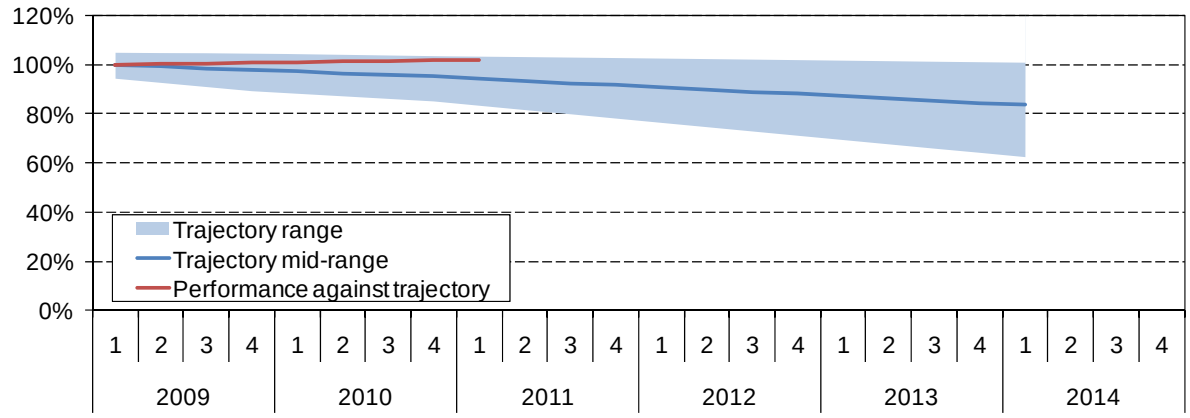
Between SRM updates, an indication of the performance against the trajectories will be provided via an interim monitoring process every six months. While not equivalent to a full update of the SRM, the interim method is designed to show the trend in risk, thereby giving an indication of the likely outcome of the full SRM updates when they are made. The interim methodology was reviewed and endorsed by Safety Policy Group (SPG)[13] in October 2009, and is in line with the interim methodology being used for tracking progress against the HLOS, which was similarly endorsed by SPG. Details on the methodology are presented in Appendix 3, for information.

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

Risk to passengers from slips, trips and falls in stations

Passenger slips, trips and falls at stations account for 23.4 FWI per year, which is 17% of the total system risk.

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

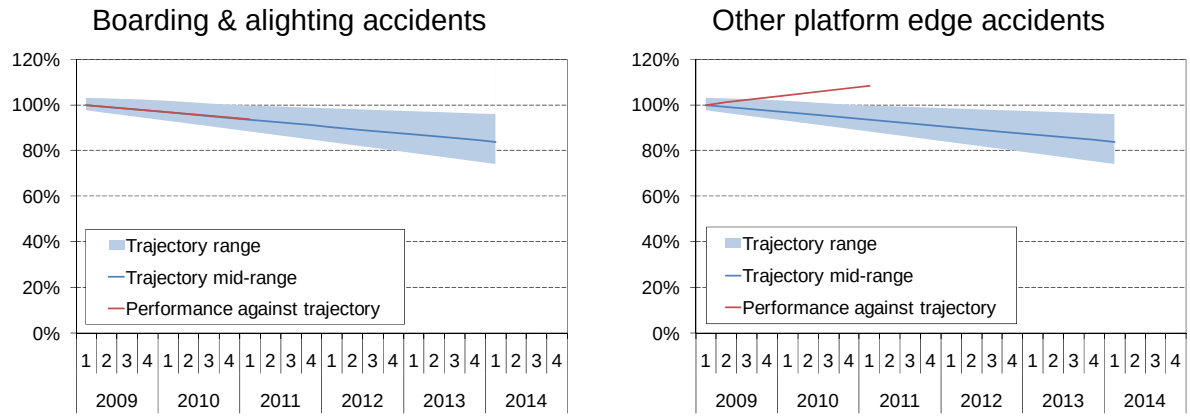


- The 2009-2014 SSP projected a best estimate improvement of around 16% by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5, risk at the end of 2010/11 is higher than at the start of CP4, but still falls within the SSP trajectory range.

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 10.4 FWI per year, which is 7% of the total system risk.

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

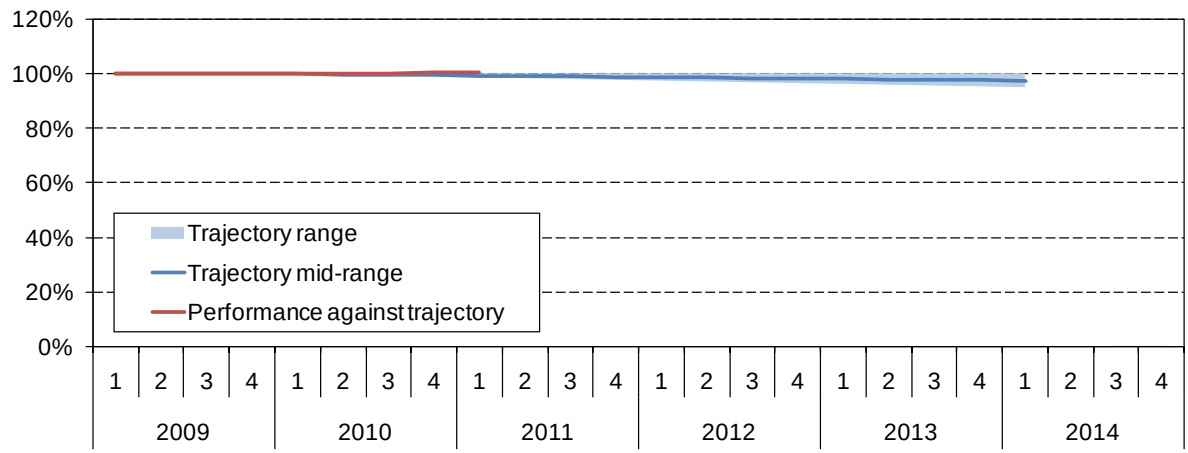


- The 2009-2014 SSP projected a best estimate improvement of around 16% by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5 for boarding and alighting risk, risk at the end of 2010/11 satisfies the SSP trajectory. Based on the comparison of SRMv7 and SRMv6.5 for other platform edge risk, risk at the end of 2010/11 does not satisfy the SSP trajectory. This reflects the charts on PTI performance, seen elsewhere in the report.

Risk to passengers from on-board injuries

Passenger injuries on board trains account for 4.1 FWI per year, which is 3% of the total system risk.

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

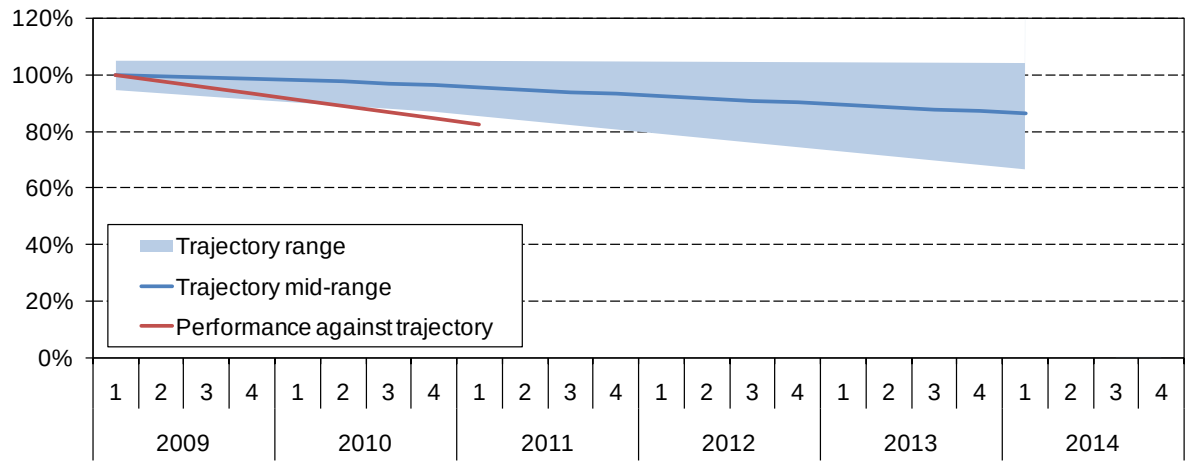


- The 2009-2014 SSP projected a best estimate improvement of around 3% by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5 for on-board injury risk, risk at the end of 2010/11 shows very little change from the start of CP4. To meet the trajectory, future improvement will need to occur.

Risk to train crew from on-board injuries

Train crew injuries on board trains account for 3.2 FWI per year, which is 2% of the total system risk.

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

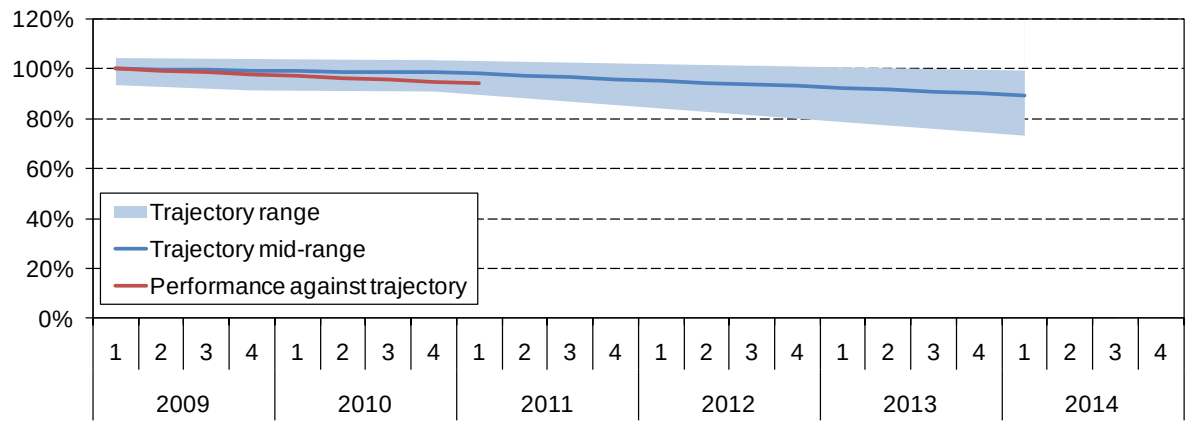


- The 2009-2014 SSP projected a best estimate improvement of around 14% by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5, risk at the end of 2010/11 satisfies the SSP trajectory.

Risk from SPADs

SPADs account for 0.9 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

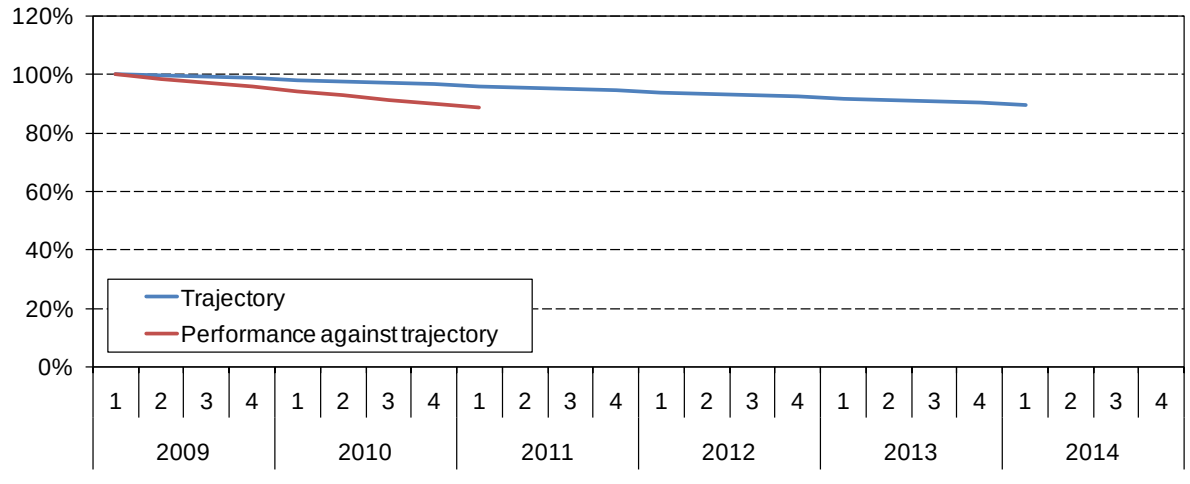


- The 2009-2014 SSP projected a best estimate improvement of around 10% by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5 risk from SPADs, risk at the end of 2010/11 satisfies the SSP trajectory.

Risk to infrastructure workers

Infrastructure worker injuries account for 10.4 FWI per year, which is 7% of the total system risk. When the adjustment for under-reporting of RIDDOR injuries is taken, the estimated level rises to 11.1 FWI.

Chart 13. Progress against trajectory related to infrastructure worker injuries

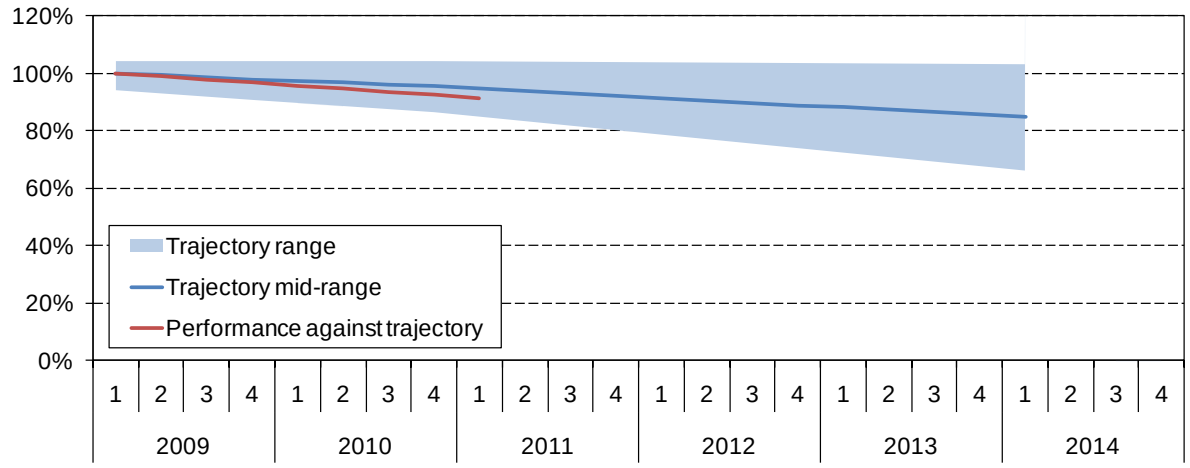


- The 2009-2014 SSP projected a best estimate improvement of around 10% by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5 (adjusted for RIDDOR under-reporting) levels of risk to infrastructure workers, risk at the end of 2010/11 satisfies the SSP trajectory.

Risk to station staff from slips, trips and falls

Station staff slips, trips and falls at stations account for 1.2 FWI per year, which is around 1% of the total system risk.

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

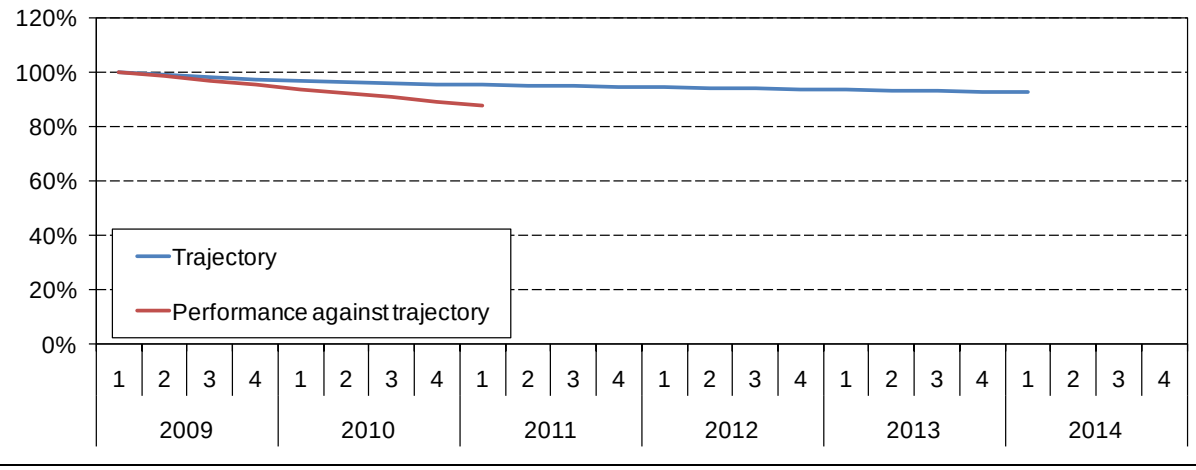


- The 2009-2014 SSP projected a best estimate improvement of around 15% by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5, risk at the end of 2010/11 satisfies the SSP trajectory.

Risk from train accidents caused by infrastructure failure

Infrastructure failure accounts for 1.4 FWI per year, which is around 1% of the total system risk. Of this, 1.2 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

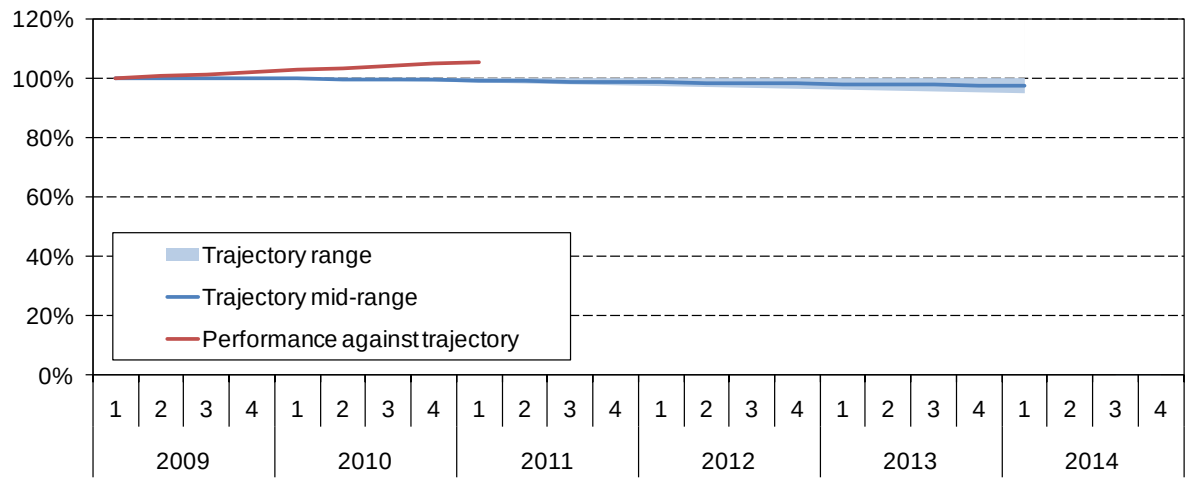


- The 2009-2014 SSP projected a best estimate improvement of around 7% by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5, risk at the end of 2010/11 satisfies the SSP trajectory.

Risk from train accidents caused by rolling stock failure

Rolling stock failure accounts for 0.6 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

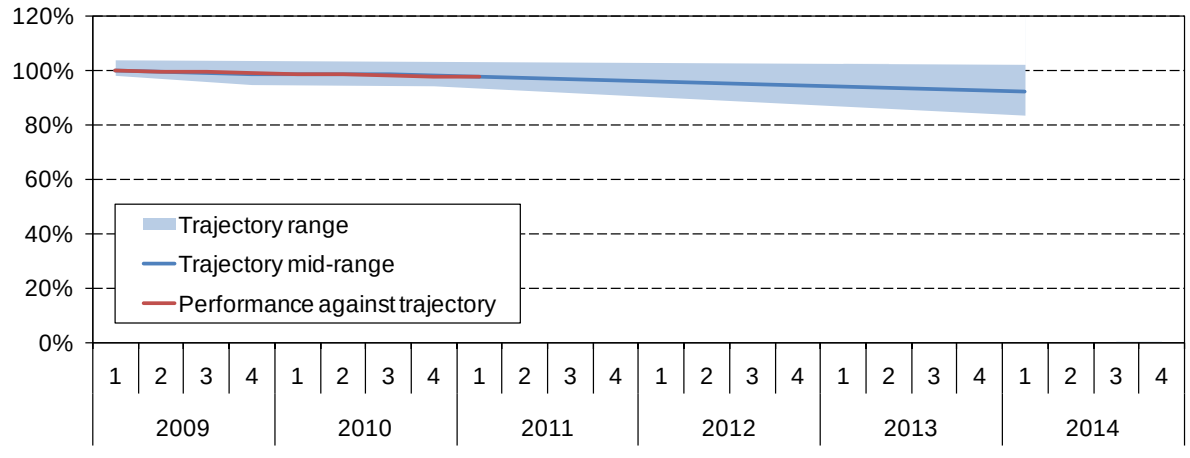


- The 2009-2014 SSP projected a best estimate improvement of around 3% by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5, risk at the end of 2010/11 is above the SSP trajectory. The rolling stock contribution to train accident risk is estimated to be very low, and small changes in absolute value can have large percentage changes. The absolute change in FWI between the two estimates is around 0.05 FWI.

Risk to passengers from assault

Assaults on passengers account for 8.1 FWI per year, which is 6% of the total system risk.

Chart 17. Progress against trajectory related to passenger assaults

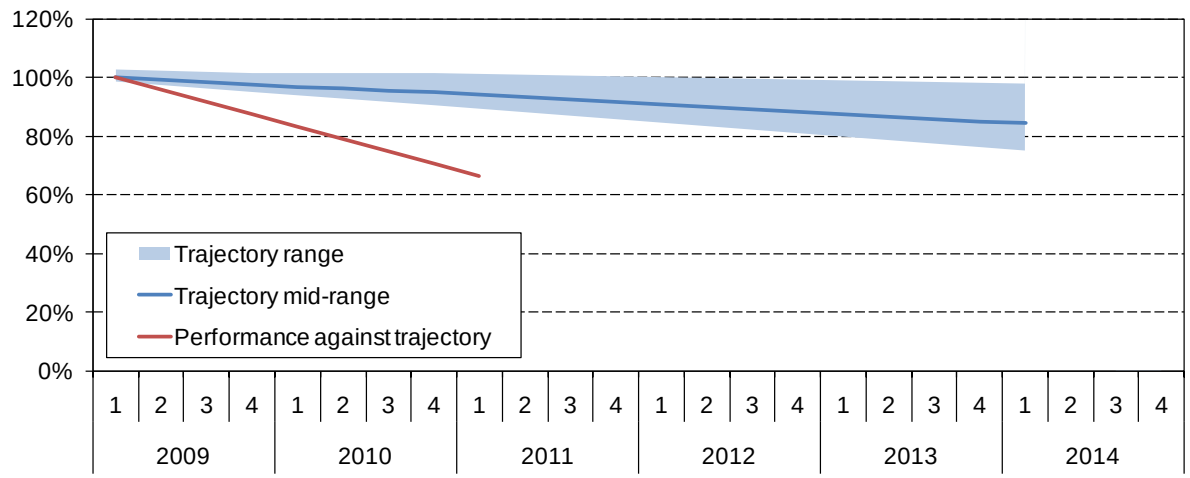


- The 2009-2014 SSP projected a best estimate improvement of around 8% by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5, risk at the end of 2010/11 satisfies the SSP trajectory.

Risk to train crew from assault

Assaults on train crew account for 1.2 FWI per year, which is around 1% of the total system risk.

Chart 18. Progress against trajectory related to train crew assaults

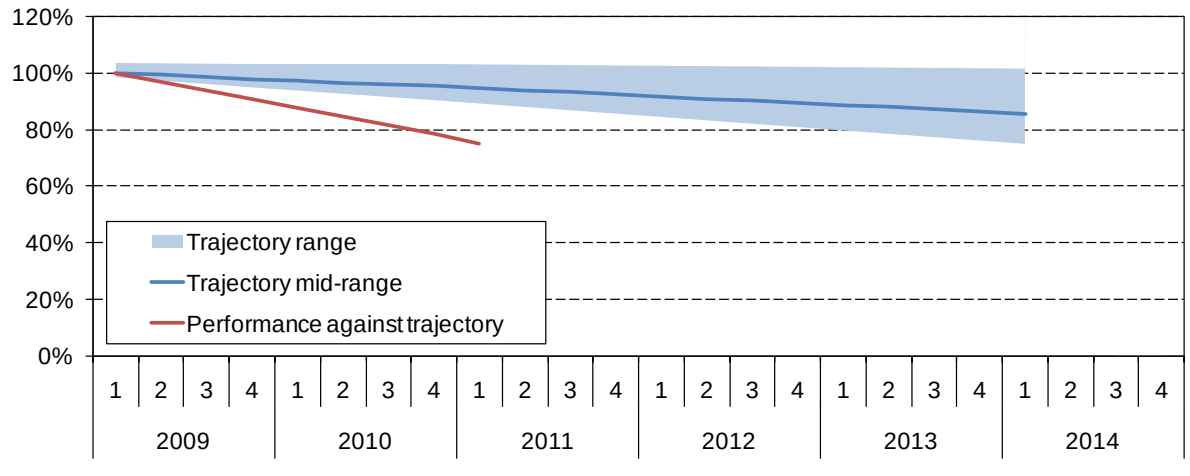


- The 2009-2014 SSP projected a best estimate improvement of around 16% by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5, risk at the end of 2010/11 satisfies the SSP trajectory.

Risk to station staff from assault

Assaults on station staff account for 1.1 FWI per year, which is around 1% of the total system risk.

Chart 19. Progress against trajectory related to station staff assaults

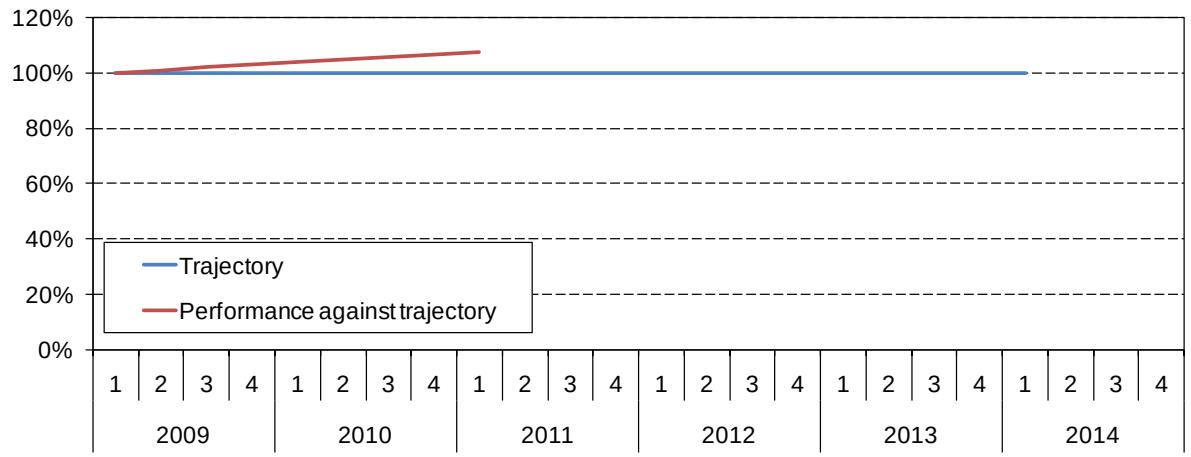


- The 2009-2014 SSP projected a best estimate improvement of around 14% by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5, risk at the end of 2010/11 satisfies the SSP trajectory.

Risk from trespass

Trespass accounts for 48.6 FWI per year, which is 35% of the total system risk.

Chart 20. Progress against trajectory related to trespass

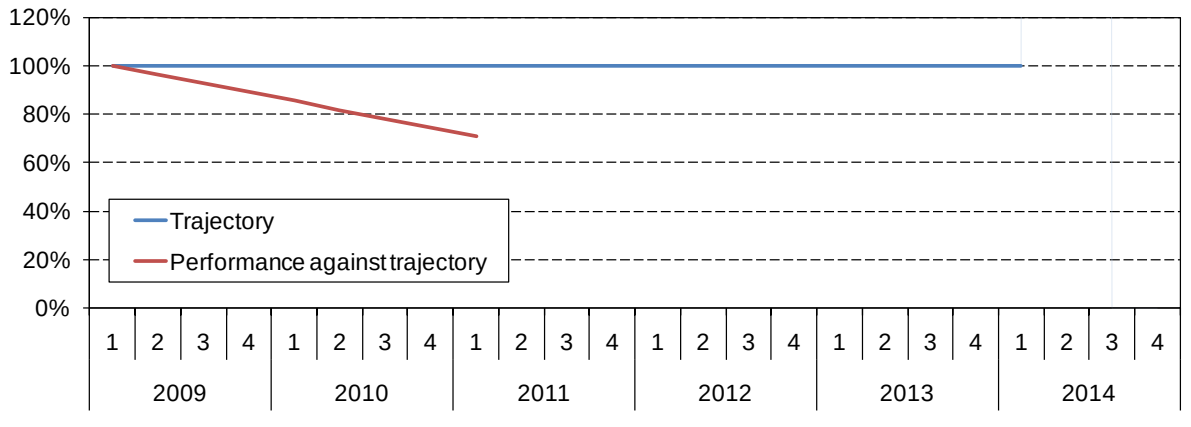


- The 2009-2014 SSP projected a level trend in trespass by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5, risk at the end of 2010/11 does not satisfy the SSP trajectory. This result may seem surprising given the fall in trespasser fatalities seen for 2010/11. The reason for the difference is the data periods covered by SRMv6.5 and SRMv7, which for trespass risk, correspond the three-year periods ending September 2008 and September 2010 respectively. Over these periods, trespass injuries increased.

Risk from vandalism

Vandalism is estimated to account for 0.5 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

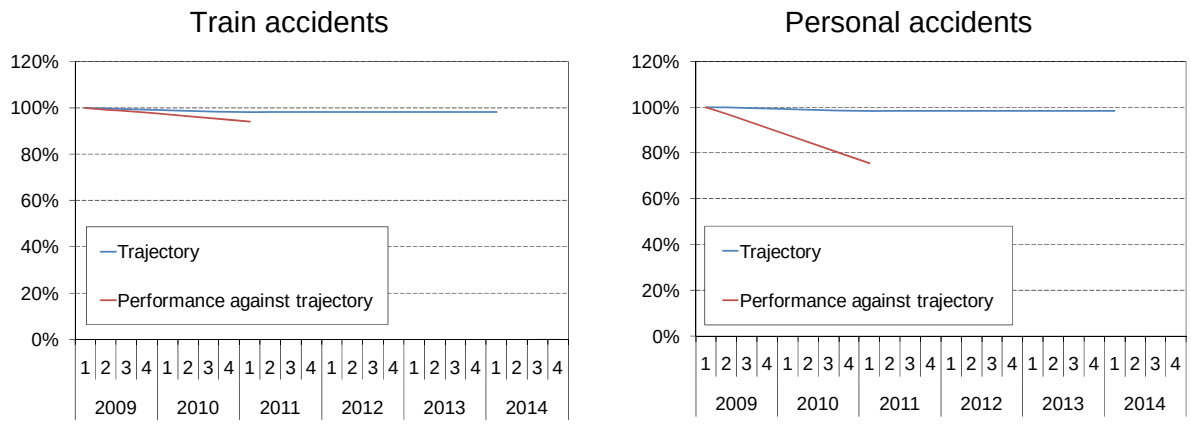


- The 2009-2014 SSP projected a level trend in vandalism risk by the end of March 2014.
- Based on the comparison of SRMv7 and SRMv6.5, risk at the end of 2010/11 satisfies the SSP trajectory.

Risk from public behaviour at level crossings

Public behaviour at level crossings accounts for 9.9 FWI per year, which is 7% of the total system risk. Of this, 3.0 FWI arises from train accidents (2.6 of which occurs to members of the public) and 6.9 FWI arises from personal accidents.

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

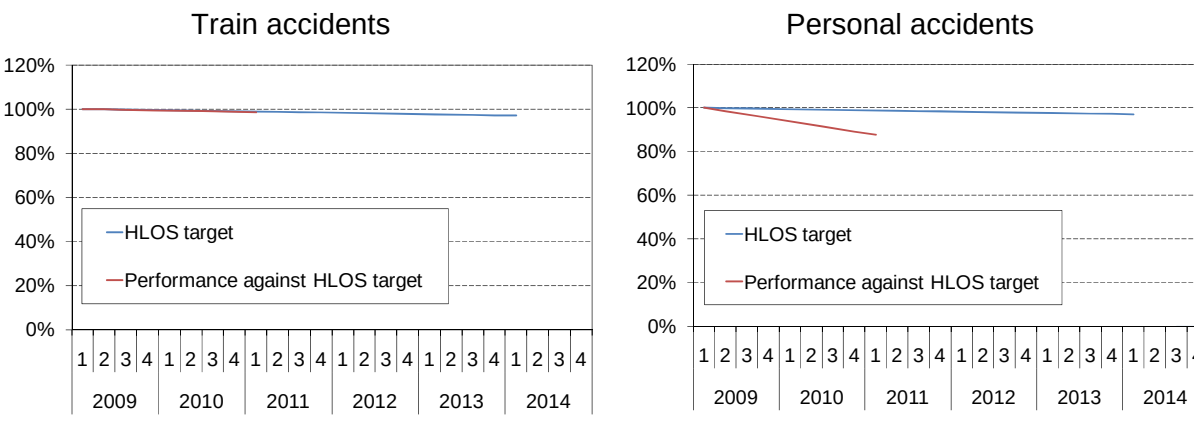


- The 2009-2014 SSP projected a best estimate improvement of around 2% by March 2014.
- Based on the comparison of SRMv7 and SRMv6.5, risk at the end of 2010/11 for both train accident risk and personal accident risk satisfies the SSP trajectory.

Trends in performance within categories not covered by an SSP trajectory

Around 16.0 FWI arises from causes that are not covered by an SSP trajectory; this is 11% of the total system risk, excluding suicide. Of this, 2.3 FWI arises from train accidents, and 13.7 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 comparison of SRMv7 and SRMv6.5, risk at the end of 2010/11 satisfies the HLOS target for both train accident risk and personal accident risk that are not covered by SSP trajectories.

3.2 DfT High Level Output Specification

In the 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 CP4, which runs from 1 April 2009 to 31 March 2014.

The HLOS metrics[14] are:

Passenger metric:	Baseline at April 2009:	0.988 FWI per billion passenger km
	Target at March 2014:	0.959 FWI per billion passenger km
Workforce metric:	Baseline at April 2009:	0.135 FWI per million workforce hours
	Target at March 2014:	0.131 FWI per million workforce hours

It has been agreed by the DfT, the ORR and the industry that the safety metrics will be monitored using the SRM. The approach for doing so is exactly the same as for the monitoring of the SSP trajectories (as outlined in section 3.1.1). The interim monitoring of the HLOS also follows the same methodology as that used for the SSP trajectories (as outlined in section 3.1.1 and in Appendix 3).

The HLOS targets 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 calculation of the HLOS is subject to additional data restrictions over and above normal SRM and ASPR scope. The following are excluded from the calculation:

- All injuries entered by Eurostar
- Workforce injuries due to being involved in road traffic accidents while on duty
- Suicide, suspected suicide and attempted suicide[15]
- Verbal assaults and threats

Results from the second annual 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 2011, 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. Trends will continue to be monitored throughout the period.

[14] The passenger and workforce baseline and target metric values are different from those published in the 2009/10 ASPR. This is because of the modelling update done to SRMv6 (termed SRMv6.5), which has resulted in a modification of the April 2009 estimates (and hence the March 2014 values, which are a 3% reduction on the baseline values).

[15] Any physical injuries, or shock/trauma, arising to third parties as a result of these events are included.

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

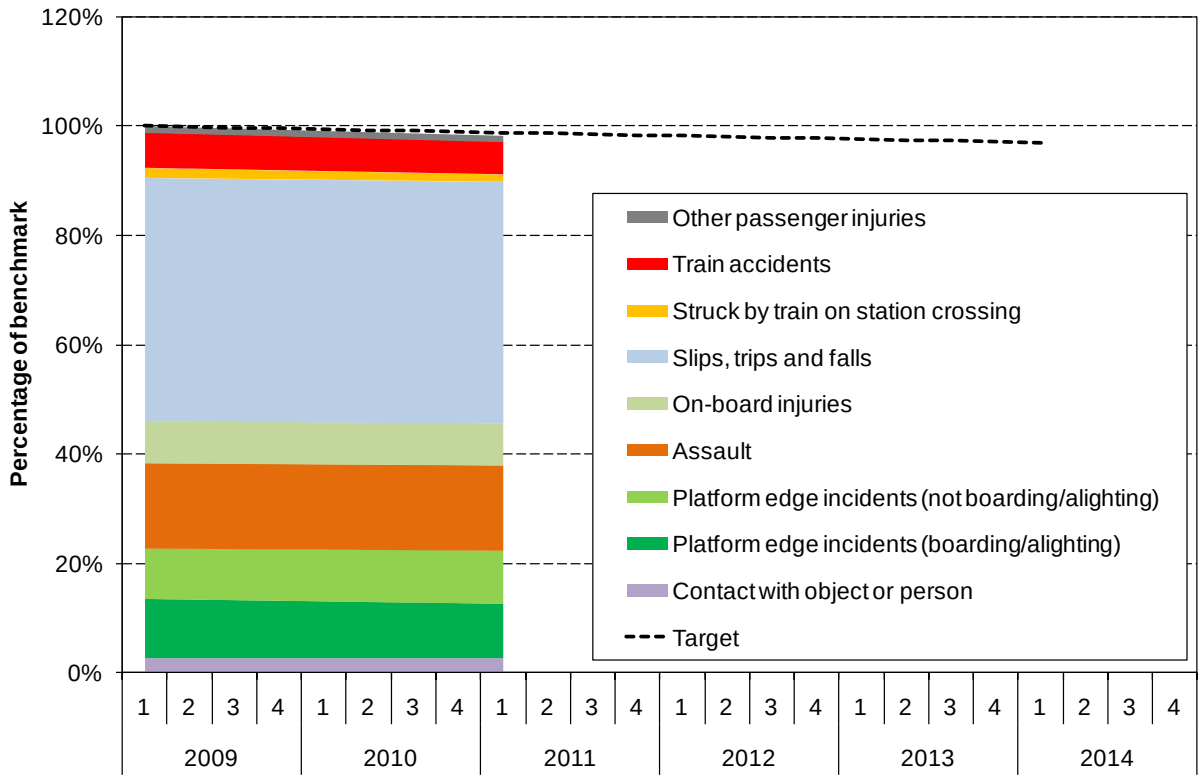
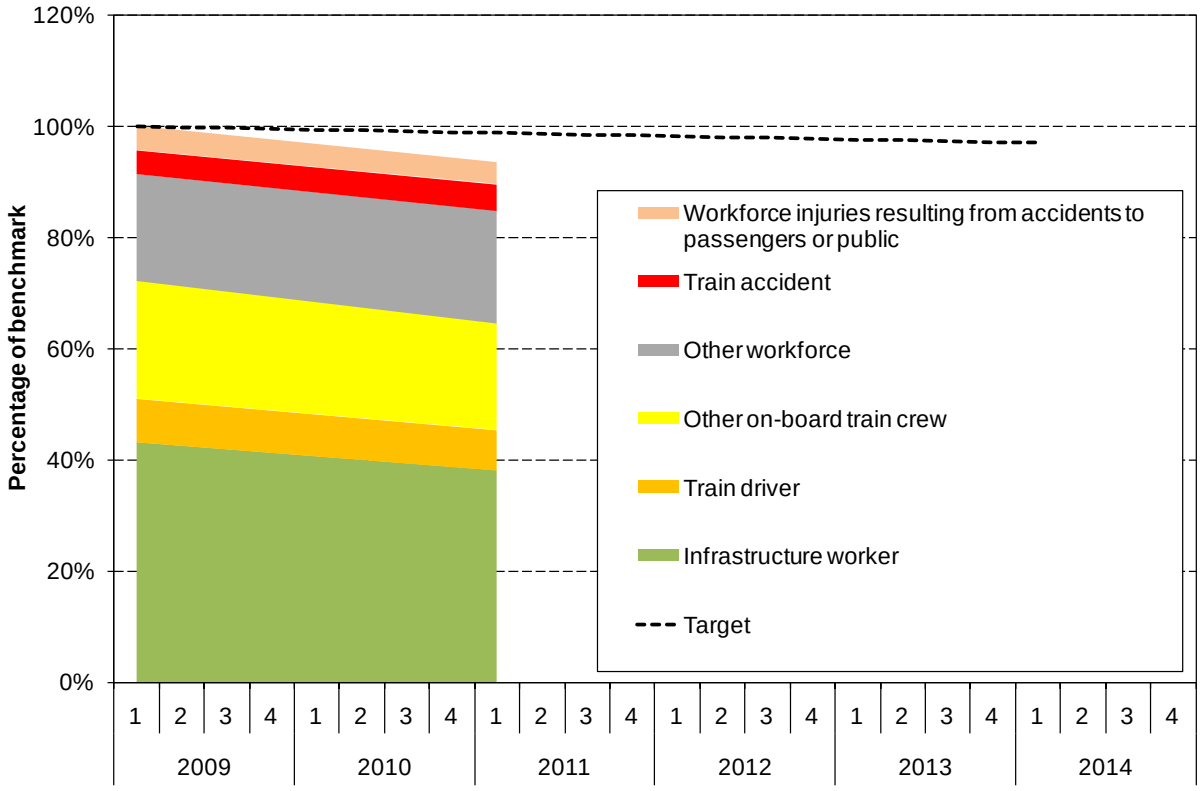


Chart 25. Progress against HLOS target for workforce risk (FWI per million workforce hours)



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 2011, the European Commission will publish the *2011 Assessment of achievement against common safety targets*, which will be based on performance in 2009. It will also publish the second set of Common Safety Targets (CSTs) and National Reference Values (NRVs) for the 25 member states with railways.

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 longer than 24 hours, is considered to be statistically equivalent to one-tenth of a fatality.

Table 3 shows the second set of NRVs and CSTs, as they will apply to the UK. The column *NRV rank* shows where the UK's NRV ranks among the 25 EU countries.[16]

Table 3. NRV and CST definitions and values[17]

NRV Category	NRV number	Definition	UK NRV		NRV rank in EU25	CST
			Second set	First set		
Passengers	NRV 1.1	Number of passenger FWSI per billion passenger train km.	2.74	6.22	1	170
	NRV 1.2	Number of passenger FWSI per billion passenger km.	0.028	0.062	1	1.65
Employees	NRV 2	Number of employee FWSI per billion train km	5.22	8.33	4	77.8
Level crossing users	NRV 3.1	Number of road vehicle occupant and pedestrian FWSI per billion train km.	23.6	23.0	1	710
	NRV 3.2	Number of road vehicle occupant and pedestrian FWSI per billion train traverses over a crossing.	n/a	n/a	n/a	n/a
Others	NRV 4	Number of other person FWSI billion per train km.	n/a	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,	85.2	94.7	5	2050
Whole society	NRV 6	Total number of passengers, employee level crossing user, other and unauthorised person FWSI per billion train km.	123.0	130.7	2	2590

For the UK, the second set of NRVs present much more challenging targets than the first set, especially in the area of passenger safety. The level of harm specified by NRVs 1.1. and 1.2 is now less than the SRMv7 estimate of the risk to passengers from accidents that are within the scope of European reporting (see section 3.3.3).

[16] Norway, which sits outside the EU but collaborates with the European Railway Agency and EU member states on matters of railway safety, has NRVs that are lower than the UK's in the categories of employees, level crossing users and whole society.

[17] NRV 3.2 has been omitted from the first and second set of NRVs because of concerns about the quality and consistency of normalising data across the member states, and NRV 4 has been omitted because of concerns about the consistency with which the definition of 'others' is being applied and the difficulty of extracting data relating to 'others' from Eurostat returns.

3.3.1 NRVs, CSTs and CSIs

The NRVs were designed to reflect the current levels of safety in each member state. The second set is based on the six-year period 2004 to 2009 (the first set having been based on the four years from 2004 to 2007), 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'.[18]

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 the second 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 will ultimately be assessed using the Common Safety Indicators (CSIs) that National Safety Authorities submit to the ERA as part of their annual safety reports. However, the assessment is currently being based on data provided to Eurostat (see the footnote on the next page).

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.

[18] Because Common Safety Indicators (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 (ie 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. ERA plans to reassess the second set of NRVs in 2015, with the aim of basing them on CSI data from the four-year period 2010-13.

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.[19]

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 require each transport operator to have a safety management system that will ensure 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.

[19] Because of concerns about the quality of CSI data being supplied by some member states, ERA is continuing to use 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 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 (18) on the previous page.

3.3.3 Current performance against the NRVs

The second assessment of performance against the NRVs – based on data from 2009 – will be published by the European Commission in summer 2011. The UK had acceptable performance in all risk measures (as did the majority of member states).

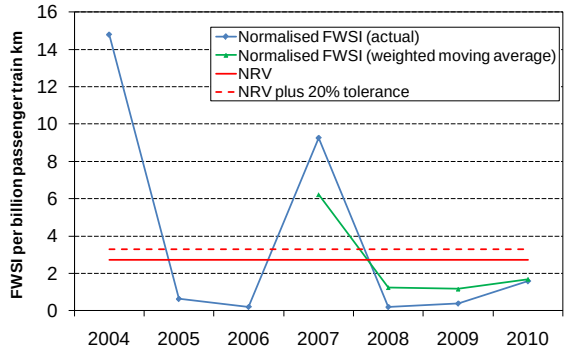
Data for 2010 has not yet been submitted to the ERA, but the charts below present provisional performance estimates based on the data that has been agreed between RSSB and Transport Operators. If the green line (the weighted moving average of normalised FWSI) lies below the dashed red line (the NRV plus 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

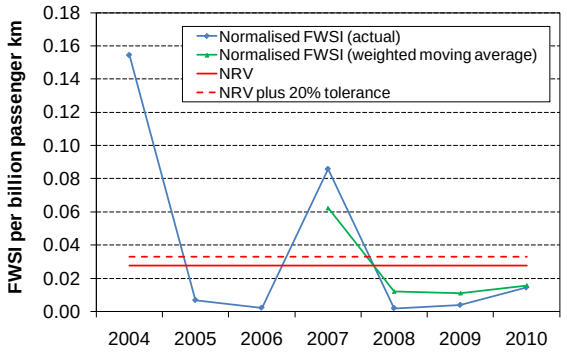
- The NRVs relating to passenger safety cover passenger fatalities and serious injuries from train accidents and from other accidents involving railway vehicles in motion (for example, a fall on board a train caused by sudden braking).
- The highest FWSI values for passengers were recorded in 2004 and 2007. These reflect the fatalities and serious injuries that occurred in the train accidents at Ufton (in 2004) and Grayrigg (in 2007) respectively.
- Performance in 2008-2010 has been well within the NRV. There were no high-consequence train accidents in those years.

Chart 26. Passenger safety: NRV 1.1



- The UK has the lowest NRVs for passenger safety of all EU member states.
- The new NRVs represent a level of passenger risk that is substantially lower than the SRMv7 estimate. This is because there were very few high-consequence train accidents in the period that was used to set the NRVs (resulting in a level of FWSI that was well below the underlying risk). Consistently meeting these NRVs will therefore be a considerable challenge for the UK railway.

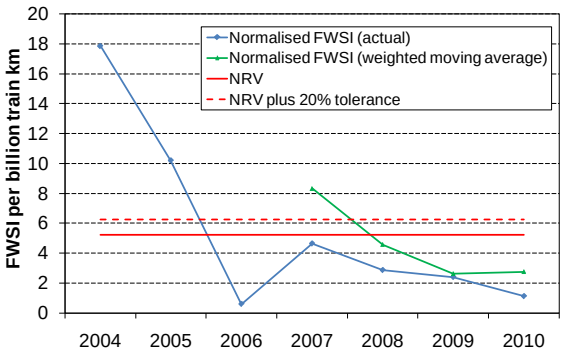
Chart 27. Passenger safety: NRV 1.2



NRV for employee safety

- Most FWSI in this category arises from infrastructure workers being struck by trains.
- Performance in 2010 was within the NRV (there were no workforce fatalities in European reporting scope).
- In 2004, there were particularly high numbers of both fatalities and serious injuries to infrastructure workers. The level of FWSI has reduced since 2004.
- When compared to estimates from SRMv7, the employee NRV is a good estimate of the underlying level of risk to employees from accidents within the scope of European reporting.

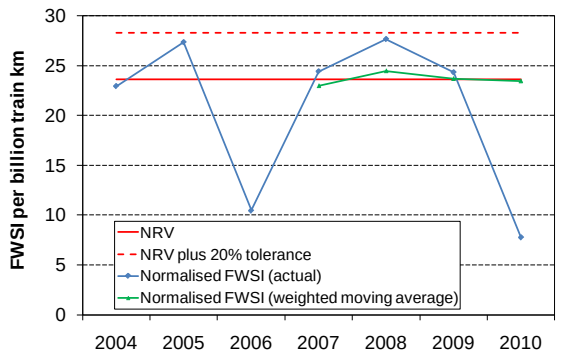
Chart 28. Employee safety: NRV 2



NRV for level crossing safety

- This NRV covers both pedestrians and road vehicle occupants on level crossings (but not train occupants).
- There was a relatively low number of level crossing user fatalities in 2010, so performance was within the NRV. In previous years, the level of normalised FWSI (and the weighted moving average) had exceeded the NRV but fallen within the 20% tolerance limit.
- The UK has the lowest NRV for level crossing safety of all EU member states.
- When compared to estimates from SRMv7, the values of the level crossing NRVs are a reasonable estimate of the underlying level of risk to level crossing users from accidents within the scope of European reporting.

Chart 29. Level crossing safety: NRV 3.1



- 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.

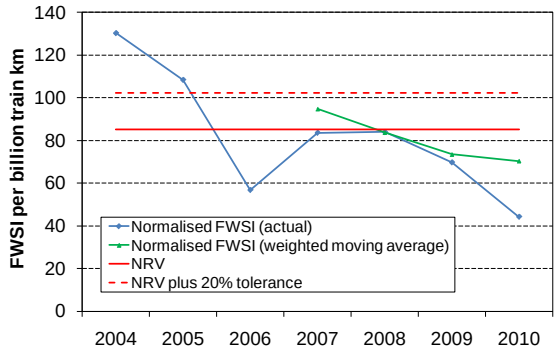
NRV for other persons

- 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.
- An NRV cannot be based on UK data because there were too few incidents.
- ERA has decided that it will not at the moment present progress against the NRV for other persons 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'. [20]
- Performance in 2010 was within the NRV: there were relatively few trespass fatalities.
- Some of the Eurostat data used to set the NRV was based on a different suicide classification than is being applied to CSI data (see footnote 18 in section 3.3.1).

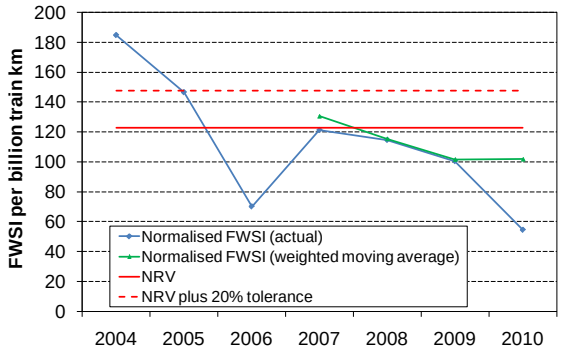
Chart 30. Safety of unauthorised persons: NRV 5



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 2010 was within the NRV.
- Unauthorised persons (ie 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 second lowest of all EU member states (behind Ireland).

Chart 31. Whole society safety: NRV 6



[20] 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 *unauthorised persons* in the chart do not necessarily meet the ERA definition of *unauthorised persons*. 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, fall into the ERA category of *others* but currently count as *unauthorised persons* in the assessment of the Common Safety Targets. See also footnote 19 in section 3.3.2 for more information.

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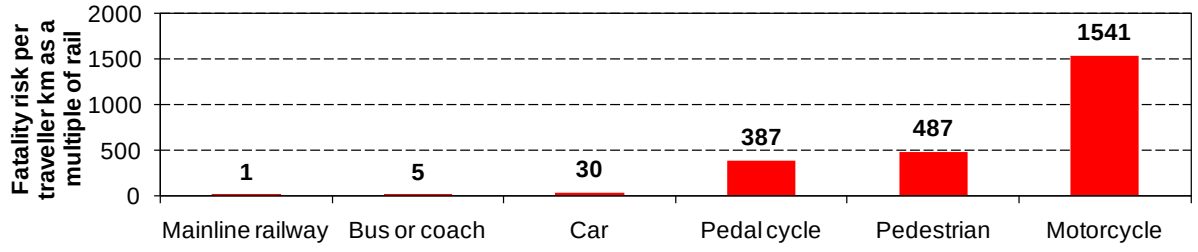
4 Benchmarking railway performance

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.

2010/11 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 travel.
- International railways differ in terms of infrastructure, rolling stock, working practices and the external hazards to which they are exposed. Safety on the UK's railways compares favourably with other EU countries.
- The *Health and Safety at Work etc Act 1974* 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.
  - Train drivers, infrastructure workers and station staff appear to be exposed to a similar or lower level of risk than comparable occupations. On-board train crew appear to have a higher level of risk from non-fatal injuries than other rail workforce groups and other customer facing occupations.
  - Data quality is likely to vary between different occupational groups.
- 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.
  - Work on leading and lagging indicators has the aim of providing information and support in the areas of safety management systems.
  - RSSB is undertaking a 'risk landscaping' project which aims to provide risk information that is tailored to individual routes, companies or locations. This will be achieved by integrating the SRM more closely with railway operations and asset data.
  - Safety data profiles provided for each train operator allow performance to be seen in the context of overall progress against the SSP trajectories.

Benchmarking at a glance

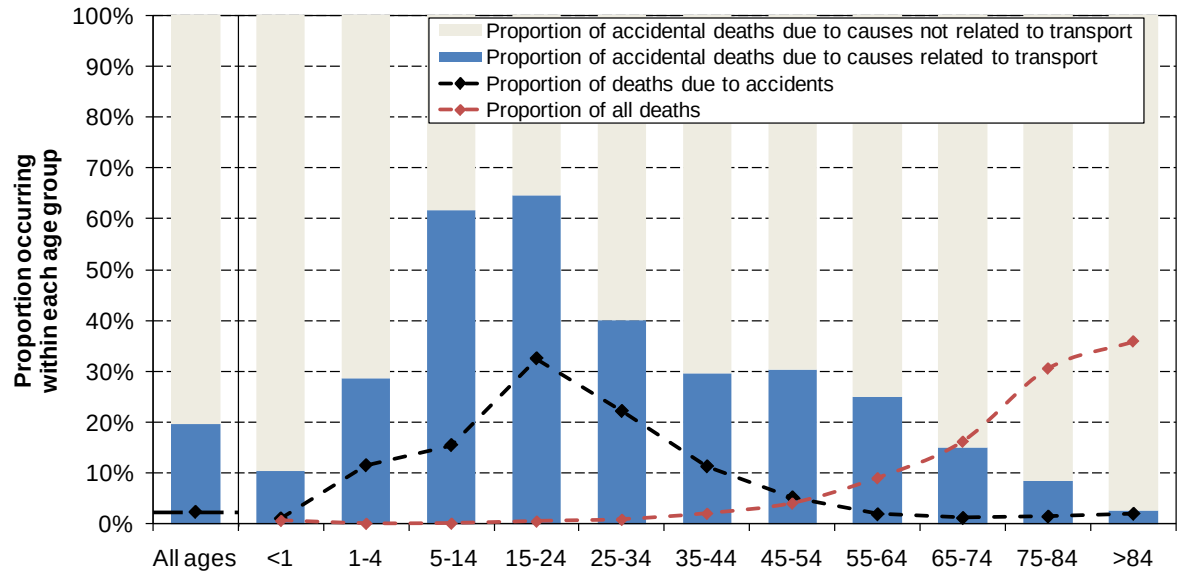


Source: See section 4.2.2

4.1 Transport risk in general

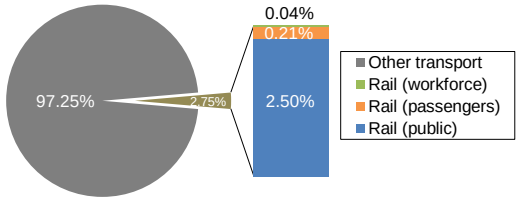
Across the British population as a whole, accidental deaths account for just over 2% of the total number of deaths. According to the National Travel Survey, the average Briton spends just over one hour per day travelling, and in total, transport accidents account for around 20% of all accidental deaths. The vast majority (95% in 2009) of transport deaths result from road traffic accidents, rather than rail, sea or air.

Chart 32. Proportion of deaths due to accidents, by age and cause, 2009



- Among the population as a whole, accidents cause 2.4% of the total number of deaths. Other deaths are caused mostly by natural causes, (eg 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%. One third of deaths in the 15-24 age group are accidental, this is the highest proportion within any age group; of these nearly two thirds are due to some form of transport. More deaths due to accidents related to transport occur to this age group than to any other.
- Over 80% of all deaths are to those aged 65 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 increases, there is a tendency to travel less, and an increasing vulnerability to accidents in other locations, such as the home.

Chart 33. Accidental transport fatalities



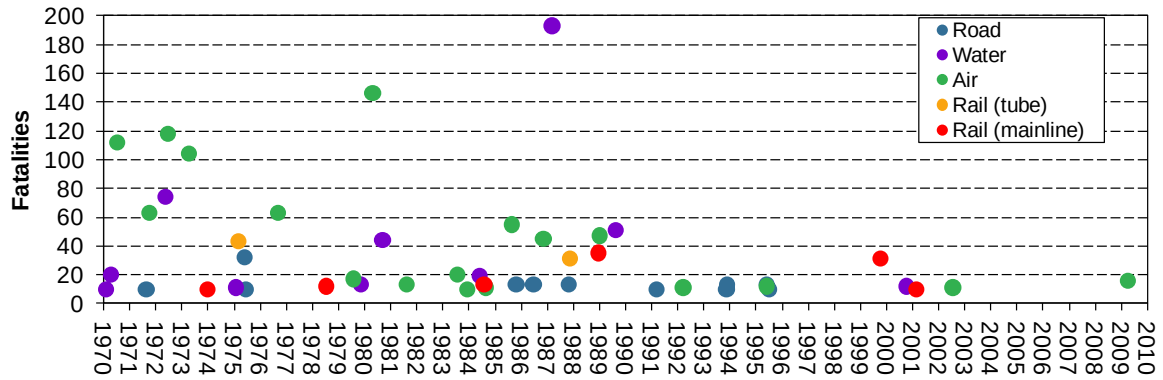
- Of all the accidental fatalities that involved transport in 2009, 2.75% involved rail transport, the majority of these deaths were members of the public.

Data sources: Office for National Statistics for accident rates by age in (Mortality statistics – deaths registered in 2009) and population estimates. Figures in Chart 32 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 public opinion. Fewer than 1,000 passengers have died in train accidents since 1945. A similar number of car occupants are killed in road accidents every year (1,059 in 2009), 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.

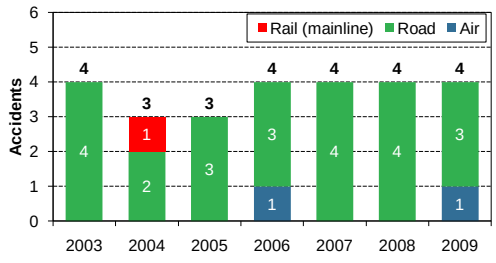
Chart 34. Transport accidents with ten or more fatalities since 1970



Rail (mainline) accidents: West Ealing (1973), Taunton (1978), Polmont (1984), Clapham Junction (1988), Ladbroke Grove (1999), Great Heck (2001)

- Since 1970, 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 two accidents with the highest consequences were the air crash in Tenerife, Canary Islands and the capsize of Herald of Free Enterprise at Zeebrugge, Belgium.
- In recent years, high-consequence accidents in all modes have become less frequent. There have been four transport accidents in the past decade with 10 or more fatalities, one of which was on the railway (Great Heck). The two most recent accidents involved North Sea helicopters carrying off-shore workers.
- 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.

Chart 35. Accidents with five or more fatalities



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 (CAP 800, UK Safety Performance - Volume I) 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. The following outlines some of the reasons.

Rail

The risk estimate for rail travellers presented on the following 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 around 0.05 passenger fatalities per billion traveller kilometres[21] corresponds to fewer than three 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

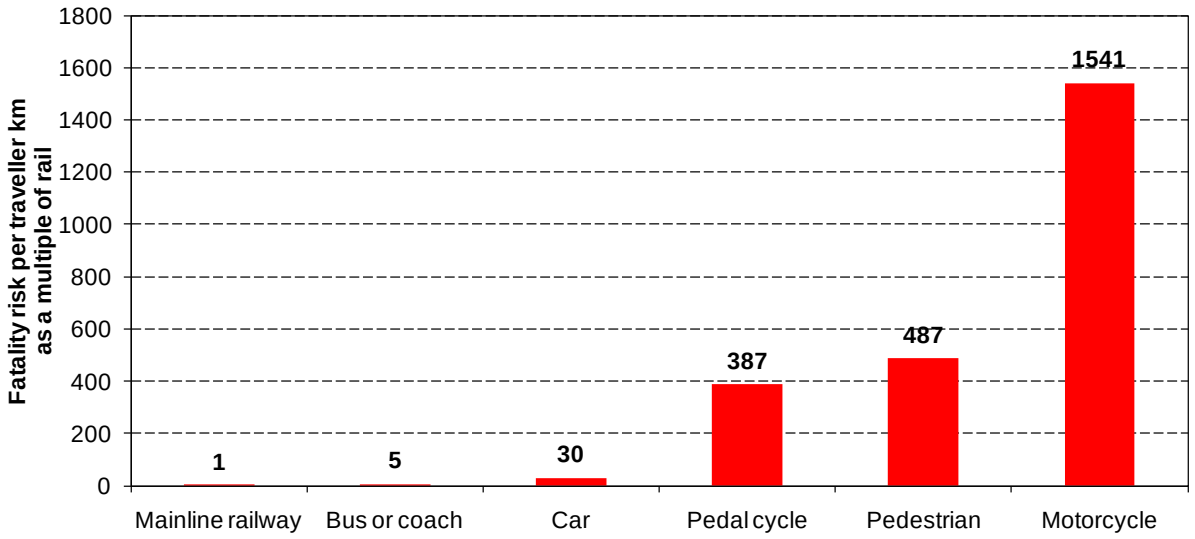
It is very difficult to obtain a robust estimate for the safety of air travel on British carriers. Civil aviation in Britain has had a very good safety record in recent years. The risk from commercial air travel is dominated by accidents that are very rare but of potentially very high consequence. Safety 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.

[21] For comparison, *Transport Statistics Great Britain 2010* estimates for rail travel that there are 0.16 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 2000-2009. 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 2007-2009 is 0.06, which is similar to 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 36. Traveller fatality risk for different transport modes (relative to rail)[22]



- 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 six times safer than making the same journey by car, but less safe than rail.
- Rail transport has the lowest traveller fatality risk per kilometre, per hour, and per trip. 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.
- 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.

Table 4. Traveller fatality risk – other metrics

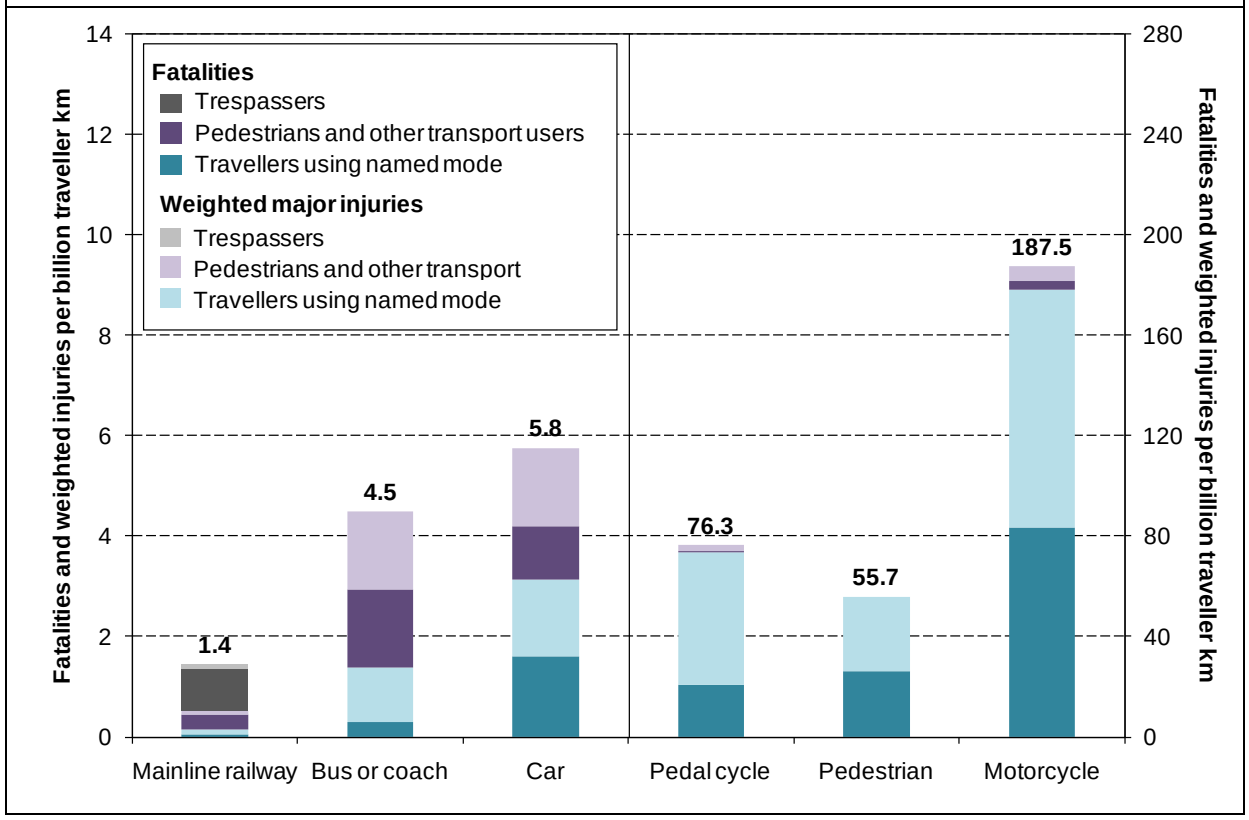
	Fatality risk per bn traveller...		
	km	hours	trips
Mainline railway	0.1	3	2
Bus or coach	0.3	5	2
Car	1.6	66	22
Pedal cycle	21.0	268	92
Pedestrian	26.4	186	28
Motorcycle	83.6	3513	1492

[22] Aviation risk is omitted, due to difficulties in obtaining robust estimates (see previous page).
Data source: SRMv7 for rail (based on data to September 2010), DfT for other modes (*Transport Statistics Great Britain 2010* for headline rates and *Reported Road Casualties Great Britain 2009* for casualties to other road users, normalised by data obtained from the National Travel Survey). A three-year average (2007-2009) was used to estimate casualty rates for bus and coach occupants, a single year (2009) for other forms of road transport. In 2009, there were 2,222 road accident fatalities: 500 pedestrians, 104 pedal cyclists, 472 motorcyclists (including 18 passengers), 1,059 car occupants (including 359 passengers), 13 bus and coach passengers (and one driver), and 73 other road users (mostly occupants of goods vehicles).

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 over other forms of motorised transport increases, even when including trespassers.

Chart 37. Traveller total risk for different transport modes (relative to rail)



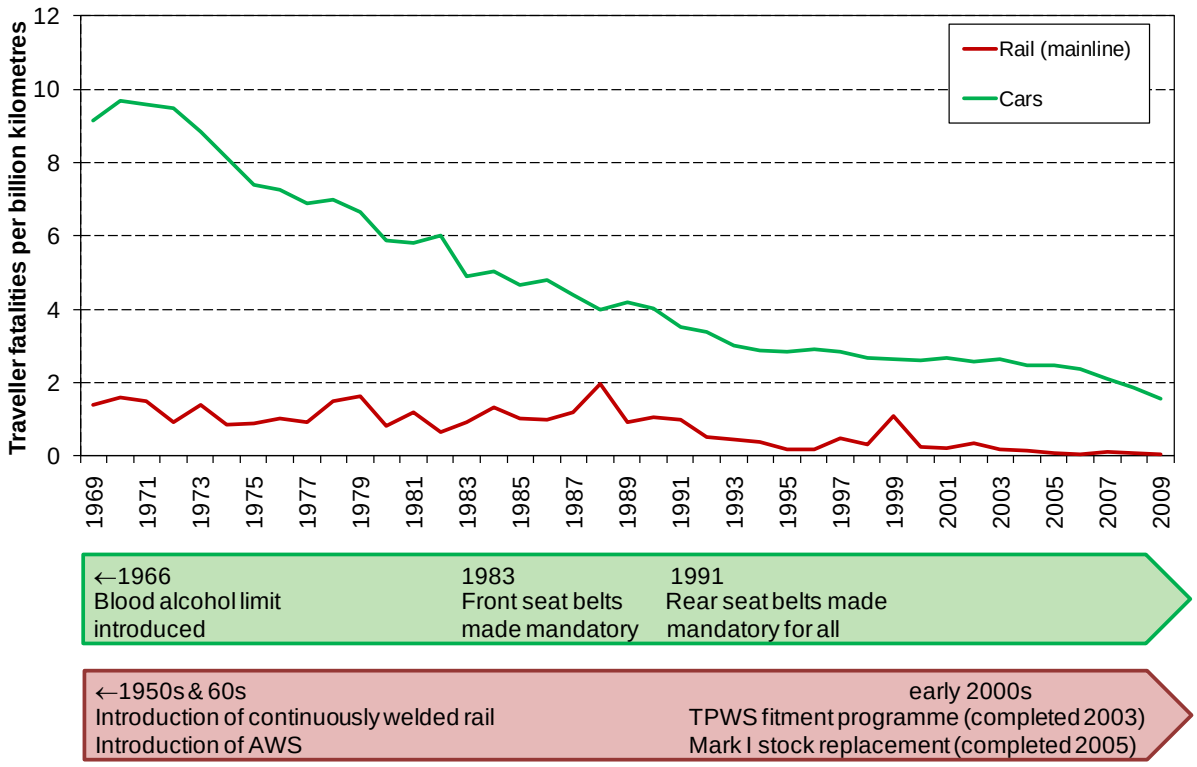
- Buses and coaches present a relatively high risk to pedestrians and other transport users. They are heavy vehicles that often operate on busy streets.
- Bus and coach travellers also have a higher rate of major injury than those on trains.
- More pedestrians and other road users are killed in accidents involving cars than accidents involving 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.
- The fatality rate of other road users in accidents involving motorcycles is the highest of the six modes analysed. This rate includes pedestrians hit by motorcycles and injuries to other road users who may have had a secondary collision.

Data source: See Section 4.2.2.
'Other transport users' includes injuries from accidents that have involved one or more users/vehicles other than the named mode. In this analysis, there is no indication as to which user caused the accident, or the existence of a secondary accident.

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, a better understanding of human behaviour, changing attitudes towards risk, increasing wealth and improvements in medical care.

Chart 38. Safety trends in rail and car travel since 1969



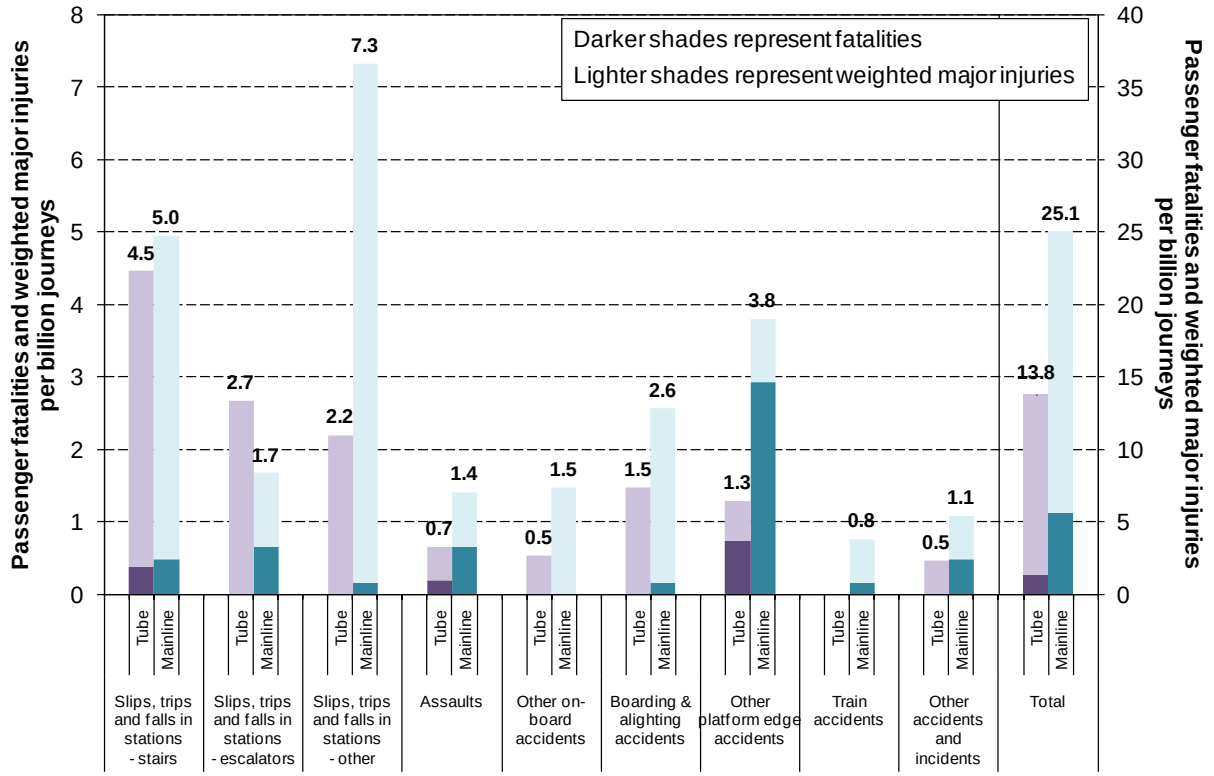
- There have been substantial improvements in the safety of both road and rail transport over the past four decades, although car travel has only recently reached a level of safety similar to that of rail travel around 40 years ago.
- The safety of car travel improved at a faster rate than rail safety between the early 1970s and the early 1990s.
- 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.
- 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 since 2007. There were reductions in a number of areas, including deaths involving younger 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 36, in which rail safety is based on data from SRMv7. 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 2010.

Chart 39. 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, many more than on the mainline rail network.
- There have been no train accidents with passenger fatalities on the Underground (excluding the terrorist attacks in July 2005). The last passenger fatality in a mainline train accident was at Grayrigg (February 2007).

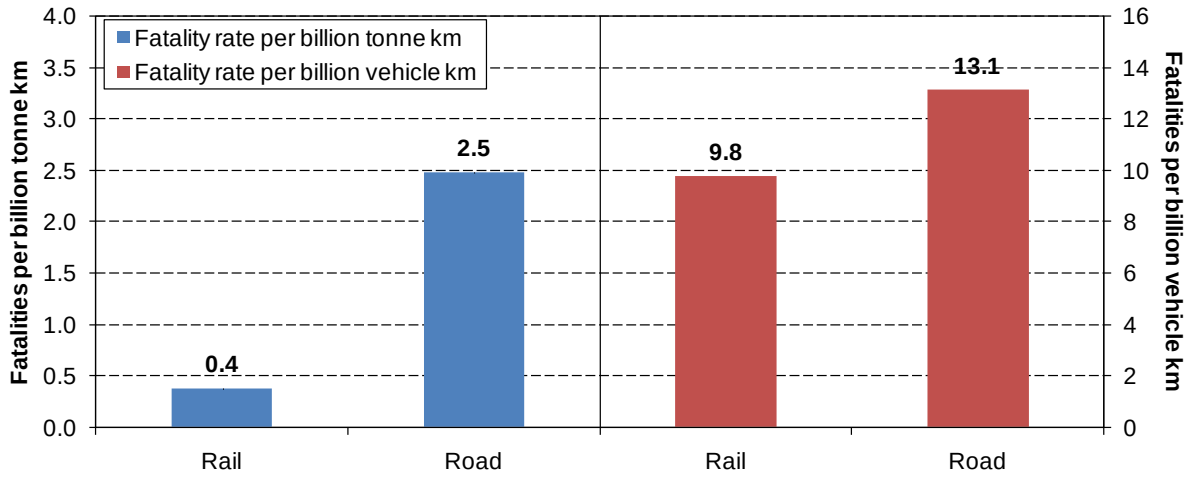
Data sources: Accident data for the London Underground supplied by Transport for London. Data for both the mainline railway and London Underground is based on the five-year period 2006-2010. Normalising data is from ORR (*National Rail Trends*) and DfT (*Transport Statistics Great Britain 2009*). Major 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

Both road and rail are used to transport freight. 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 it 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 the 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.

Chart 40. Freight fatality rates on road and rail 2006-2009



- The statistics indicate a rate of 2.5 fatalities per billion tonne km for road freight, compared with 0.4 fatalities per billion tonne km for rail freight. On this basis, rail compares favourably with road. There is less difference if the comparison is made on a per vehicle km basis (counting each wagon and locomotive as a separate vehicle). This is because on average, per km travelled, a rail vehicle carries more than five times the tonnage of a road vehicle. 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 by weight is coal (a relatively dense material), while for road freight the proportion is 1%.

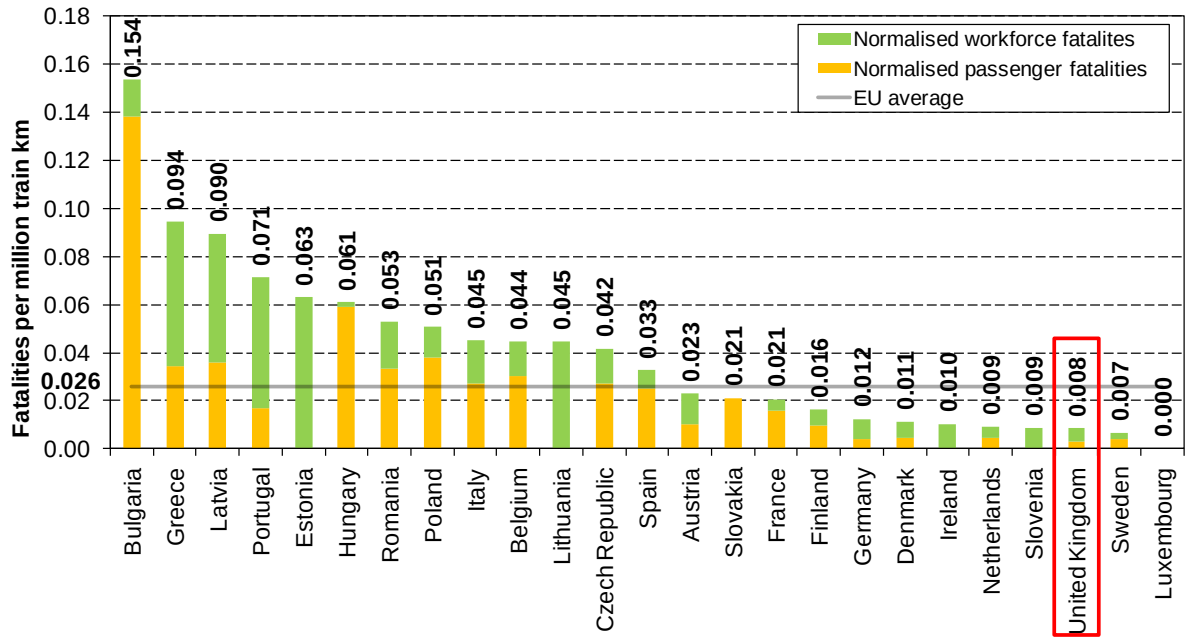
Data sources: Road: Transport Statistics Great Britain 2010, DfT; Road freight statistics 2009. Rail: SMIS (fatalities), SRM (train accident fatality estimate), Network Rail (Freight vehicle km).
Over the four-year period between 2006 and 2009 on which the chart is based, the amount of freight carried by road was 600.5 billion tonne km. There were 113.6 billion road freight vehicle km (carried by vehicles over 3.5 tonnes) and 1490 fatalities involving road freight transport. Over the same period, the amount of freight carried by rail was 83 billion tonne km. There were 3.23 billion rail vehicle freight km and around 26 fatalities involving freight trains (including an estimation of 5.2 fatalities involving freight trains where the train type is not known). There were no fatalities caused by train accidents involving freight trains over the period, but to take account of the possibility of this, the number of fatalities is adjusted by the SRMv7 estimated contribution from this source. This brings the expected total to 31.7 fatalities.

4.3 International comparisons

4.3.1 Comparing rail safety within the EU

Countries across Europe have been submitting their Common Safety Indicators (CSIs) to the European Railway Agency (ERA) since 2007. In 2011, the ERA unveiled the second set of National Reference Values (NRVs) that will be used to monitor safety performance across member states.

Chart 41. Passenger and workforce fatality rates on European Union railways 2004-2009



- Passenger and workforce fatality rates in the UK were well below the EU average over the six-year period 2004-2009. (This is the same period as the one used by ERA to set the second set of NRVs.)
- The countries with similar rates to the UK 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 passenger fatalities in the period) is an exception.

Table 5. UK NRV rank

NRV Category	NRV Number	NRV rank in EU 25
Passengers	NRV 1.1	1
	NRV 1.2	1
Employees	NRV 2	4
Level crossing users	NRV 3.1	1
	NRV 3.2	n/a
Others	NRV 4	n/a
Unauthorised persons on railway premises	NRV 5	5
Whole society	NRV 6	2

- A single multiple fatality accident can have a significant effect on the accident rate, especially for smaller countries.
- The UK ranks highly among the 25 EU countries across all NRVs.

Data source: Eurostat. The data cover the six-year period 2004-2009. 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 for the UK (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 25 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 2010/11, in which five or more passengers and workforce were killed. There were 14 such accidents.

The worst incident was in Mumbai, India on 30 May 2010, where more than 100 people died in a derailment, possibly caused by terrorist activity. The worst accident in the EU, was on 30 January 2011 when 11 people died following a collision in Magdeburg, Germany, caused by a possible SPAD. The route was not fitted with automatic train protection.

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 in 2010/11 with five or more fatalities

Date	Place, country	Fatalities	Accident type	Key issues
12/04/10	Latsch, **Italy**	7	Passenger train derailment (landslide).	Burst irrigation pipe. RSSB contributed an article on landslides to *Red Alert* 38 (see Opsweb for details).
23/05/10	Jiangxi, **China**	19	Passenger train derailment (landslide).	Natural causes (heavy rain).
30/05/10	Mumbai, **India**	100+	Passenger train derailment.	Possible sabotage.
15/06/10	Sinaloa, **Mexico**	13	Collision (two freight trains).	Signaller error (most of the deceased had been surfing the US-bound train).
22/06/10	Brazzaville, **Rep of Congo**	76	Passenger train derailment.	Overspeeding on curve.
29/06/10	Madiun, **East Java**	6	Passenger train derailment.	Possible overspeeding.
19/07/10	West Bengal, **India**	60	Rear-end collision (passenger)	Driver error (SPAD).
13/08/10	Inner Mongolia, **China**	11	Freight train derailment.	The fatalities were track workers; the train had been delivering stone to the worksite.
20/09/10	Madhya Pradesh, **India**	34	Collision (passenger and freight).	Driver error (SPAD).
02/10/10	Central Java, **Indonesia**	23	Rear-end collision (passenger).	Possible signaller error.
08/12/10	Dhaka, **Bangladesh**	19	Collision (passenger).	Possible wrongside failure.
28/01/11	Banjar, **Indonesia**	5	Collision (passenger).	Cause unknown.
30/01/11	Magdeburg, **Germany**	11	Collision (passenger).	Driver error (possible double SPAD).
30/01/11	Mandalay, **Burma**	6 (4 on train)	Level crossing collision.	Road user behaviour.

Note: Excludes train accidents with solely public fatalities.

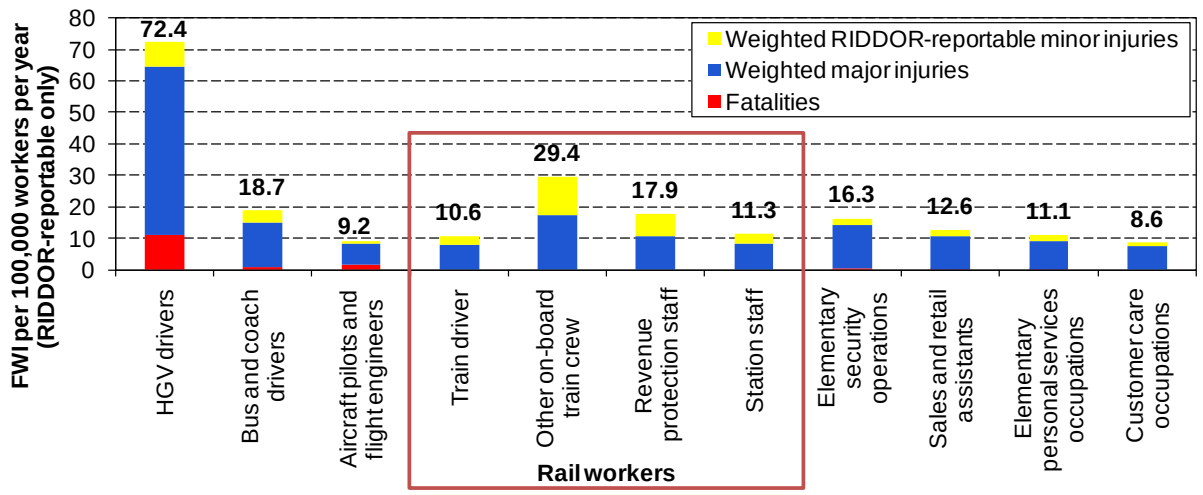
4.4 Occupational risk: comparisons with other industries

The *Health and Safety at Work etc Act 1974* requires employers to ensure, so far as is reasonably practicable, the health, safety and welfare at work of employees.[23]

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. In previous ASPRs, this chart underestimated the risk levels for non-rail occupations. Following a review of the methodology, the analysis has been updated, as presented in Chart 42.

Chart 42. Train crew and station staff risk compared with other occupations 2007/08-2009/10



Data sources: see section 4.4.2.

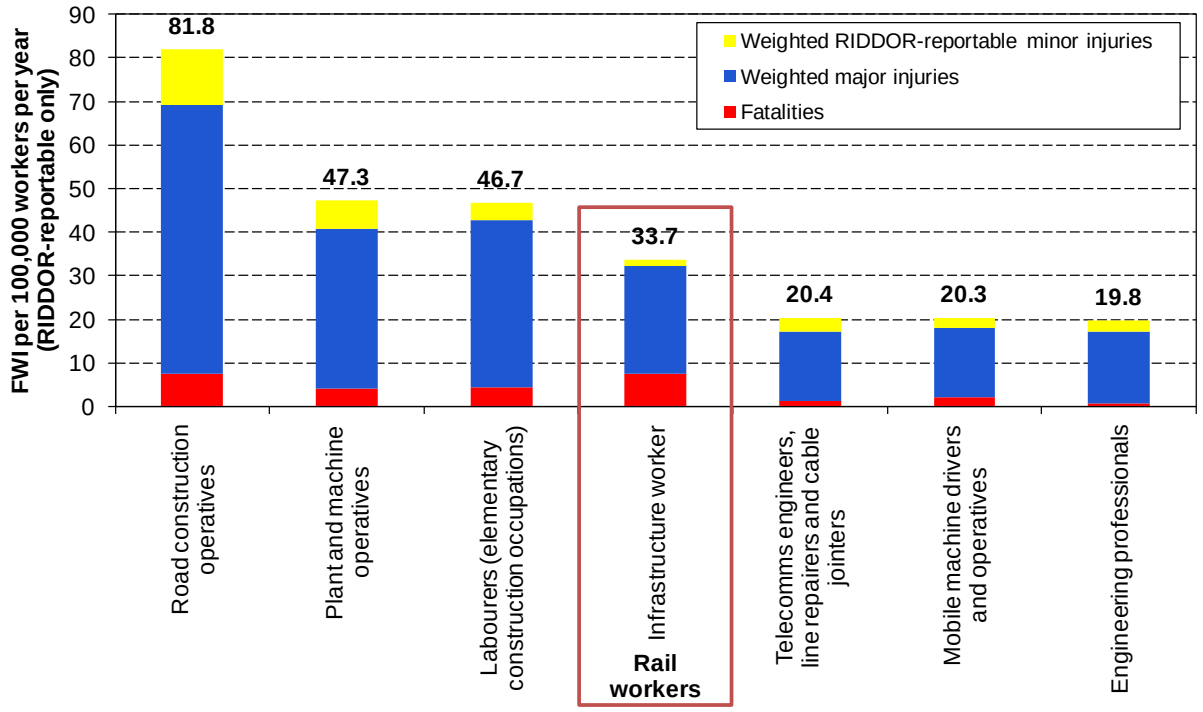
- Train drivers have a lower level of risk than the drivers of large road vehicles. HGV drivers have a higher fatality rate than bus and coach drivers as they are involved in more road accidents. Many major injuries to HGV drivers can occur while loading and unloading or moving around depots and loading bays. Train drivers have a comparable level of risk to aircraft pilots and flight engineers.
- Other on-board crew appear to have a high level of risk compared with similar occupational groups such as security operatives. 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*. Around a third of these accidents are caused by physical assault and verbal abuse, other causes include: slips, trips and falls on trains and in stations; boarding and alighting accidents and other on-board accidents.
- Revenue protection staff also have a higher level of risk compared to similar occupations involving security. As this group is split between those that work on trains and in stations, the risk level appears to be between other on-board train crew and station staff.
- Station staff have a comparable level of risk to other customer-facing jobs such as sales and retail assistants.

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

4.4.2 Safety at work: infrastructure workers

Infrastructure 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. In previous ASPRs, this chart underestimated the risk levels for non-rail occupations. Following a review of the methodology, the analysis has been updated, as presented in Chart 43.

Chart 43. Rail infrastructure worker risk compared with other occupations 2007/08-2009/10



- Infrastructure workers appear to be exposed to a level of risk lower than road construction operatives, plant and machine operatives and labourers, but higher than mobile machine drivers, telecoms engineers and other engineering professionals. However, there is a substantial element of uncertainty in these estimates.
- Other groups of workers, such as shunters in the freight sector, may be exposed to a higher level of risk than infrastructure workers. Shunter risk was the subject of an RSSB special topic report published in 2008.

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 2009*). Other injuries in road traffic accidents are excluded because the statistics contain no equivalent to RIDDOR-reportable injuries. 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 regulated industries. The independent review of RIDDOR reporting found that during the period 2005/06 to 2009/10 many RIDDOR-reportable injuries, predominantly to infrastructure workers, are likely to have gone unreported, this is covered in more detail in Chapter 6 *Risk to the workforce*. Also, HSE estimates that, across the board, roughly 50% of RIDDOR-reportable non-fatal injuries are not reported to them. HSE are currently consulting a proposal to extend the period for reporting injuries that lead to a worker being incapacitated for work from three days to seven days. This may improve levels of reporting. 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 apply to fatalities and serious injuries when considering road accidents.

4.5 Assessing risk at a local level

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.

Research into safety performance indicators (SPIs)

RSSB is currently finalising 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 covers the generic principles and application of SPIs, and is aimed at the industry as a whole. Detailed examples focus primarily on passenger train operating companies, although future extensions to cover other parts of the industry are being considered.

Localised risk assessment

RSSB is undertaking a 'risk landscaping' project which aims to provide risk information that is tailored to individual routes, companies or locations. This will be achieved by integrating the SRM more closely with railway operations and asset data. The new model will enable:

- Localised risk assessment, so that targeted investment and savings can be made as well as providing a more coherent estimate of national risk.
- The risk from changes to the timetable, or changes to the assets to be assessed.

By displaying the risk profile on a Geographic Information System the system will allow visualisation of the risk profile and plotting of incidents, and so improve the communication of the railway risk profile. The accuracy of the risk profile will improve as more of the factors driving changes to the risk profile will be included within the model.

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 2009-2014 SSP.

RSSB will be working with the ATOC, which produces regular key performance indicators for train operators, to determine how to best meet the needs of its members in 2011/12.

5 Risk to passengers

Within this report, 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.[24] 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*).

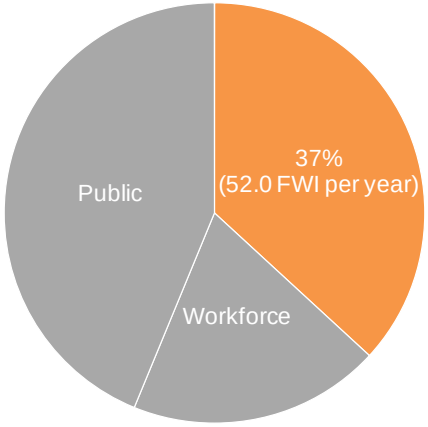
A detailed breakdown of passenger fatalities and injuries is presented in the key safety facts table at the end of this chapter.

2010/11 Headlines

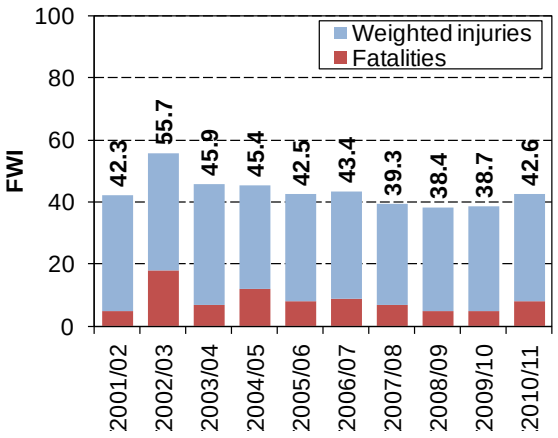
- There were 1,355 million passenger journeys in 2010/11.
- There were no passenger fatalities in train accidents. This is the fourth year running with no such fatalities.
- There were eight passenger fatalities, 240 major injuries, 5,555 minor injuries and 227 cases of shock/trauma reported.
- The eight passenger fatalities occurred in separate incidents at stations. This was the highest number recorded since 2006/07.
- The total level of passenger harm recorded in 2010/11 was 42.6 FWI, compared with 38.7 FWI in 2009/10; this is a 10% increase. When normalised by passenger journeys, the rate for 2010/11 is a 2% increase on the rate for 2009/10.
- BTP data shows that while the absolute number of assaults has risen, the normalised rate of passenger assault has continued to reduce; the rate for 2010/11 is just under 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 off-peak periods, when leisure travellers account for a higher proportion of journeys. Winter weather also affects the rate of slips, trips and falls.

Passenger safety at a glance

Passenger risk in context (SRMv7)



Trend in passenger harm



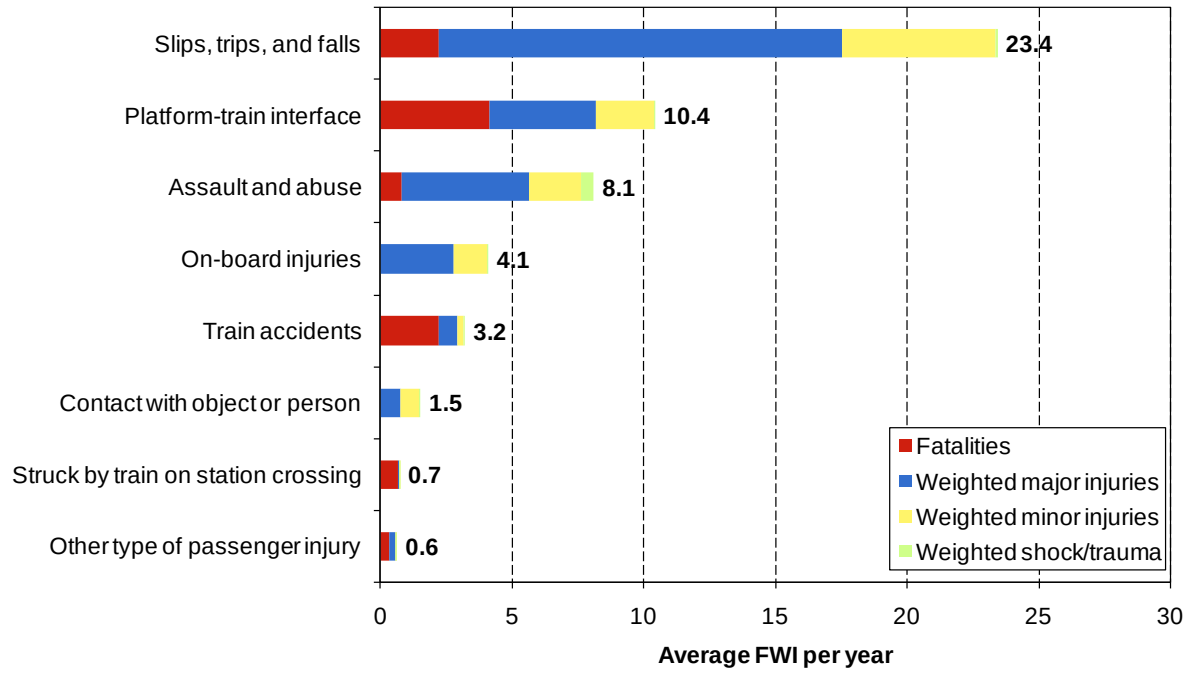
[24] This differs from the ERA definition of a passenger, which is: 'Any person, excluding workforce, who makes a trip by rail and who is on-board the train at the time of an accident, or who was boarding or alighting the train.'

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 shown in Chart 44 are shown in Appendix 6.

Chart 44. Passenger risk by accident type: 52.0 FWI per year



Source: SRMv7

- Slips, trips and falls account for 45% 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 40%. 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 21% of passenger fatality risk, which, along with slips, tips and falls, is the next highest contributor to passenger fatality risk after accidents at the platform-train interface.
- Assault on passengers is estimated to contribute 8.1 FWI per year, which is 16% 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 2010/11

More than a billion passenger journeys take place each year. Fewer than one in every 200,000 result in any kind of injury. In 2010/11, the following injuries were recorded:

Fatalities

- There were no passenger fatalities in train accidents during 2010/11.
- There were eight passenger fatalities in other, separate, incidents. Five of these were reported as involving intoxication.

Table 7. Passenger fatalities in 2010/11

Date	Location	Accident type	Territory	Description of incident
15/05/10	Park Lane, Tyne & Wear	Slip, trip or fall	London North Eastern	An elderly woman fell on the escalator, causing her husband to fall and sustain a large cut to his forehead. The man was taken to hospital, where he later died.
05/06/10	Earlsfield	Platform-train interface	South East	A male was injured after falling from the platform and coming into contact with the electrified third rail. The man had been drinking and the platform was wet. He died from his injuries en route to hospital.
01/07/10	Stansted Mountfichet	Platform-train interface	South East	A passenger who was standing close to the platform edge was struck and killed by a passing train. The passenger was under the influence of alcohol and drugs at the time of the incident.
08/07/10	Langley Green	Platform-train interface	London North Western	A passenger train struck and killed a person who had fallen from the platform whilst under the influence of alcohol.
20/07/10	Leytonstone High Road	Physical assault	South East	A passenger was fatally injured after falling down the stairs after being assaulted by another passenger. The police treated the incident as murder. A man was later arrested and charged.
23/07/10	Twickenham	Platform-train interface	South East	A passenger alighted from a train, staggered across the platform and fell from the edge to the track. He was electrocuted on the third rail.
22/09/10	Sudbury & Harrow Road	Platform-train interface	London North Western	A passenger fell from the platform whilst under the influence of alcohol. He was struck by a train and sustained fatal injuries.
24/03/11	Canterbury West	Slip, trip or fall	South East	A man had been helped from a train whilst under the influence of alcohol the previous night and remained on the platform. He later fell on his face whilst walking along the platform and died from his injuries.

Major injuries

- There were 240 passenger major injuries in 2010/11.
- 83% occurred at stations, and around three-quarters of these were slips, trips and falls.
- Six major injuries occurred in two train accidents.[25]

Minor injuries

- There were 5,555 recorded minor injuries, 1,201 (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 of these again being due to slips, trips and falls.

Shock and trauma

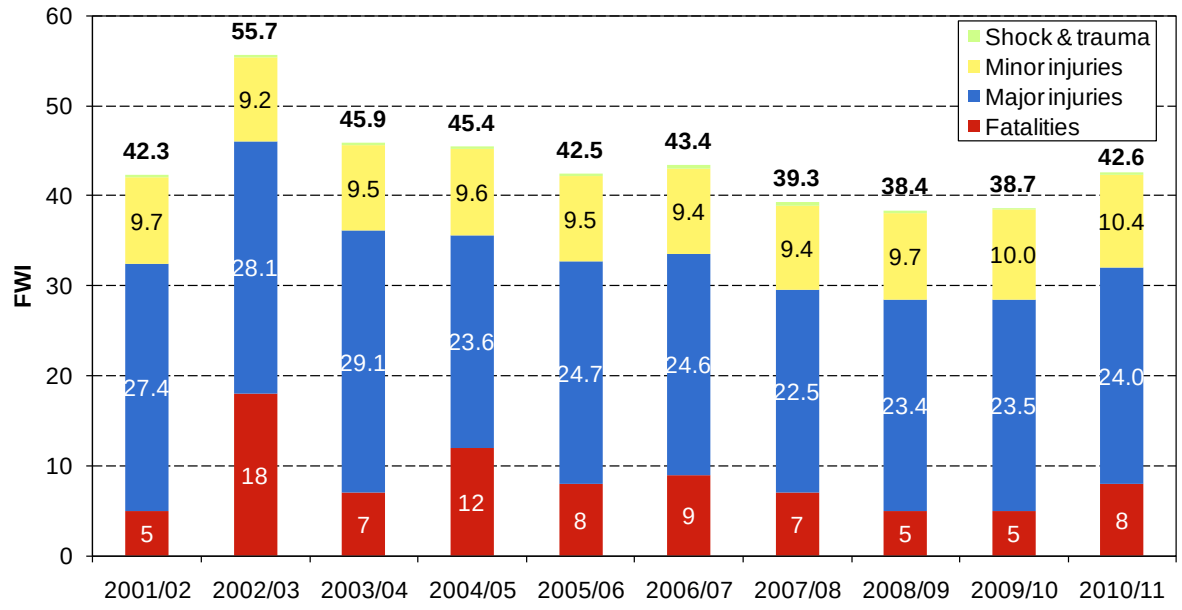
- There were 227 recorded cases of passenger shock or trauma, seven of which were Class 1.

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

5.3 Trends in passenger harm by injury degree

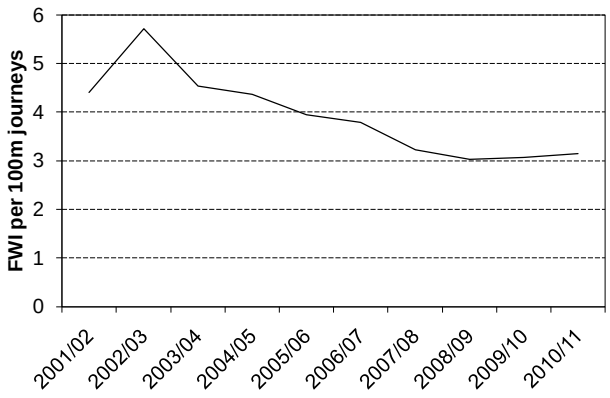
Based on SRMv7, the average level of risk to passengers is 52.0 FWI per year, of which 10.4 (20%) is fatalities. The SRM figure includes the risk from low-frequency, high-consequence events, so the actual level of harm in any particular year may be lower (or higher) than the SRM estimate. SMIS data does 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 45. Passenger FWI by injury degree



- The level of passenger FWI recorded for 2010/11 was 42.6. This is the highest level since 2006/07 and an increase of around 10% on the previous year.
- Much of the rise in FWI was due to an increase in fatalities, which at eight, was the highest number recorded since 2006/07.
- Weighted major injuries dominate total passenger harm over the period shown. The number of major injuries for 2010/11 was the highest since 2006/07.
- When performance is normalised by passenger journeys, 2010/11 shows an increase of 2% compared with the previous year. Some of the 10% increase in passenger FWI is therefore explained by the increase in passenger journeys seen in 2010/11.

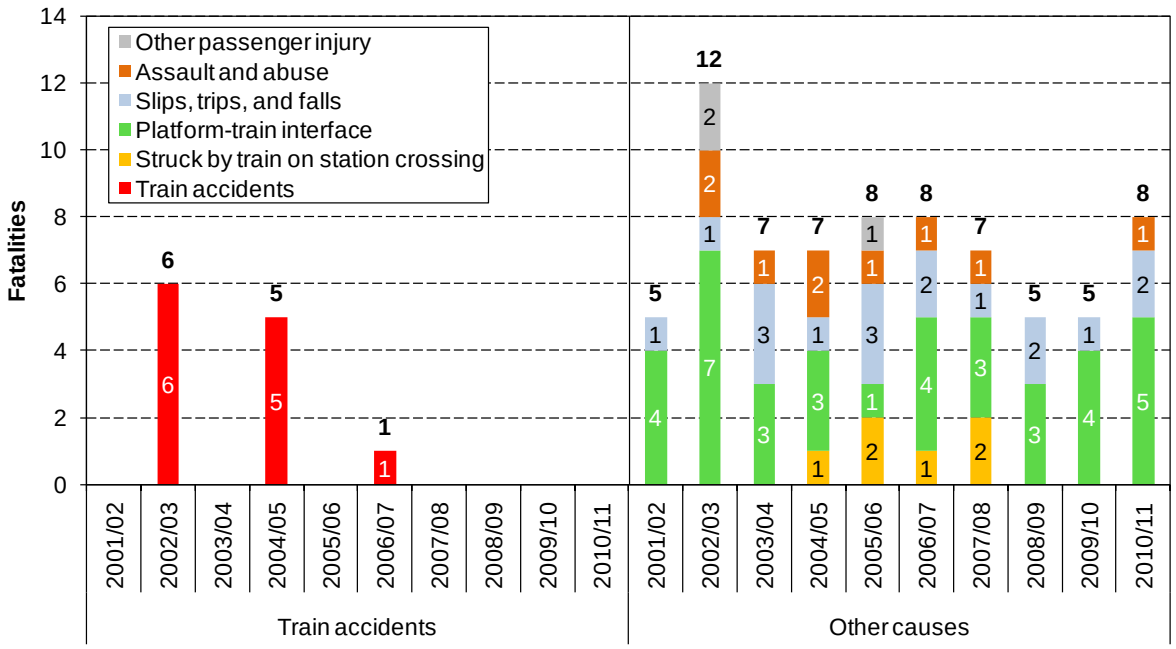
Chart 46. Normalised FWI rate



5.3.1 Passenger fatalities

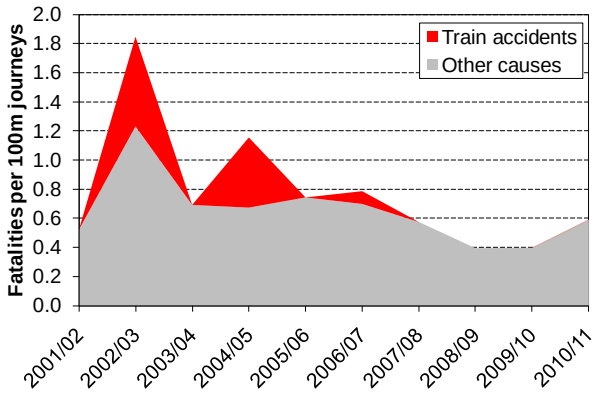
Of the 10.4 fatalities per year estimated by SRMv7, 2.2 (21%) are estimated to occur in train accidents, while the risk from other accidents is estimated to be 8.2 fatalities per year (79%). However, as train accidents are low-frequency but potentially high-consequence events, the actual number of train accident fatalities in any given year can differ greatly from this.

Chart 47. Passenger fatalities by accident type



- The eight passenger fatalities in 2010/11 all occurred in separate accidents at stations. Five occurred at the platform-train interface, none of which were during boarding or alighting. Two were the result of falls, one on an escalator and one on the platform. The eighth fatality was as a result of an assault.
- It is possible for a single train accident to result in many fatalities; conversely, there have been a number of years with no fatalities in train accidents. The last four years have seen no passenger fatalities in train accidents. The effect of train accidents on the fatality rate is illustrated in Chart 48.

Chart 48. Normalised fatality rate



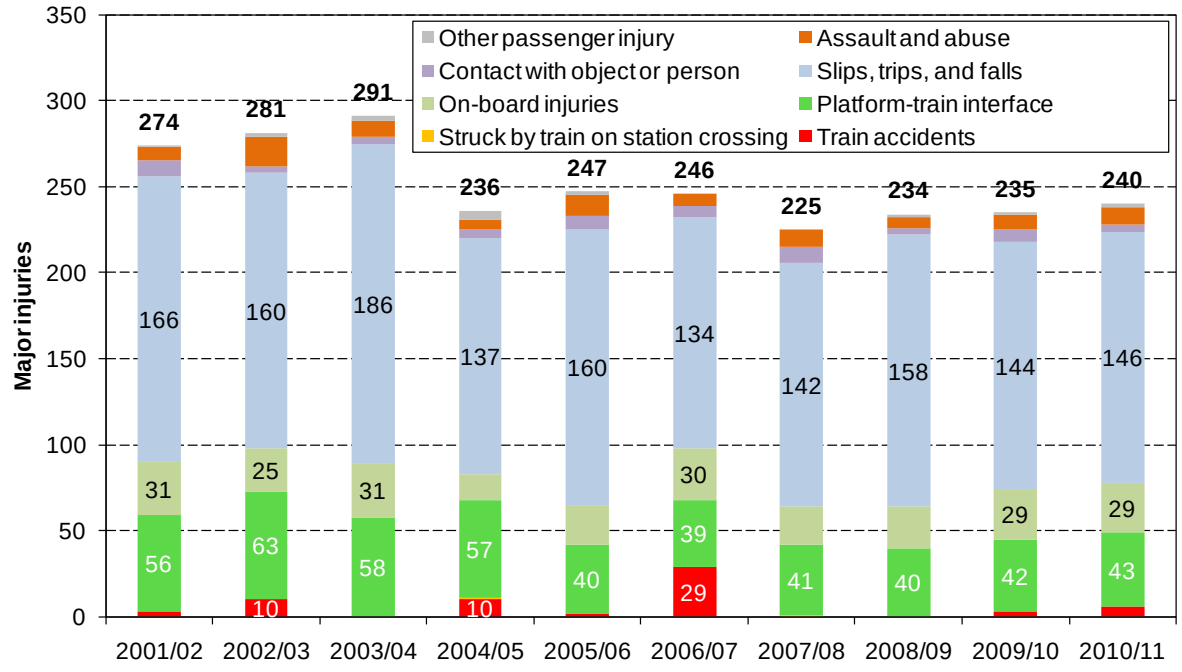
- Since 2003/04, there have been no passenger fatalities as a result of falling from moving trains.[26] The risk associated with falls from moving trains has reduced since the early part of the decade, largely due to the removal of Mark 1 (slam door) rolling stock.

[26] In 2007, there were two incidents of people deliberately jumping from High Speed Trains (HSTs), which utilise Mark III coaching stock. The doors on these coaches 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

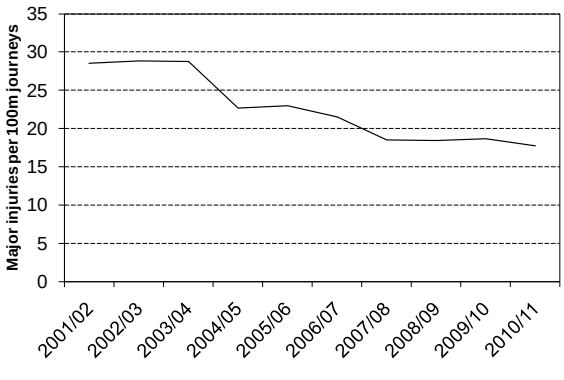
A passenger injury is classed as major where it satisfies RIDDOR 1995 Schedule 1.[27] SRMv7 estimates passenger major injuries to account for 28.6 FWI per year, which is 55% of the total passenger risk. Most major injuries to passengers occur when people are moving around the station – predominantly as a result of slips, trips and falls.

Chart 49. Passenger major injuries by accident type



- The total number of major injuries in 2010/11 has increased slightly for the third year running and is at its highest level since 2006/07. The number seen in 2010/11, however, is still considerably lower than in 2003/04 and the preceding two years.
- Six passengers received major injuries in two train accidents in 2010/11. Both accidents were train collisions with road vehicles. One was at Sewage Works Lane user-worked crossing, where a passenger train collided with a sewage tanker and derailed. The other train accident was the result of a vehicle incursion at a road-over-rail bridge near Oxshott, where a lorry crashed through the parapet and fell onto a passing passenger service, damaging and partially derailing it.
- The majority of major injuries are due to slips, trips and falls, the number of which increased slightly in 2010/11.
- Unlike the overall FWI rate, the rate of major injuries decreased in 2010/11 when normalised by passenger journeys.

Chart 50. Normalised major injury rate

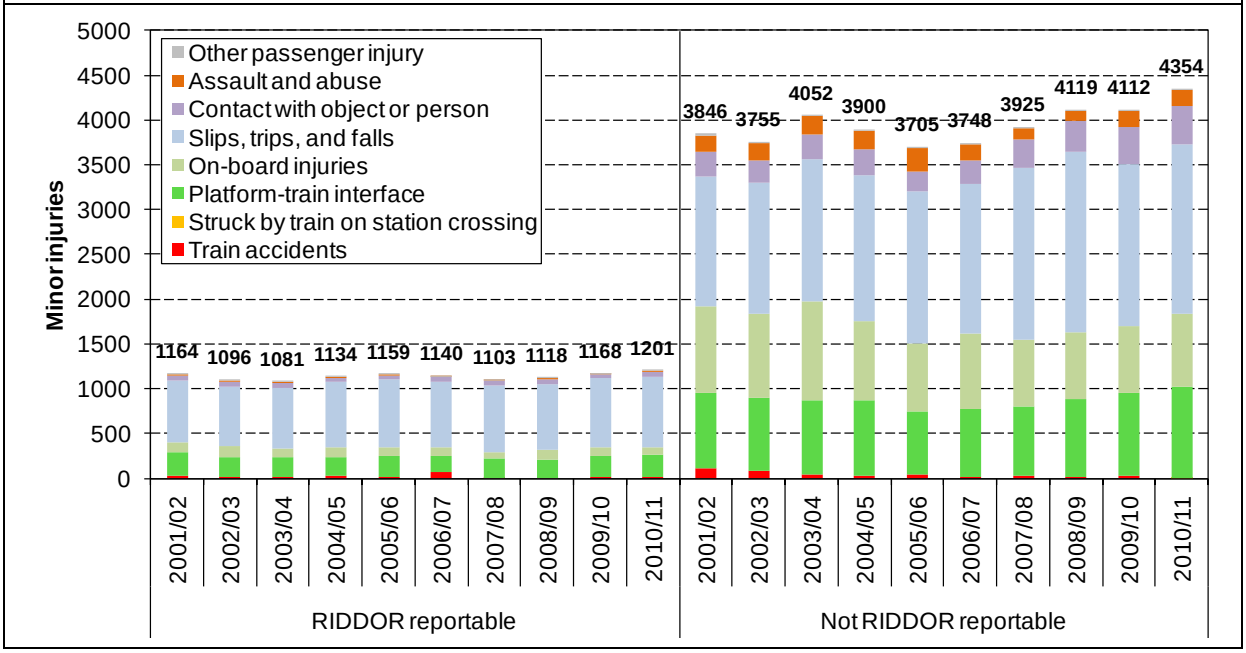


[27] This includes losing consciousness, most fractures, major dislocations and loss of sight (temporary or permanent) and other injuries that resulted in hospital attendance for more than 24 hours. RIDDOR refers to the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995: a set of health and safety regulations that mandates the reporting of, inter alia, work-related accidents. See Appendix 7 for further details.

5.3.3 Passenger minor injuries

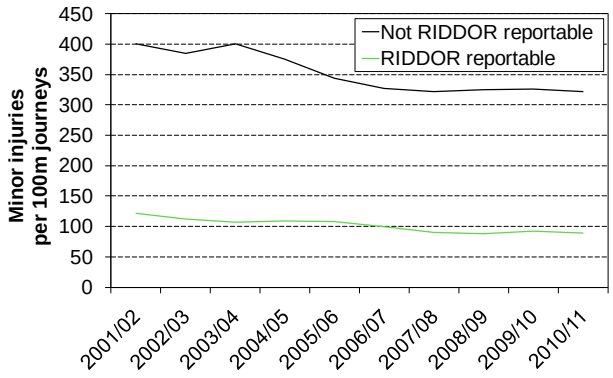
Passenger minor injuries are classed as RIDDOR-reportable if they are not major injuries, but the person is taken to hospital from the scene of the accident. Minor injuries that are not RIDDOR-reportable are generally of a less serious nature than reportable ones, and are consequently given a lesser weighting when calculating weighted injuries. SRMv7 estimates RIDDOR-reportable passenger minor injuries to account for 7.1 FWI per year, which is 14% of the total passenger risk, and other minor injuries to account for 5.2 FWI per year, which is 10% of total passenger risk.

Chart 51. Passenger minor injuries by accident type



- The 1,201 RIDDOR-reportable minor injuries for 2010/11 is an increase of around 3% compared with 2009/10. The number is at the highest level seen in the reporting period.
- The 2010/11 level of non-reportable minor injuries is also at the highest level seen in the reporting period, showing around a 6% increase on the previous year.
- The minor injury rates (normalised by passenger journeys) have remained roughly the same for the last four years
- 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 a difference in the propensity for reporting different types of accident, which would affect the observed ratios. Examples of differences are on-board injuries, where 12% of minor injuries since 2001/02 have been RIDDOR-reportable, and slips, trips and falls, where 43% have been RIDDOR-reportable.

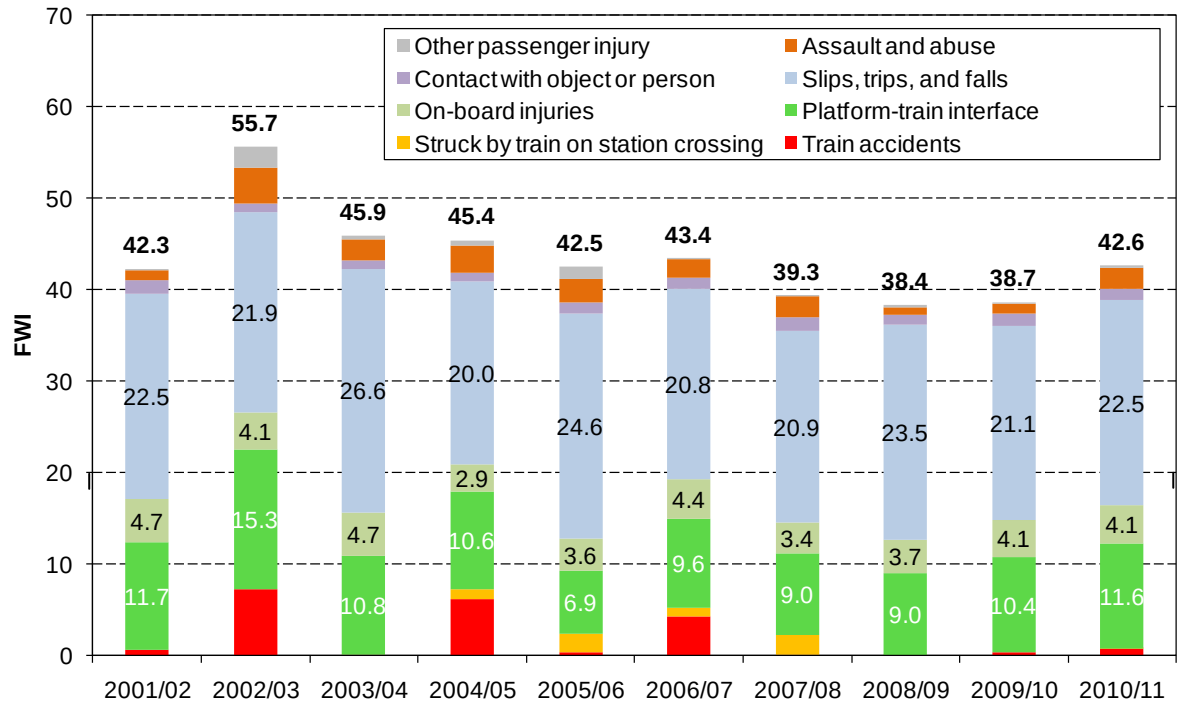
Chart 52. Normalised minor injury rate



5.4 Trends in passenger harm by accident type

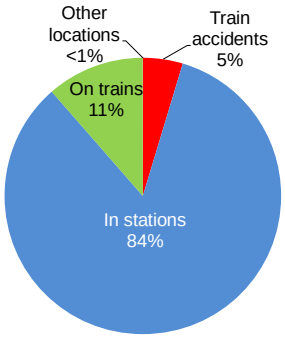
Analysis of passenger harm by accident type enables the causes of changing trends to be identified and considered further.

Chart 53. 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 a slight increase in harm over the previous year.
- The next largest contribution is from accidents at the platform-train interface. There has been an increase in harm from platform-train interface accidents in each of the last two years.
- The contribution from train accidents is variable, reflecting their low-frequency, high-consequence nature.
- Recorded levels of FWI from assaults differ noticeably from the SRMv7 estimate of 8.1 FWI. As noted previously, SMIS is not the main means of recording these events, which are more usually recorded by BTP.[28]
- The majority of passenger harm occurs in stations – around 84% since 2001/02, as seen in Chart 54.

Chart 54. FWI by location since 2001/02

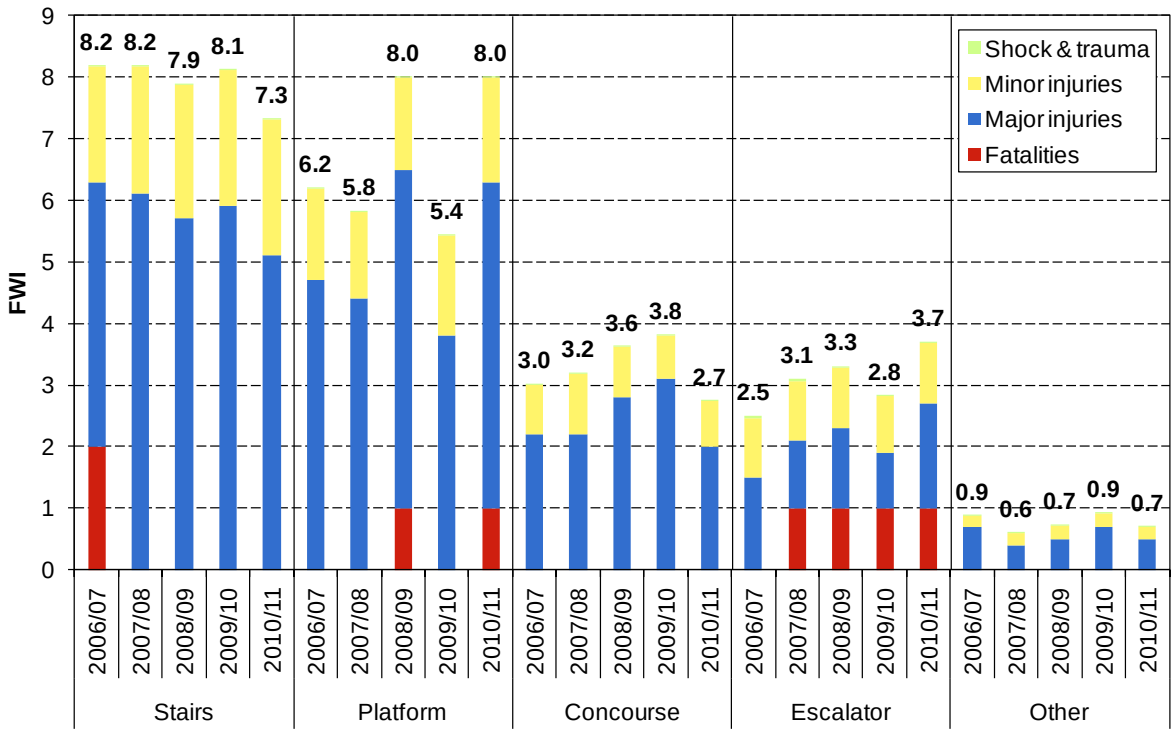


[28] See the report from research project T723: *Making the most of data associated with railway crime*, which is available on the RSSB website. This project considered the identification and analysis of various sources of railway crime intelligence, including BTP's CRIME and RSSB's SMIS systems, to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

5.4.1 Slips, trips and falls in stations

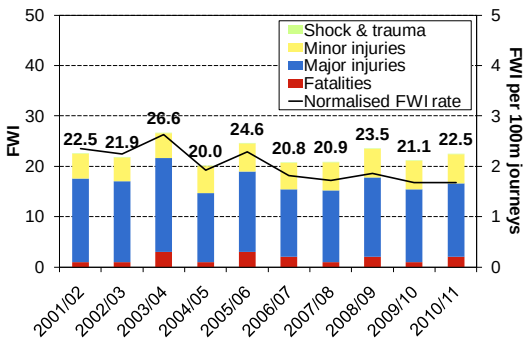
From SRMv7, slips, trips and falls in stations are estimated to account for 45% (23.4 FWI) of passenger FWI risk and 21% (2.2 FWI) of passenger fatality risk. Of the SRM FWI risk from slips, trips and falls, around 39% occurs on stairs. The platform accounts for a further 28% of the SRM risk, with the concourse and escalators accounting for 16% and 14% respectively. Other areas of the station make up the remainder.

Chart 55. Passenger harm from slips, trips and falls



- The increase in harm from slip, trip and fall injuries in 2010/11 was due mainly to a rise in the harm on platforms, compared with 2009/10. Most of this rise was due to an increase in major injuries, although there was also one fatality. After normalisation by passenger journeys, the FWI rate in 2010/11 remained roughly the same as in 2009/10.
- 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 four 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.

Chart 56. Slips, trips and falls FWI



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. The Operations Focus Group (OFG) is currently sponsoring RSSB work and a special topic report into this significant area of risk.

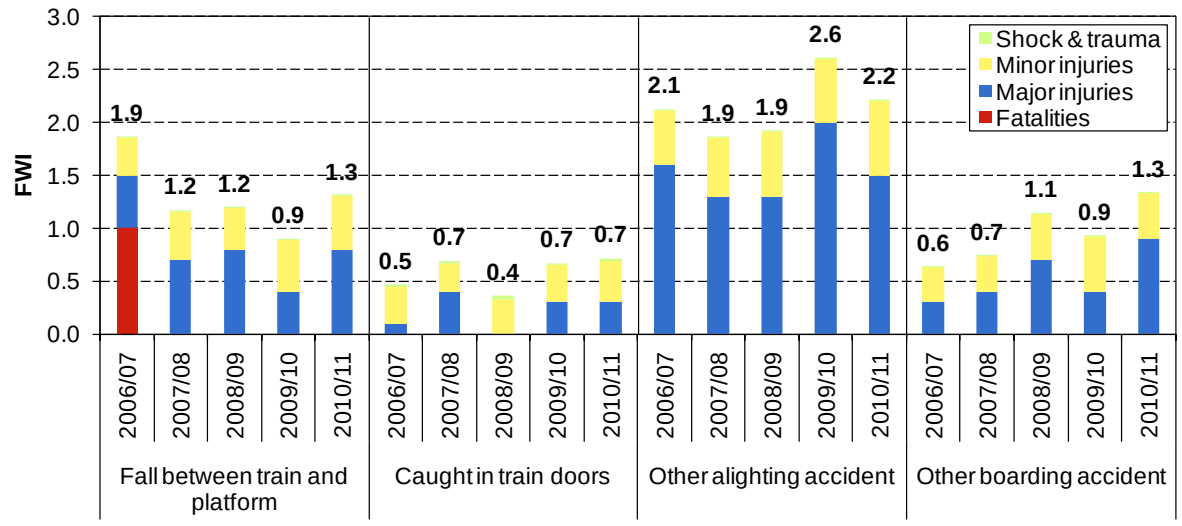
Table 8. Passenger FWI at the platform train interface

Year	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
FWI	11.7	15.3	10.8	10.6	6.9	9.6	9.0	9.0	10.4	11.6

Accidents during boarding and alighting

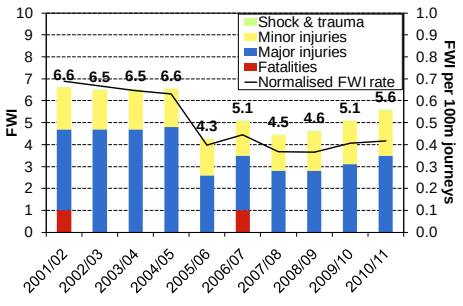
SRMv7 estimates that 10% (5.1 FWI) of passenger FWI risk and 3% (0.3 FWI) of passenger fatality risk occurs during boarding and alighting.

Chart 57. Passenger FWI from boarding and alighting accidents



- Both the level of harm and the rate of harm (normalised by passenger journeys) from boarding and alighting increased in 2010/11; this is the second year running that the rate of harm has increased.
- The categories *fall between train and platform* and *caught in train doors* include both boarding and alighting injuries.
- The largest category covers events termed *other alighting accidents*. Alighting accidents overall account for twice the amount of harm as boarding accidents, despite only accounting around half the number of accidents. Although harm from *other alighting accidents* is high, 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.

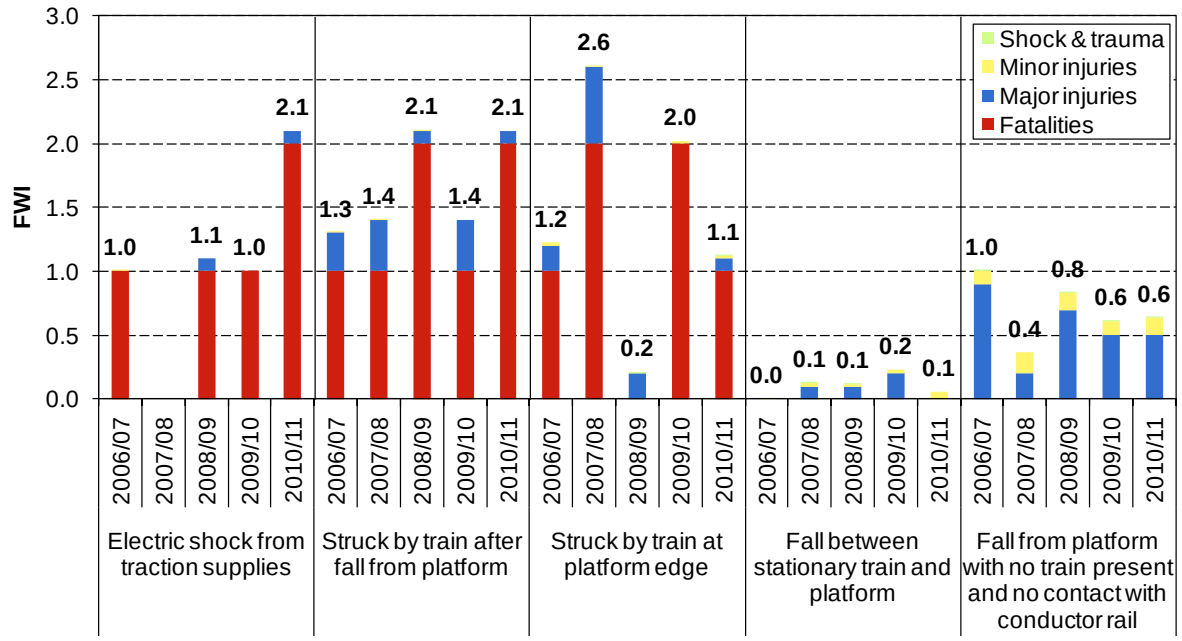
Chart 58. Boarding & alighting FWI



Other accidents at the platform-train interface

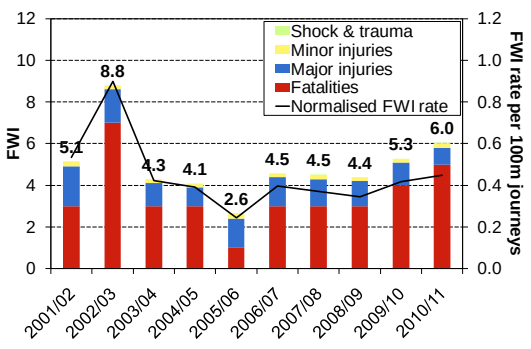
Other accidents at the platform-train interface are estimated by SRMv7 to account for 10% (5.3 FWI) of the total passenger FWI risk. However, they account for 37% (3.8 FWI) of the passenger fatality risk: by far the greatest contributor of any accident type.

Chart 59. Other passenger accidents at the platform-train interface



- Both the level of harm and the rate of harm (normalised by passenger journeys) from other platform edge accidents is the highest since 2002/03; five of the eight passenger fatalities this year were due to this type of accident and four of these involved intoxication.
- 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.
- Since 2001/02, there have been 17 injuries due to a passenger falling from the platform and coming into contact with the conductor rail; seven of these were fatal. The likelihood of fatality is comparatively high when this type of accident occurs.
- A number of fatalities result from being too close to the edge of the platform such that contact with a train entering the station occurs.[29] On occasions where the contact is sufficiently serious, or the person subsequently loses balance and falls 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, without them having subsequently either been struck by a train or come into contact with the conductor rail.

Chart 60. Other platform-train interface FWI

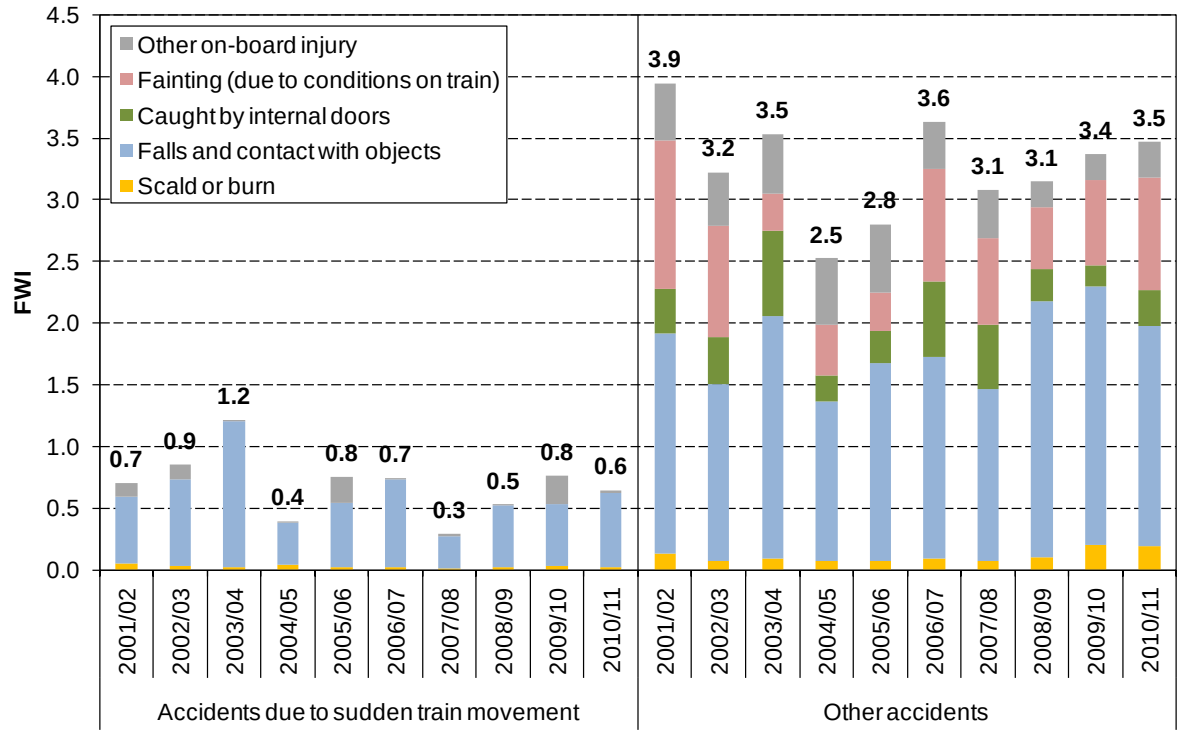


[29] This category includes people standing, walking, running, or otherwise being too close to the platform edge.

5.4.3 Passenger harm from accidents on board trains

The category of on-board injuries does not include train accidents, falls from trains, or assaults, which are considered under separate categories. On-board injuries account for 8% (4.1 FWI) of the total passenger risk profile, based on SRMv7. Passenger fatality risk from on-board accidents is estimated to be negligible.

Chart 61. Trends in on-board passenger FWI (excludes train accidents and assaults)

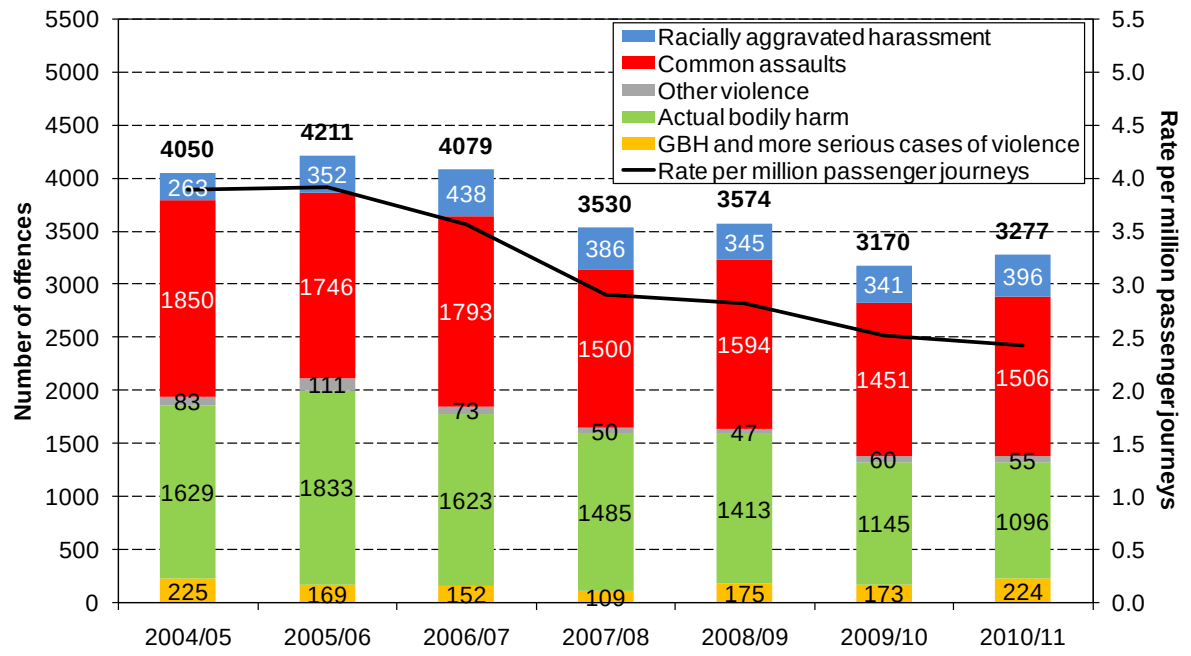


- On average over the past ten years, *falls* and *contact with objects* within the train have accounted for 58% of injuries on board trains (excluding injuries from train accidents, falls from trains and assault). The same proportion applied in 2010/11.
- Injuries attributable to sudden movements of the train due to lurching or braking have accounted for around 17% of on-board harm since 2001/02. In 2010/11, the proportion was around 16%. However, it is not always straightforward to determine whether train movement was a causal factor in an accident. Therefore, some other accidents may also be a result of train movement.
- Harm from on-board accidents not attributable to sudden train movements increased in 2010/11, this is the fourth consecutive year it has increased. However, when looking over the whole period, there is no obvious trend in harm.
- Fainting accounts for a large proportion of on-board FWI because loss of consciousness (which includes fainting) is always categorised as a major injury under RIDDOR guidelines.

5.5 Passenger personal security[30]

Assaults occur to people on the railway, as they do in any public environment. SRMv7 estimates that assaults contribute 16% (8.1 FWI) of the passenger FWI risk, and 8% (0.8 FWI) of the fatality risk, for passengers. In 2010/11, there was one passenger fatality due to assault. 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 non-travelling members of the public, nor is it possible to categorise the seriousness of the non-fatal injuries reliably.

Chart 62. Assaults on passengers and public



Source: BTP CRIME data

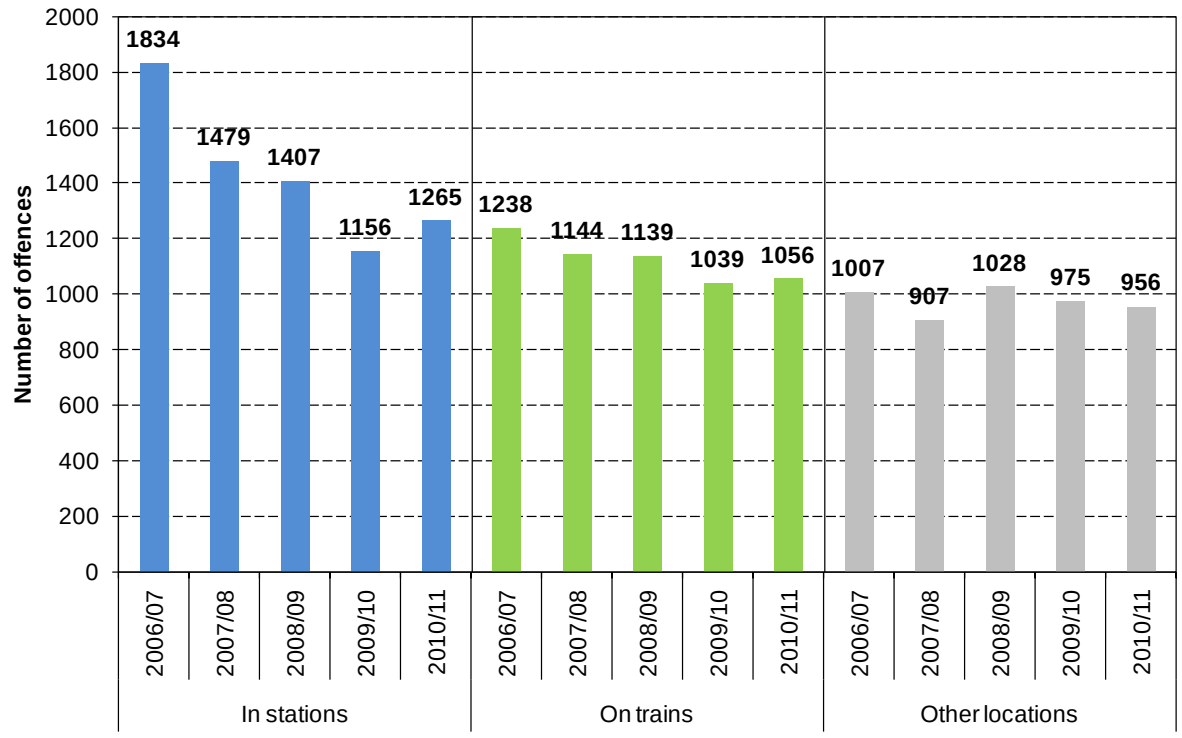
- The current year shows an increase of 3% in the total number of passenger and public assaults, compared with 2009/10. However, the number is the second lowest recorded over the period shown.
- The overall rise is due to increases in the categories of common assault (4%), racially aggravated harassment (8%) and more serious cases of violence, including grievous bodily harm (29%)
- Since 2005/06, the normalised assault rate has decreased steadily, and is currently lower than one per 400,000 journeys. The rate for 2010/11 is 4% lower than for 2009/10, owing to the rise in 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 racially motivated crime.

[30] 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 locations* includes assaults outside the station, or inside the station but at locations operated by third parties, such as shops.

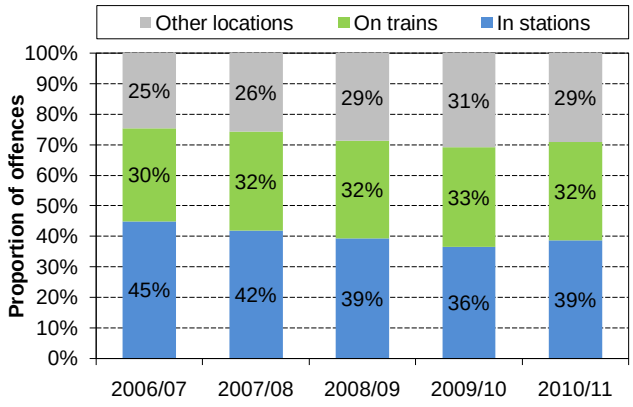
Chart 63. Passenger and public assaults by location



Source: BTP CRIME data

- Over the period shown, the majority of assaults have been recorded as occurring in stations. Compared with 2009/10, there was an increase in the number of assaults in stations, although the level is still second lowest over the period shown.
- The second most common location recorded is on trains. Again, compared with 2009/10, there was an increase in the number of assaults, although the level is also the second lowest over the period shown.
- The 'third party' locations that comprise the category *other locations* 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 real trend in this category.

Chart 64. Proportion of assaults by location



5.5.2 Perceived security

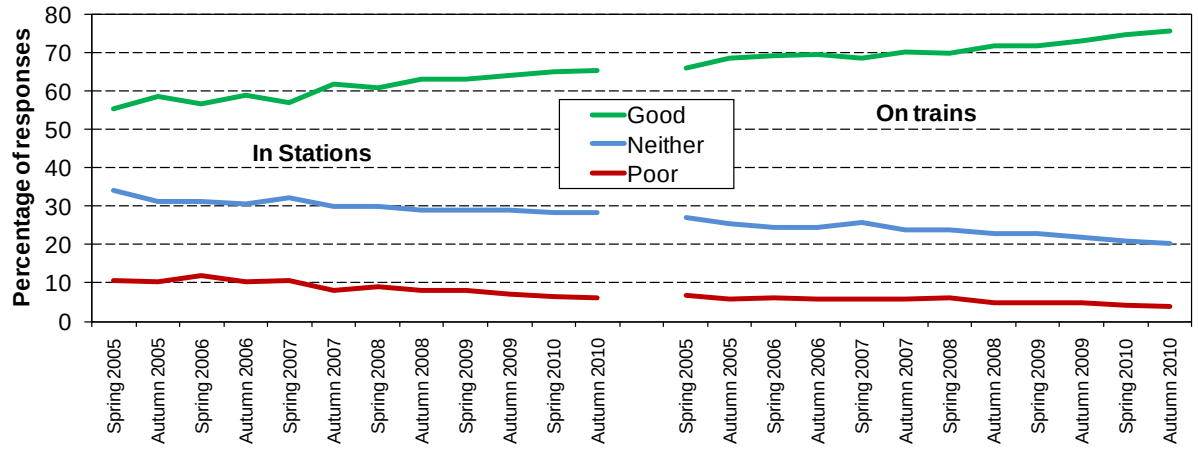
BTP data indicates that the probability of falling victim to violent crime is relatively low, at less than 1 in 400,000 per journey. Media coverage of events can affect public perceptions of personal security, and feeling vulnerable to such offences may still deter people from travelling by train. Passenger 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 2010)

	In the station			On the train		
	Good	Neither	Poor	Good	Neither	Poor
Long distance	74%	23%	3%	84%	14%	2%
London and South East	64%	30%	6%	74%	22%	4%
Regional	66%	26%	8%	78%	18%	4%
National Total	65%	28%	6%	76%	20%	4%

- Passengers appear to be more satisfied with their level of personal security on trains than in stations. Overall, 65% of passengers perceive their personal security at the station to be good, and 76% 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.

Chart 65. Trends in perceived personal security at stations and on trains



Source: National Passenger Survey

- 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 Perceptions of security on the railway – more detail

In the Autumn 2010 NPS, a number of more detailed questions looking at security on the railway were asked.

When passengers were asked: '*During the last six months, have you had cause to worry about your personal security whilst making a train journey?*', respondents answered 'yes' 16% of the time, which is just under one-in-six passengers. As a follow-up to this question, those who answered 'yes' were asked the reason(s) for their concern. Respondents could provide more than one reason.

Table 10. Five most common reasons for having cause to worry

	At the station	On the train	In the station vicinity
1	Anti-social behaviour on the station (58%)	Anti-social behaviour on the train (70%)	Anti-social behaviour by people in the neighbourhood (34%)
2	Lack of station staff (45%)	Lack of on-train staff (43%)	Lack of staff/police officers in the neighbourhood (26%)
3	Lack of other passengers (20%)	Lack of police officers (30%)	Lack of other people in the neighbourhood (21%)
4	Poor on-station lighting (17%)	Lack of other passengers (17%)	Poor lighting around the station (20%)
5	Lack of information (12%)	Saw actual vandalism or violence on the train (9%)	Station in an isolated location (16%)

Note: Percentages shown apply only to the 16% of passengers who expressed having had cause to worry.

- Witnessing anti-social behaviour continues to be the highest cause of worry to passengers when making a train journey. Seven out of ten who felt cause for worry on a train listed this as the reason. Lack of other persons also features high on the list of worries, amongst those passengers surveyed.

Passengers were also asked whether they knew the BTP existed prior to responding to the questionnaire, with 79% saying they did. Further questions were then asked about passengers' views on BTP's effectiveness in carrying out a number of specific duties.

Table 11. Passenger assessment of BTP

Passenger assessment of how well the BTP are in the following areas	Good	Fair	Poor
Providing a visible patrolling presence	31%	28%	41%
Dealing with drunk or rowdy people	39%	31%	30%
Dealing with young people hanging around	30%	32%	38%
Tackling drug dealing and drug use	38%	29%	33%
Tackling graffiti and vandalism	35%	30%	35%

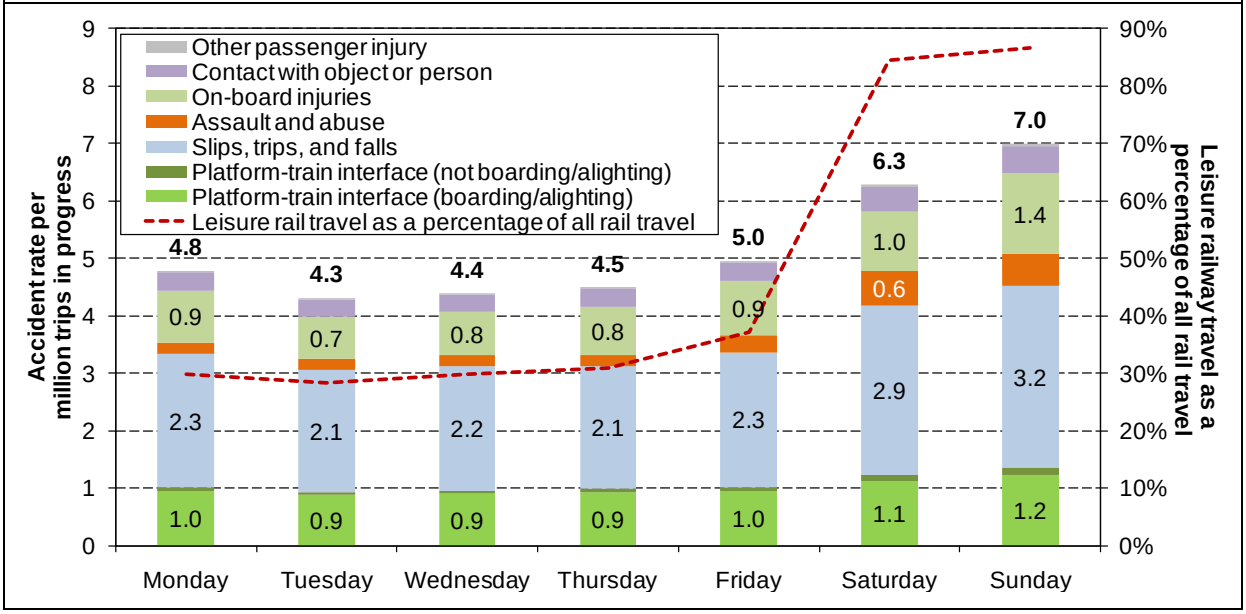
Finally, passengers were asked what their top two priorities were for BTP to focus their resources on when considering their own personal security whilst using the rail network. Most of the respondents provided only one priority, and there were a wide range of responses received, however the five most common groups were: visibility/presence/patrols; tackling anti-social behaviour; security/safety/crime; issues related to alcohol; issues related to terrorism.

5.6 Further analysis of passenger safety

5.6.1 Passenger safety by day of week

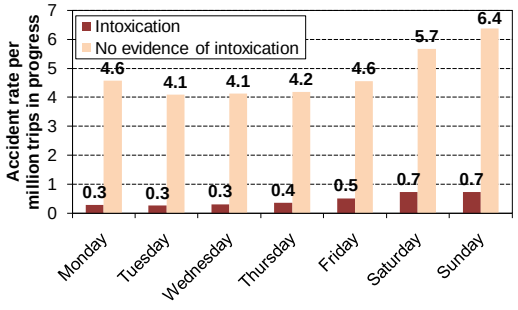
Reported passenger accident rates vary according to the day of the week. Passenger accidents of all levels of consequence are included in the analysis.

Chart 66. Passenger accident profiles by day of week 2001/02 to 2010/11



- The rate of accidents, normalised by trips in progress,[31] increases from Tuesday through to Friday, with the highest rates on Saturdays and Sundays. The rate on Mondays is also relatively high.
- The trend in accidents follows the trend in proportion of travel for the purposes of leisure, with higher proportions of leisure travel between Fridays and Mondays. This correlation is explained further in section 5.6.3.
- All accident types share this trend, but accidents involving *assault and abuse*, and *platform-train interface (not due to boarding/alighting)* show the greatest relative change, with a rate nearly three times higher on a Sunday than on a Tuesday.

Chart 67. Intoxication involvement in accidents by day of week 2001/02 to 2010/11



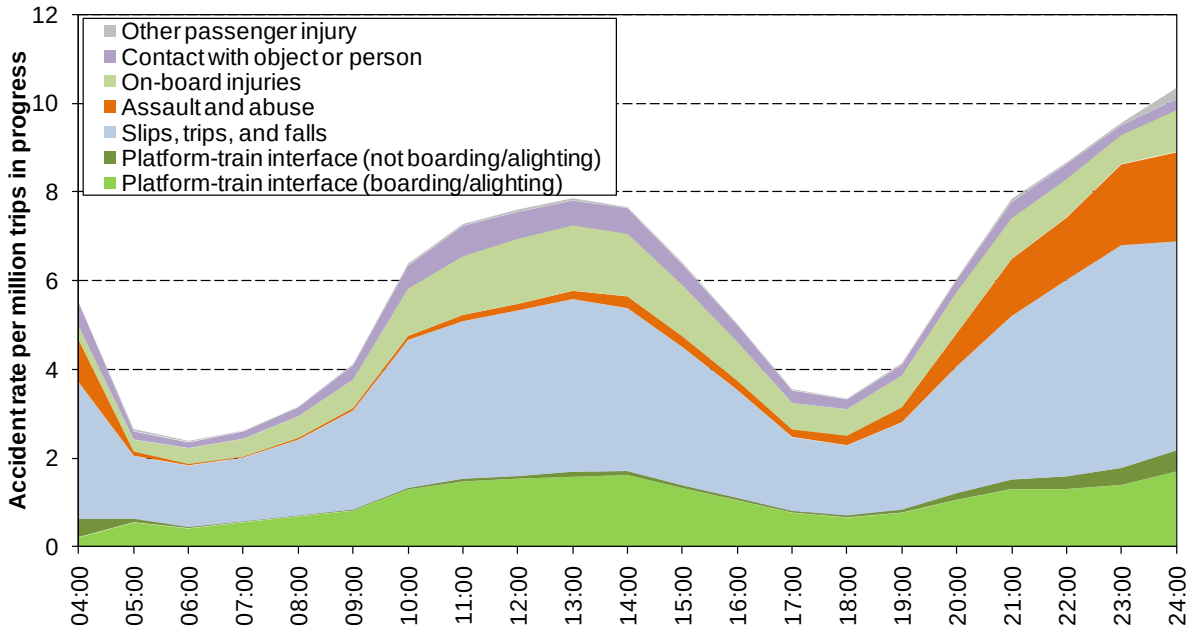
- The rate of accidents with evidence of intoxication (see Chart 67) also increases during the week, more than doubling between Monday and Sunday. This may account for some of the increase in accident rates, especially assaults. However, this analysis is based on SMIS data, which is more limited than BTP data in relation to assaults on passengers. The rate of accidents with no recorded evidence of intoxication shows the same trend (although with a higher rate on Mondays), so it is likely that other factors are involved. Also, intoxication is not always recorded when it has been a factor.

[31] Estimated using data from the DfT National Travel Survey. 'Trips in progress' are only counted if the railway is the main mode of travel, around 5% of trips include a rail stage as a minor part of a longer journey and are therefore not included in the calculation to estimate the proportion of travel that occurs on different days.

5.6.2 Passenger safety by time of day

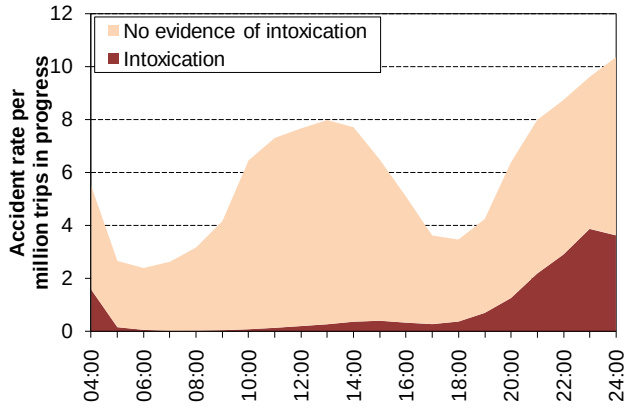
Reported passenger accident rates and profiles also vary according to the time of day. Again, passenger accidents of all levels of consequence are included in the analysis.

Chart 68. Passenger accident profiles by time of day 2001/02 to 2010/11



- The rate of accidents, normalised by trips in progress,[32] appears to be at its highest at off-peak times, between 10:00 and 16:00, and again between 19:00 and midnight. Those travelling off-peak are less frequent commuters who are at higher risk because they are less familiar with the hazards of rail travel. Additionally, it may be that 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.
- The extent to which this trend is evident varies between accident types. The rates of *slips, trips and falls*, *boarding/alighting accidents*, *on-board accidents* and *contact with object or person*, are high between 10:00 and 16:00. The rates of these accident type are also higher in the evening, combined with higher rates of *assaults* and *platform-train interface (not boarding/ alighting)* accidents. These two accident types are more often associated with intoxication than other types.
- Chart 69 illustrates that intoxication has a notable effect on the evening accident peak but not on the daytime accident peak.

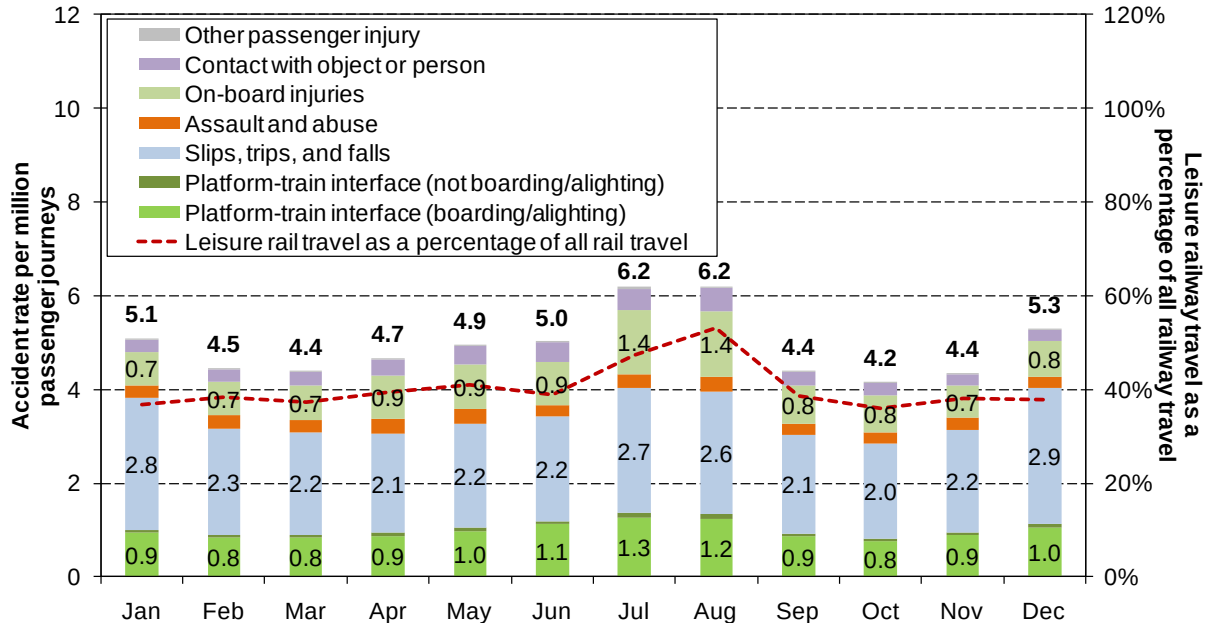
Chart 69. Intoxication involvement in accidents by time of day 2001/02 to 2010/11



[32] Estimated using data from the DfT National Travel Survey.

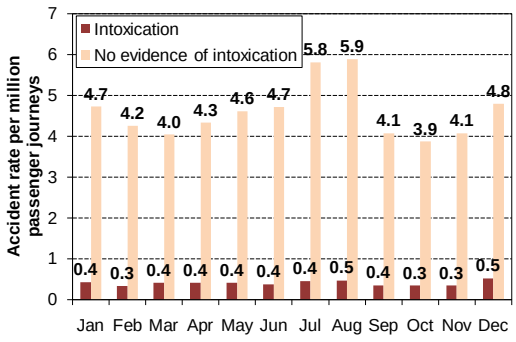
5.6.3 Passenger safety by month of year

Chart 70. Passenger accident profiles by month of year 2001/02 to 2010/11



- The highest accident rates[33] can be seen during the summer months of July and August. The accident rate is also higher in the winter months of December and January.
- Different accident types show different trends. The rate of reported *slips, trips and falls* is highest in December and January, with a smaller peak in July and August. The rate of *boarding/alighting accidents* increases during the spring and is highest in July and August, with a smaller peak in December. The rate of *on-board injuries* peaks in July and August but not in winter and a similar pattern is seen with the *contact with object or person* accident rate.
- The rates of accidents with and without evidence of intoxication increase in summer and winter months.

Chart 71. Intoxication involvement in accidents by month of year 2001/02 to 2010/11



- The trend in accidents does, to an extent, follow the trend in proportion of travel for the purposes of leisure, particularly the increases in July and August. Passengers who travel at these times may be less frequent users of the railway and therefore less experienced with its associated risks, as well as being more likely to be carrying luggage. They may also be more likely to report an accident for the reasons stated in section 5.6.2. Unlike in summer, there is little increase in leisure travel in winter.
- It is likely there are other factors that can affect the accident rate to varying degrees. A possible factor involved in the increase in *slips, trips and falls* seen in the winter months is the weather. This is explored further in section 5.6.4.

[33] Number of accidents normalised by trips in progress, estimated using data from the DfT National Travel Survey.

5.6.4 The effects of weather on passenger safety[34]

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. The effect of weather on slips, trips and falls was analysed by comparing the number of accidents to the weather occurring on that day.

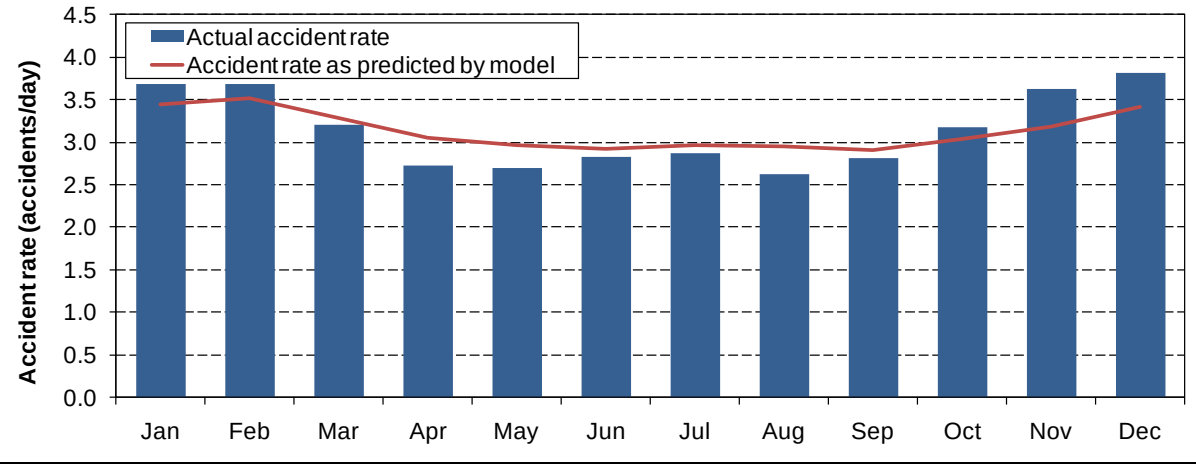
Table 12. Rate of slip, trip and fall accidents in different weather conditions in sample areas

Absolute rate		
Incidents/day	No ice	Ice
Dry	2.67	3.57
Wet	3.18	4.47

Relative rate		
Incidents/day	No ice	Ice
Dry	1.00	1.34
Wet	1.19	1.68

- There are more incidents occurring when the weather is wet and icy[35] than when conditions are dry and ice-free. Overall, when the weather is bad (either wet or icy) there is an increase in the accident rate of over 25%, compared with good conditions (dry and no ice). When wet and icy conditions occur together, the increase in rate is around 68%.

Chart 72. Slips, trips and falls by month with estimated rate using model based only on weather conditions

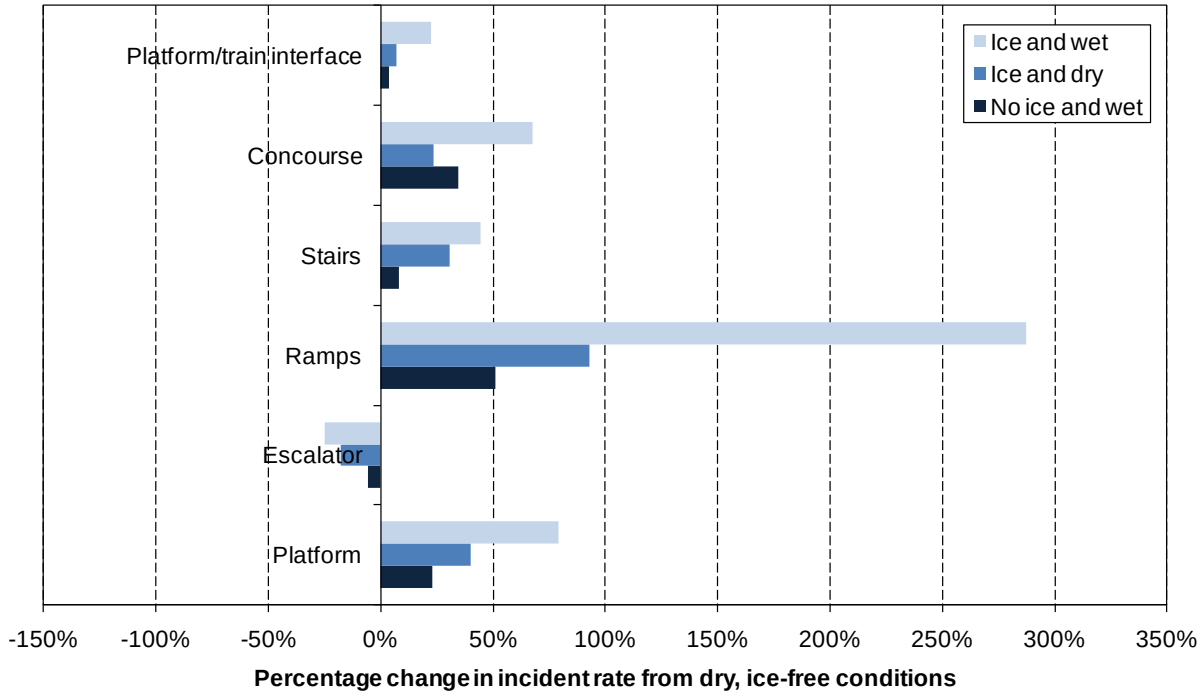


- The monthly rate of incidents was estimated, using observed weather patterns and the ratios derived from Table 12. Some seasonal variation in the rate of incidents is evident, with higher frequencies in the colder months, peaking in December.
- The model appears to be reasonably accurate in estimating the seasonal change. The incident rate in winter months is slightly under-predicted, and, in summer months is generally slightly over-predicted. This suggests that other factors may also have an influence. These factors could include variations in the demographic of passengers and the possible influence of alcohol consumption, as discussed in sections 5.6.1 to 5.6.3.

[34] The charts and table in section 5.6.4 use weather analyses taken from the RSSB board paper on Passenger Risk (November 2010). For the analyses, incident data from January 2001 to September 2010 was taken from SMIS for the urban counties of Greater London, Merseyside, West Midlands, Greater Manchester, Strathclyde and West Yorkshire. Together, these counties account for more than half of all incidents. Weather also varies less across these counties as they are relatively small, allowing weather data from the principal city to be used.
[35] Icy conditions are when temperatures fall below 1°C, allowing the possible formation of ice on the ground.

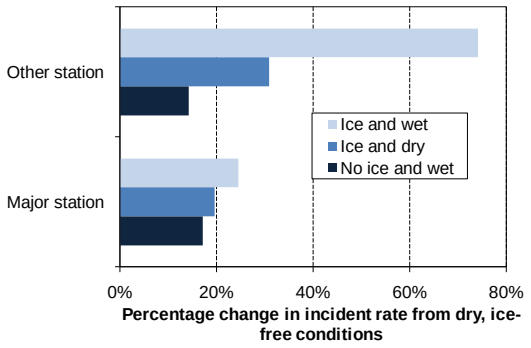
The effect of weather on slips, trips and falls varies depending on where the passenger is in the station and on the type of station they are in.

Chart 73. Percentage change in rate of slips, trips, falls (including boarding/alighting incidents) compared to dry ice-free conditions



- The weather seems to have little effect on the rate of incidents on escalators; it even appears that there are fewer injuries on escalators in bad weather. It is likely that the lack of effect is due to the fact that passengers are more often stationary on escalators and that escalators are under cover (only 2% of slips, trips and falls on escalators were due to surface contamination, compared to 59% on platforms). It is also possible that fewer at-risk passengers may travel during poor weather (analysis has shown that elderly passengers account for a high proportion of escalator injuries).
- Icy weather appears to have an effect on the rate of incidents on platforms, stairs, the concourse and especially on ramps. Wet weather also appears to have an effect, though it is less than icy weather. The combination of the two weather conditions seems to have the largest effect.
- Freezing conditions have a much greater effect in non-major stations (see Chart 74); wet and freezing weather increases the incident rate by more than 70%. This is possibly because major stations are more generally covered and more intensively managed.

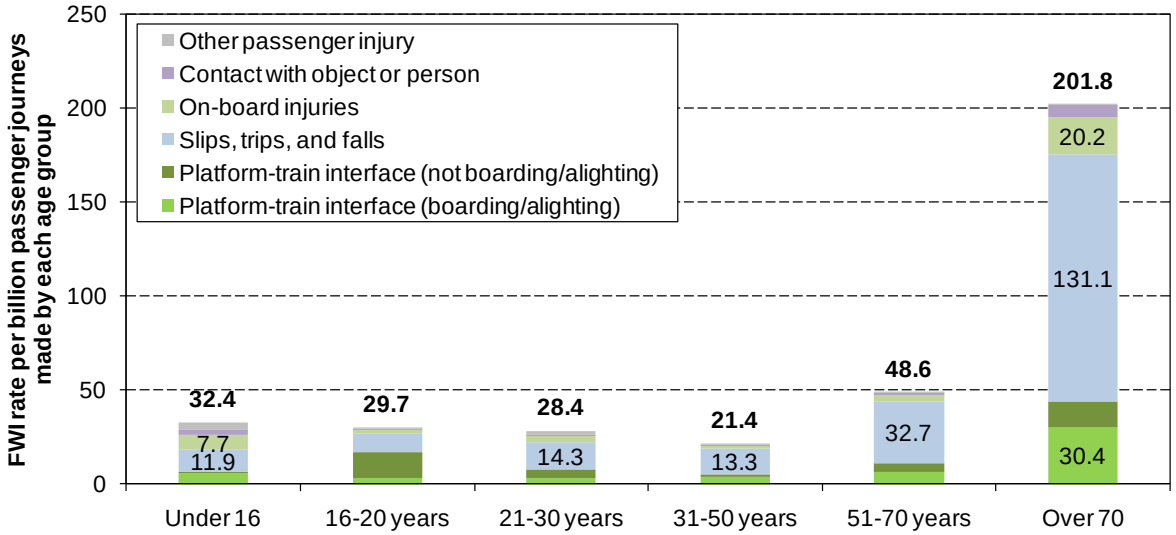
Chart 74. Percentage change in accident rates grouped by station type



5.6.5 Passenger safety and age

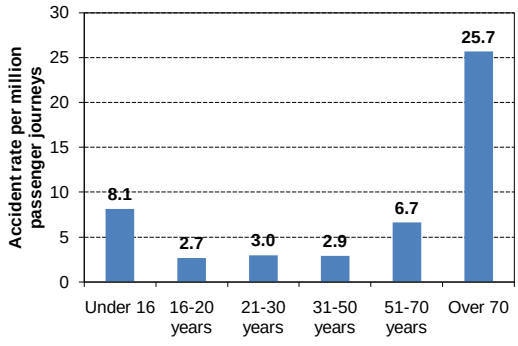
Passenger risk profiles vary by age group, with differences being most notable for older people. The ageing population and consequent issues related to reduced mobility present a challenge to the railway. The industry is already taking steps to address this, for example by improving the station environment 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 passenger assaults are not well recorded in SMIS.

Chart 75. Passenger harm by age group 2001/02 to 2010/11



- The age groups containing the oldest passengers have the highest rates of harm per journey. Children also have a relatively high rate of harm.
- The proportion of slips, trips and falls increases with age for adult passengers. They account for just over 30% of FWI rate in the 16-20 age group, but more than 60% in the over 70 age group.
- Almost half the rate of harm in passengers aged between 16 and 20 is due to *platform-train interface (not boarding/ alighting)* accidents. For 21-30-year olds they account for 17% and for other age groups they account for less than 10% of the FWI rate.
- 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 an injury if it occurs to those in their care. This may explain the difference between the relative accident rate (in Chart 76) and FWI rate (in Chart 75) seen in under 16-year olds .

Chart 76. Passenger accident rate by age group 2001/02 to 2010/11

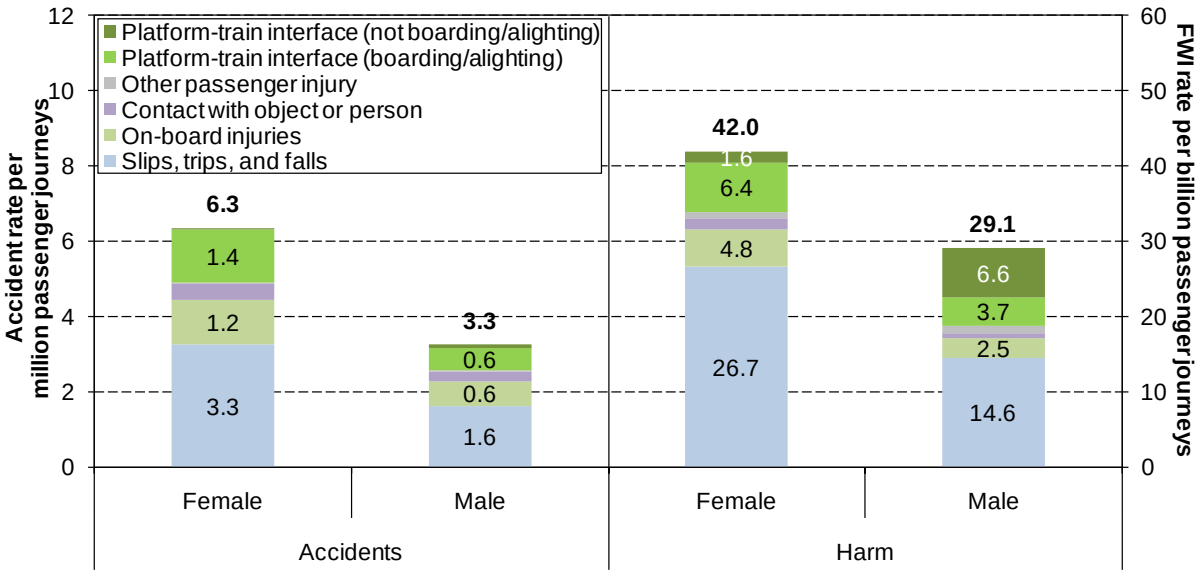


Data source: SMIS data from 2001/02 to 2010/11 where victim's age was recorded. FWI has been normalised using data from the DfT *National Travel Survey* and population estimates from ONS.

5.6.6 Passenger safety and gender

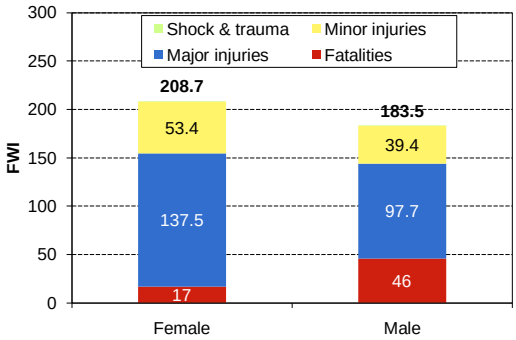
In recent years, men have made up around 57% of the journeys, and women around 43%. There are some notable differences in the accident profiles that tend to occur to each. For reasons stated in the previous section, the analysis does not include data on train accidents or assaults.

Chart 77. Passenger accident and FWI rate by gender 2001/02 to 2010/11



- The reported accident rate in females is around twice that of males when normalised by the number of journeys made by each gender. The rate of harm in females is around 1.5 times that of males.
- This difference is seen in most accident types apart from *platform-train interface (not boarding/alighting)* accidents which make up 0.5% of the overall accident rate in females compared to 2.5% in males.
- While differences in footwear between the sexes may explain some of the differences in accident rates (such as those due to *slips, trips and falls* and *boarding/alighting)*, it is likely there are also differences in reporting rates.
- Much of the difference between accident and FWI rate in males is due to *platform-train interface (not boarding/alighting)* accidents. There have been 30 male fatalities and 5 female fatalities due to this type of accident in the analysis period. The effect that this has on observed harm to males is illustrated in Chart 78.

Chart 78. Passenger harm by gender 2001/02 to 2010/11



Data source: Incident data from SMIS. Normalised using data from National Travel Survey, DfT and population estimates from ONS. Between 2001/02 and 2010/11 there were 51.8 weighted injuries to individuals where the sex was not reported, these have been apportioned to each gender according to the proportions of injuries to individuals where the sex was reported. The sex was always reported when the accident was fatal.

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	2006/07	2007/08	2008/09	2009/10	2010/11
Fatalities	**9**	**7**	**5**	**5**	**8**
Train accidents	1	0	0	0	0
Slips, trips, and falls	2	1	2	1	2
Platform-train interface	4	3	3	4	5
Assault and abuse	1	1	0	0	1
On-board injuries	0	0	0	0	0
Contact with object or person	0	0	0	0	0
Struck by train on station crossing	1	2	0	0	0
Other type of passenger injury	0	0	0	0	0
Major injuries	**246**	**225**	**234**	**235**	**240**
Train accidents	29	0	0	3	6
Slips, trips, and falls	134	142	158	144	146
Platform-train interface	39	41	40	42	43
Assault and abuse	7	10	6	9	10
On-board injuries	30	22	24	29	29
Contact with object or person	7	9	4	7	4
Struck by train on station crossing	0	1	0	0	0
Other type of passenger injury	0	0	2	1	2
Minor injuries	**4888**	**5028**	**5237**	**5280**	**5555**
RIDDOR reportable	1140	1103	1118	1168	1201
Non-RIDDOR reportable	3748	3925	4119	4112	4354
Incidents of shock	**322**	**330**	**260**	**205**	**227**
Class 1	10	13	5	3	7
Class 2	312	317	255	202	220
Fatalities and Weighted injuries	**43.41**	**39.32**	**38.39**	**38.67**	**42.61**
Train accidents	4.28	0.12	0.03	0.39	0.72
Slips, trips, and falls	20.77	20.90	23.55	21.11	22.47
Platform-train interface	9.64	8.98	8.98	10.37	11.60
Assault and abuse	2.08	2.29	0.84	1.19	2.29
On-board injuries	4.38	3.37	3.68	4.13	4.12
Contact with object or person	1.22	1.51	1.05	1.35	1.14
Struck by train on station crossing	1.00	2.10	0.00	0.00	0.01
Other type of passenger injury	0.04	0.05	0.26	0.13	0.27
Passenger kms (billions)	**46.2**	**48.9**	**50.8**	**51.4**	**54.5**
Passenger journeys (millions)	**1145**	**1218**	**1267**	**1259**	**1355**

BTP Passenger & Public Assaults	2006/07	2007/08	2008/09	2009/10	2010/11
Total	**4079**	**3530**	**3574**	**3170**	**3277**
Actual bodily harm	**1623**	**1485**	**1413**	**1145**	**1096**
Common Assaults	**1793**	**1500**	**1594**	**1451**	**1506**
GBH and more serious cases of violence	**152**	**109**	**175**	**173**	**224**
Other Violence	**73**	**50**	**47**	**60**	**55**
Racially Aggravated Harassment	**438**	**386**	**345**	**341**	**396**

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6 Risk to the workforce

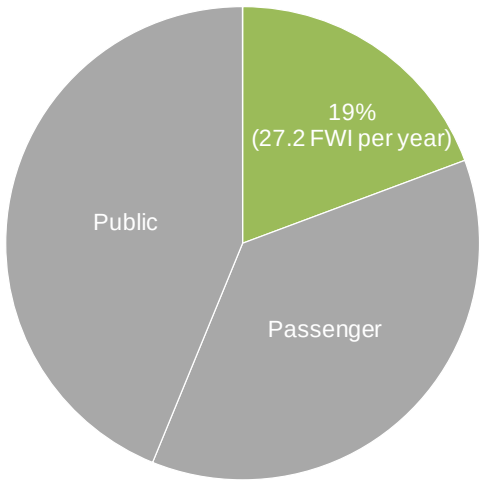
A person is classed as a member of the workforce if he or she is working for the industry on railway activities, either as a direct employee or under contract. This chapter investigates the range of accidents that occurs to the wide variety of railway occupations, from infrastructure workers to station staff. The term 'infrastructure worker' is now being used by RSSB in its safety performance reporting to replace the term 'track worker', with exactly the same scope. This is because the new term more accurately reflects the wide range of activities performed by those within the grouping. It encompasses those whose work involves inspecting, maintaining and renewing the track, signalling and telecommunications equipment, and other railway infrastructure, such as earthworks and bridges. A detailed breakdown of the workforce fatalities and injuries is presented in the key safety facts table at the end of this chapter.

2010/11 Headlines

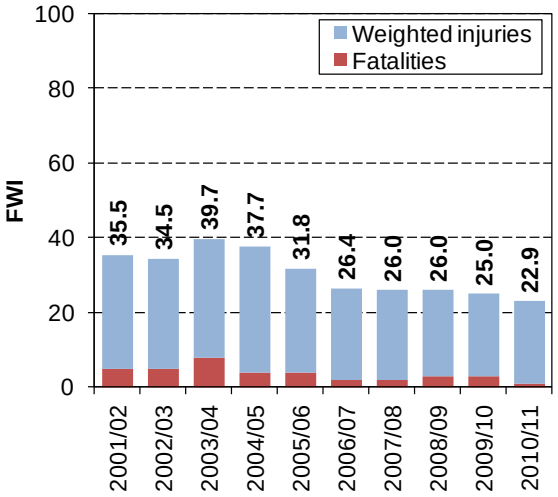
- There were no workforce fatalities in train accidents. There was one workforce fatality from other causes: an infrastructure worker died as a result of a fall from height.
- In total, there were: one fatality, 122 major injuries, 5,335 minor injuries and 1,101 cases of shock/trauma reported. This equates to 22.9 FWI, which is a decrease of 8% compared with 2009/10.
- Since 2006/07, levels of workforce harm have been consistently lower than before that time. This general trend is unlikely to have been affected by the under-reporting of RIDDOR lost time injuries by Network Rail staff and its contractor companies, identified in RSSB's independent review.
- Infrastructure workers remain the workforce group with the highest level of FWI. RSSB's SRM versions 6.5 and 7 provide estimates of unreported FWI likely to result from the under-reporting of RIDDOR events. The SRM modelling indicates that even after adjusting for unreported accidents, infrastructure safety has improved over recent years.

Workforce safety at a glance

Workforce risk in context (SRMv7)



Trend in workforce harm



6.1 RSSB's independent review of RIDDOR reporting by Network Rail and its contractors

In April 2010, the ORR highlighted some concerns regarding the number of RIDDOR lost time injuries that were being reported by Network Rail and its contractors when compared to the total number of RIDDOR major injuries reported. It would be expected that for every reported major injury there would be increasing numbers of lost time injuries, injuries requiring first aid, near misses, and so on. For the data covering the reporting year 2009/10 the ratio of RIDDOR-reportable lost time injuries to RIDDOR major injuries for Network Rail was around one to one, where a more expected rate would be at least two or more lost time injuries to each major injury.

Network Rail carried out a review of its data, and concluded that some misclassification of lost time injuries had indeed taken place, and thus under-reporting had occurred. Following discussions at the Network Rail Annual General Meeting in June 2010, and correspondence and discussion between the Unite union and the Chairman of Network Rail, the Chairman of Network Rail agreed that an independent review of RIDDOR reporting by Network Rail and its contractors should be undertaken. RSSB was tasked with establishing the level of under-reporting and exploring the reasons.

The full findings of the review can be found in the report of the study, which is downloadable from the RSSB website: http://www.rssb.co.uk/Pages/RIDDORReview.aspx. The key finding, in terms of relevance to analysing trends in workforce safety, was that there has been a significant level of under-reporting of RIDDOR lost time injuries by Network Rail staff and its contractor companies over the five-year period 2005/06 to 2009/10. Based on its review of reporting levels prior to 2004/05 and post Period 4 2010/11, in both Network Rail Maintenance and Infrastructure Projects, together with consideration of reporting levels of comparative industries, RSSB concluded that a ratio of 3:1 RIDDOR lost time injuries to major injuries would be a more reasonable estimate for the type of work to which Network Rail Maintenance and contractor staff are exposed. RSSB therefore estimated that, in total, 500 to 600 RIDDOR lost time injuries may not have been reported by Network Rail Infrastructure Projects and Maintenance between 2005/06 to 2009/10. This estimate represents between 37% and 42% under-reporting of RIDDOR lost time injuries for these two Network Rail functions. The majority of the under-reporting (80%) has been within Infrastructure Projects with the under-reporting in Maintenance only being prevalent since the start of 2008/09.

Assessing the effects of this level of under-reporting on overall trends in workforce safety and risk can be done reasonably easily, by making some general assumptions based on the expected level of total reporting. However, assessing the effects of under-reporting at a lower level, for example at the level of different accident types, is not so easily done; knowing that some events have not been reported does not reveal what type of events have been missed.

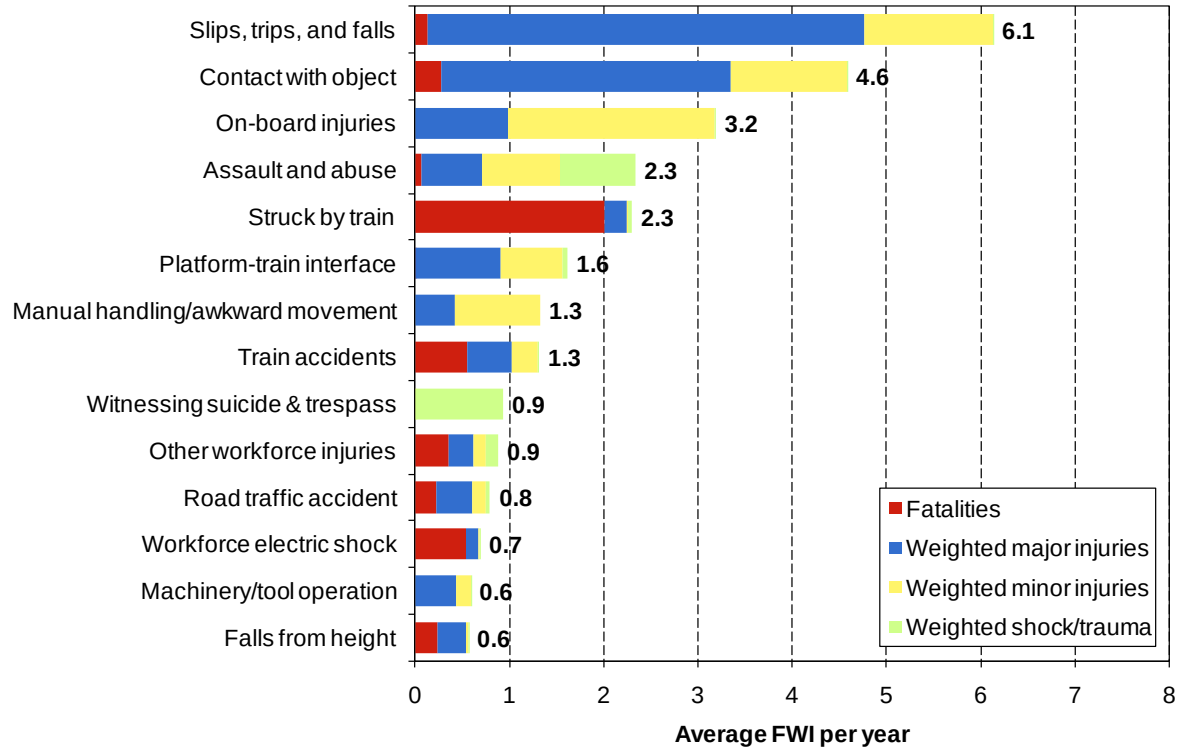
Therefore, in the appropriate workforce charts in this chapter, the effect of taking into account the missing injuries has been shown as an overlaid line. All other workforce analyses, and the workforce key safety facts sheet at the end of the chapter, are based on reported injuries only.

6.2 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 6.

Chart 79. Workforce risk by accident type: 27.2 FWI per year



Source: SRMv7

- 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 3%.
- The greatest source of fatality risk is being struck by a train, which accounts for 8% of the overall workforce risk profile, but 46% of the fatality risk profile. Injuries from this cause have a relatively high likelihood of being fatal.
- Train accidents account for 5% of the FWI risk profile and 13% of the fatality risk profile.
- The greatest causes of workforce shock & trauma are assault and abuse, and witnessing suicide and trespass fatalities, which account for 0.8 FWI and 0.9 FWI per year respectively.

6.3 Workforce fatalities and injuries in 2010/11

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.

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

Fatalities[36]

There was one workforce fatality during the year, which occurred to an infrastructure worker.

Table 13. Workforce fatalities in 2010/11

Date	Location	Accident type	Description of incident
13 April 2010	Stewarton Viaduct	Fall from height	A contractor working for Network Rail was fatally injured after the cherry picker, which he was using while engaged on strengthening work, toppled over, causing him to fall around 70ft.

Major injuries

- There were 122 major injuries in 2010/11, of which 73 (60%) involved infrastructure workers; the most common causes were slips, trips and falls and contact with objects. This latter category covers a variety of events, such as being struck by rails or sleepers while engaged on track work, or bumping into equipment around stations.

Minor injuries

- There were 5,335 recorded minor injuries, 571 (11%) 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 1,101 reports of shock or trauma in 2010/11; of these, 255 (23%) were Class 1.[37]

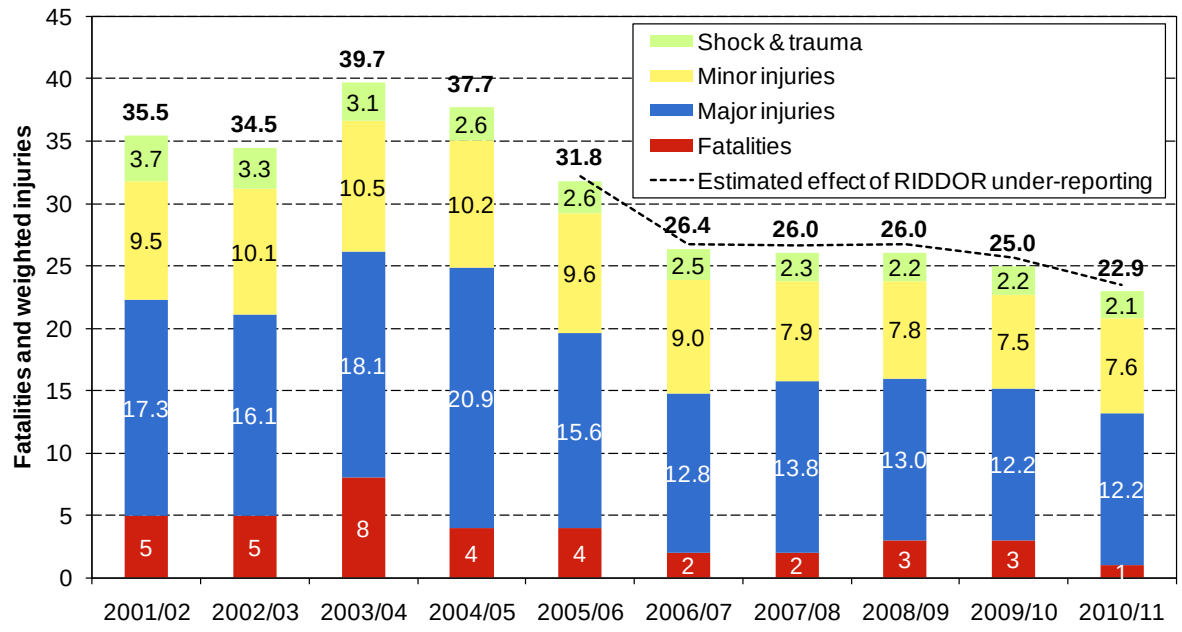
[36] A second, non-accidental, fatality occurred on 27 July 2010. The driver of a passenger service reported that his train had struck the guard of a second passenger service, which was running on the opposite line. The guard was seen to step from the inward opening rear crew door of the unit as the trains approached each other, into the path of the oncoming train. Early indications suggest that the guard committed suicide, although investigations remain ongoing. This event is therefore reported within the public risk chapter.

[37] 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.

6.4 Trend in workforce harm by injury degree

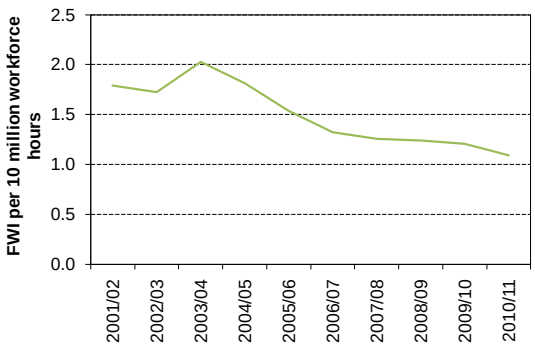
Based on SRMv7, the average level of harm to the workforce is 27.2 FWI, of which 4.4 (16%) is fatalities. In any given year, the observed levels of harm may differ from SRM estimated values. One reason for this is statistical variation. Another is that the SRM provides an estimate of underlying risk, and includes the risk from events that may not have occurred during the year, such as train accidents involving workforce injuries.

Chart 80. Workforce FWI by injury degree



- The level of workforce harm for 2010/11 showed a decrease of 8% compared with the previous year, the main reason for which was the occurrence of two fewer fatalities. The normalised rate of harm also shows a decrease, of 10%.
- The last five years have seen fewer workforce fatalities than previously. Since recording began, there have been no financial or calendar years without workforce fatalities.[38]
- Two of the years shown in the chart contain multi-fatality accidents. In 2003/04 four infrastructure workers were killed in an accident involving a runaway trailer, at Tebay, and in 2004/05, two infrastructure workers at Hednesford were killed in another accident involving a road-rail vehicle.
- The chart shows the estimated effect on the total FWI of the under-reporting of RIDDOR-reportable injuries by Network Rail and its contractors; the increase to recorded risk for those years is approximately 2%.

Chart 81. Normalised FWI rate

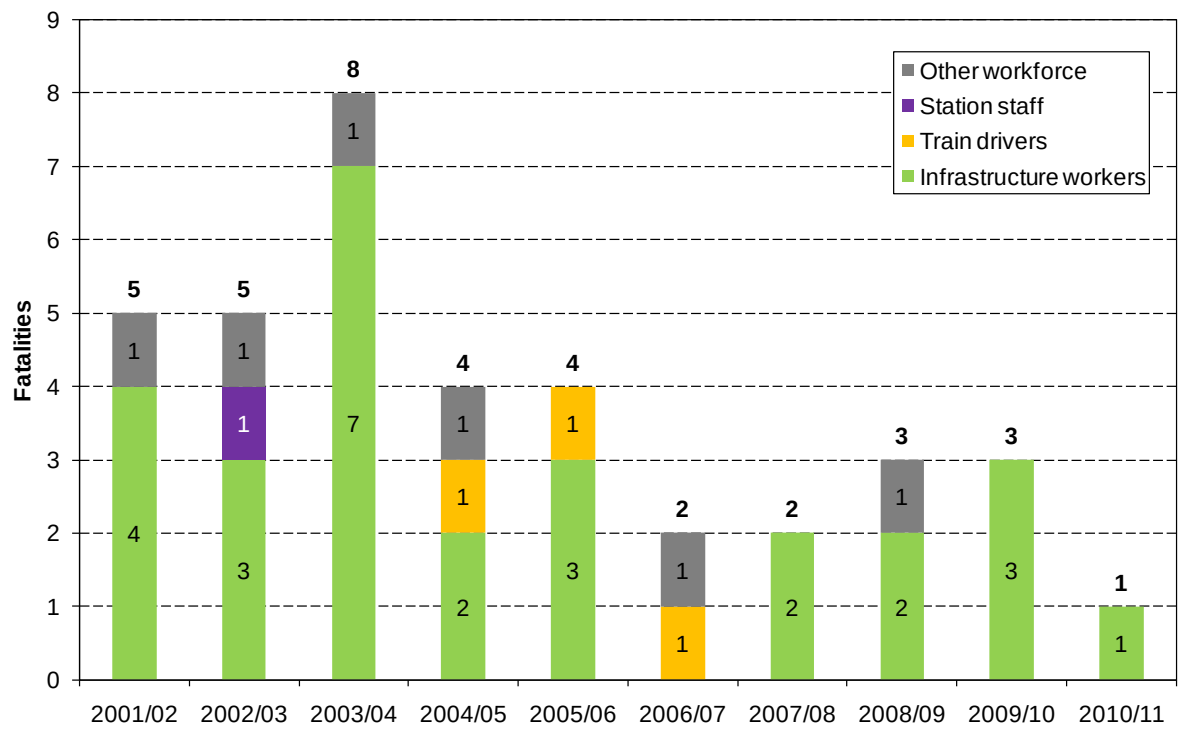


[38] There have, however, been two occasions where more than 12 months have passed with no workforce fatality: between 08/11/96 and 10/03/98 (487 days) and between 12/07/08 and 02/12/09 (508 days).

6.4.1 Workforce fatalities

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

Chart 82. Workforce fatalities by type of worker



- Since 2001/02, there has been a total of 37 fatalities, 27 of which have occurred to infrastructure workers.
- In 2010/11, there was one workforce fatality, which occurred to an infrastructure worker who fell while working at height.
- Over the period shown, the highest number of fatalities occurred in 2003/04, when eight workforce members died, four of whom were the infrastructure workers fatally injured in the Tebay incident.
- The fatalities included in the *other workforce* category include two shunters, two fitters, a person delivering to site, and a banksman.

Workforce fatality by location

Infrastructure 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 14. Workforce fatalities by location and activity 2001/02 to 2010/11

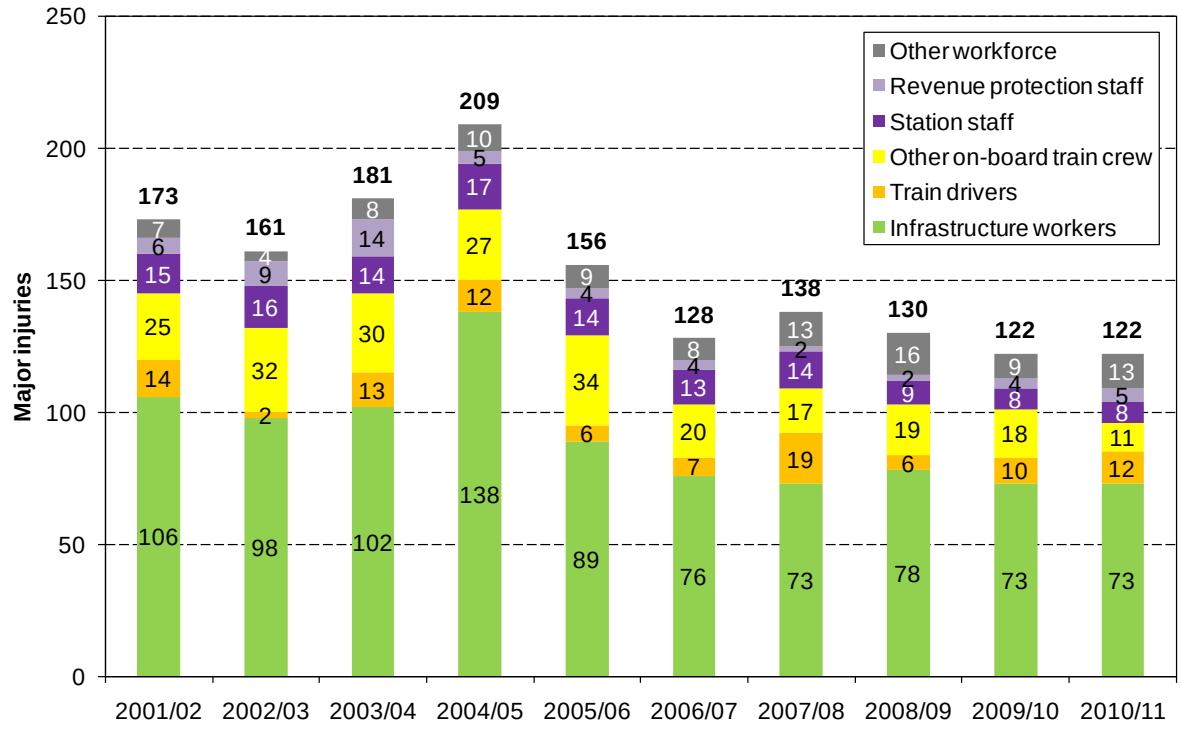
		Site type					
		Running line	In depots, yards and sidings	On trains	On railway infrastructure - not trackside	Public /private property (non railway owned)	Total
Infrastructure worker	Track maintenance	11		1			12
	Lookout	4					4
	CoSS	2					2
	Civil structure maintenance				3		3
	Hand Signaller	2					2
	Civil structure inspection				1		1
	S&T renewal/upgrade	1					1
	Electrification maintenance	1					1
	Machine controller	1					1
Train driver		2		1			3
Station staff				1			1
Other workforce	Shunter		2				2
	Fitter		2				2
	Banksman					1	1
	Non-railway personnel delivering to site	1					1
	Total	25	4	3	4	1	37

- Most fatalities have occurred to infrastructure workers 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 22 fatalities in this category, half of whom were engaged on track maintenance.
- 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. The reporting of non-fatal injuries in these locations is not mandatory in SMIS.

6.4.2 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. SRMv7 estimates workforce major injuries to account for 12.9 FWI per year, which is 47% of the total workforce risk.

Chart 83. Workforce major injuries by type of worker

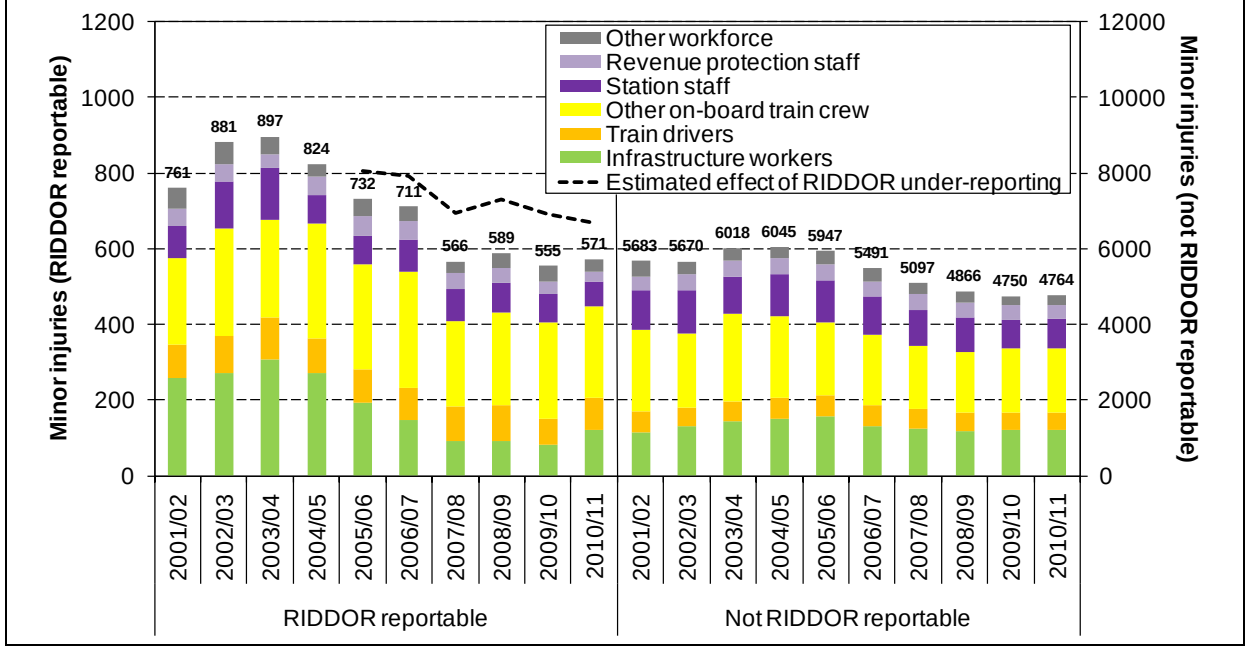


- At 122, the number of workforce major injuries in 2010/11 was the same as in 2009/10.
- Since 2001/02, 60% of all major injuries have occurred to infrastructure workers. This proportion has stayed fairly constant over the period shown in the chart. The year with the largest proportion of infrastructure worker major injuries was 2004/05, with 66%. The year with the smallest proportion was 2007/08, with 53%.
- Although the majority of workers who sustain a major injury are able to return to their normal employment, in a small number of cases, such injuries can be life-changing.
  - On 27 December 2010, an infrastructure worker was un-strapping a five-tonne robust kerb on a trailer. When he released the last ratchet, the robust kerb fell onto its side. The man was knocked backwards off the trailer, with the fallen beam trapping him by the lower legs, leaving him suspended from the trailer. He suffered crush trauma to both legs and although major surgery was performed in an attempt to reconstruct the lower part of both legs, this was unsuccessful, with both legs requiring amputation below the knee.

6.4.3 Workforce minor injuries

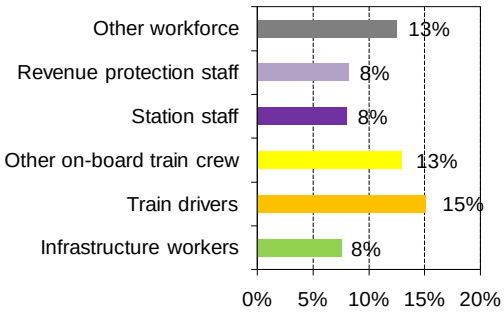
Workforce minor injuries are classed as RIDDOR-reportable if they are not major injuries but result in the staff member being unable to return to their normal duties for more than three days. While all fatalities and the vast majority of major injuries occurring to the workforce are recorded, this is not necessarily the case with minor injuries and shock/trauma events, where different worker types may display different reporting cultures. SRMv7 estimates workforce minor injuries to account for 7.9 FWI per year, which is 29% of the total workforce risk.

Chart 84. 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, infrastructure 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 the recorded number of RIDDOR-reportable minor injuries since 2003/04, mainly due to a fall in the recording of infrastructure 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 8% for infrastructure workers to 15% for train drivers.
- The review of RIDDOR reporting by Network Rail and its contractors found that during the period 2005/06 to 2009/10 around 500 to 600 RIDDOR-reportable injuries, predominantly to infrastructure workers, are likely to have gone unreported. The estimated effects of this under-reporting are shown on Chart 84.

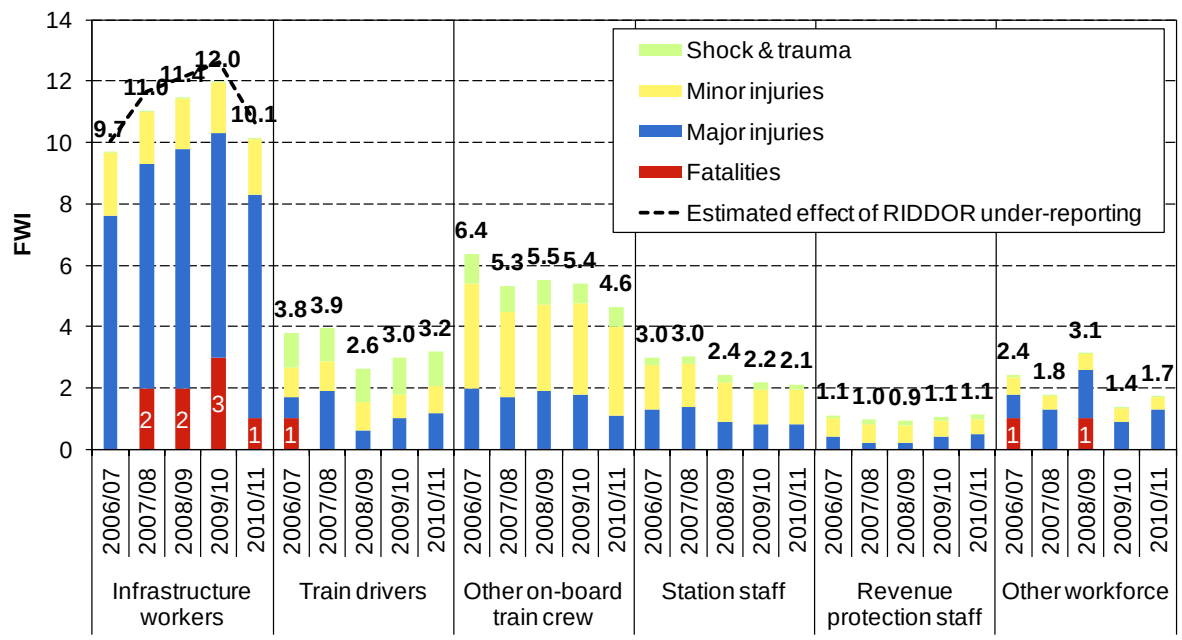
Chart 85. Proportion of RIDDOR-reportable minors since 2008/09



6.5 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 people employed in the different roles, but also due to the different environments to which each is exposed.

Chart 86. Workforce fatalities and weighted injuries by type of worker



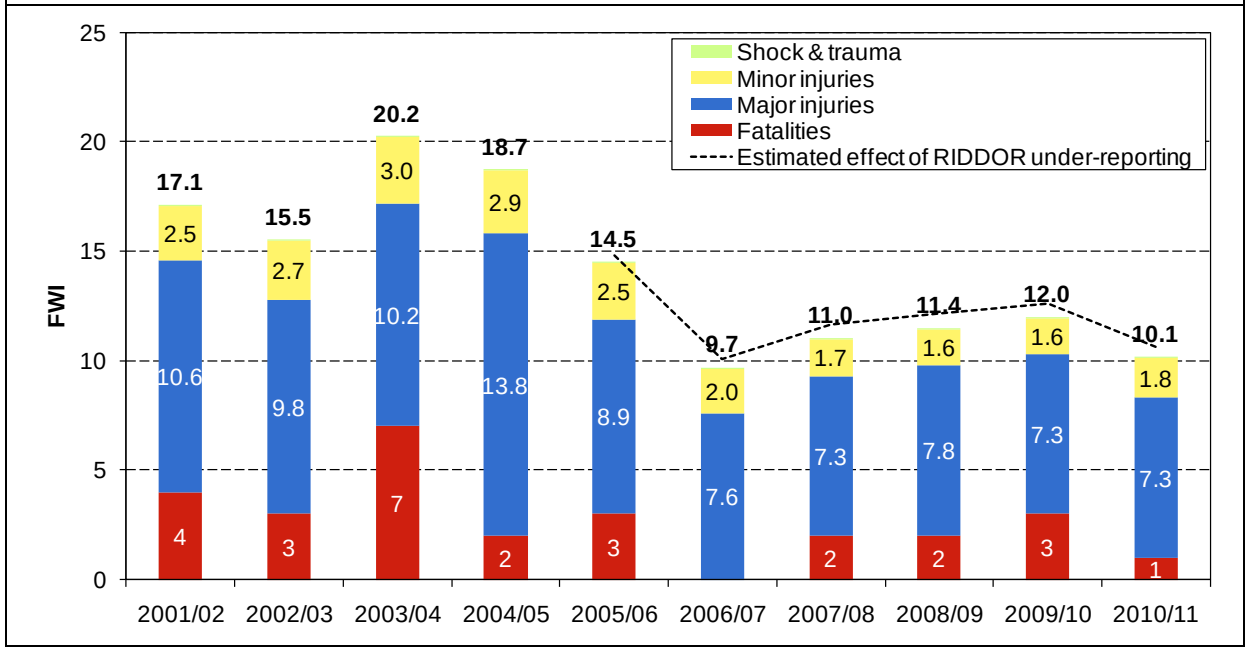
- Infrastructure workers suffer the greatest proportion of harm, with 43% of the total workforce harm over the period shown. The total level is affected by the number of fatalities, but is dominated by major injuries. When only non-fatal injuries are considered, a flatter trend is observed.
- Train drivers and other train crew have the next greatest proportion of harm, with 35% 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 other train crew has decreased since 2006/07, while that for train drivers shows a less stable trend.
- 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[39] have recorded the lowest levels of harm over the period, at 4% and 8% respectively. However, their injury profiles are again very different, with other staff having a greater apparent tendency for fatality and major injury. The reason for this is likely to be partly due the locations where this category of work are based; non-fatal injuries are not mandated to be reported into SMIS.
- 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.

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

6.5.1 Rail infrastructure workers

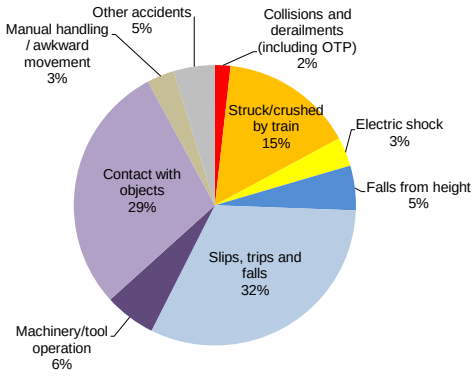
The term 'infrastructure worker' is now being used by RSSB in its safety performance reporting to replace the term 'track worker', with exactly the same scope. This is because the new term more accurately reflects the wide range of activities performed by those within the grouping. It encompasses those whose work involves inspecting, maintaining and renewing the track, signalling and telecommunications equipment, and other railway infrastructure, such as earthworks and bridges. There are around 30,500 full-time equivalent infrastructure workers in the industry. Since 2001/02, the average level of infrastructure worker FWI per year has been 14.0, and the average level of fatalities 2.7 FWI.

Chart 87. Trend in infrastructure worker FWI



- Infrastructure worker harm peaked in 2003/04 at 20.2 FWI. Following a large decrease over the period up to 2006/07, recent years had seen a slight rising trend. However, levels of infrastructure worker harm are still historically low. 2010/11 saw a fall compared with the previous year, largely due to the fewer fatalities. The chart shows the estimated effects of the under-reporting of RIDDOR-reportable injuries by Network Rail and its contractors.
- The category which is responsible for the largest proportion of infrastructure worker harm is *slips, trips and falls*, which over the period shown has accounted for 32%. This is closely followed by the category *contact with object*, which has accounted for 29%. There is more discussion of these accident types on pages 98 and 99.
- Electric shock, train accidents, and being struck by a train are relatively rare events, but are more likely to result in fatality than other types of accident.

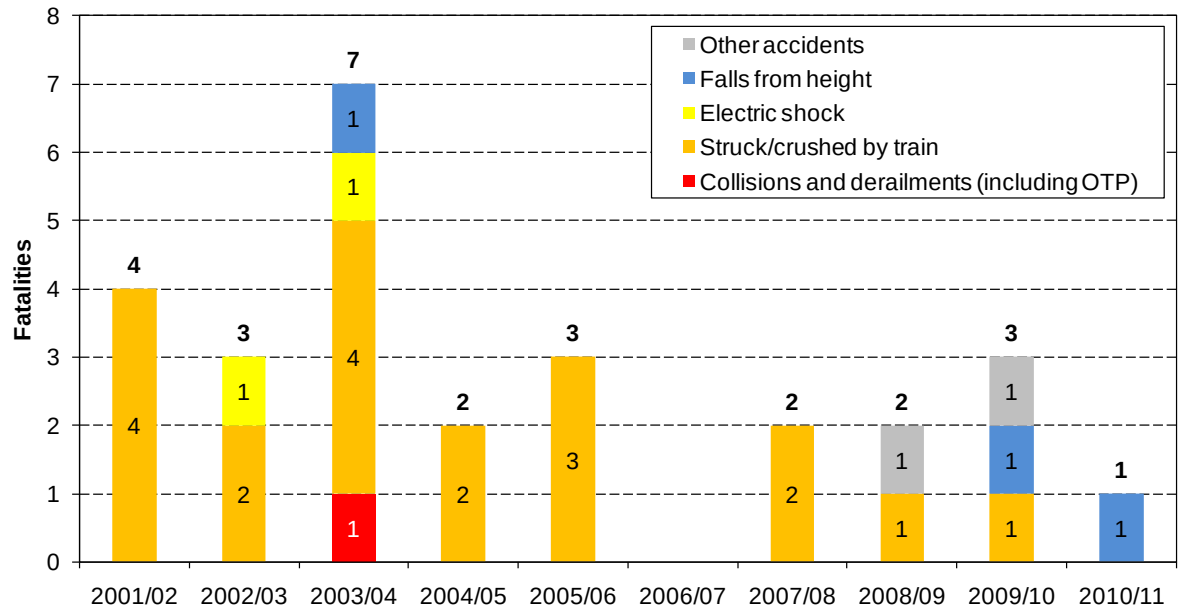
Chart 88. Infrastructure worker FWI by accident type since 2001/02



Infrastructure worker fatalities

Since 2001/02, around one fifth of infrastructure worker harm has been due to fatalities. Infrastructure 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 89. Infrastructure worker fatalities by accident type



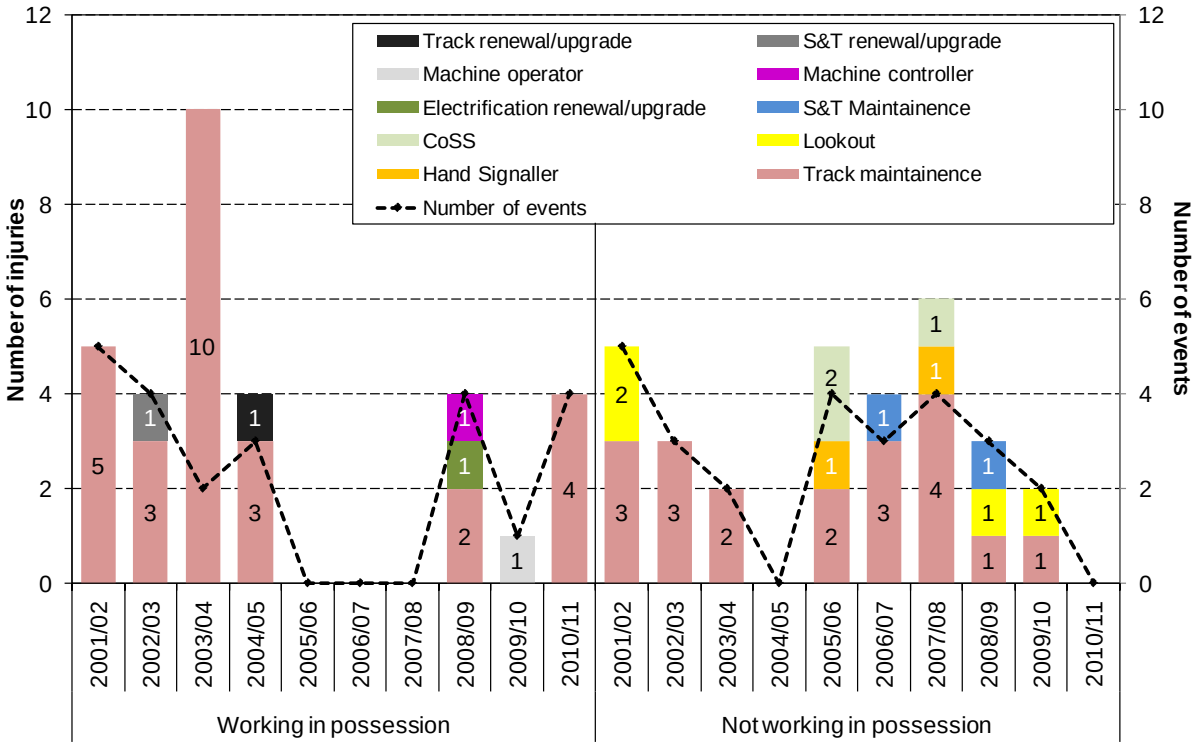
- The most common cause of fatality for infrastructure workers is being struck or crushed by trains; over the period shown, 19 of the 27 infrastructure worker fatalities have been due to this cause.
- Four of the fatalities shown in the chart involved falls from height. In 2003/04, an abseiler working 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 accidents* in the chart above, because it involved working with on-track plant. In both 2009/10 and 2010/11, the fatalities involved infrastructure workers engaged in bridge maintenance. There is more analysis of falls from height on page 100. A further fatality in 2009/10 occurred to an infrastructure worker engaged on bridge maintenance. In this case, the man was overcome by fumes from the chemicals he was using.
- 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 *collisions and derailments (including OTP)*, 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.

Infrastructure worker risk from being struck by train[40]

On the previous page, Chart 89 showed that the majority of infrastructure 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 90 looks at all events (ie both fatal and non-fatal) involving this type of accident.

Since 2001/02, there have been 49 events in which infrastructure workers were struck by trains. Five of these resulted in multiple injuries; of these, two events involved multiple fatalities (Tebay in 2004/05 and Hednesford in 2003/04).

Chart 90. Events in which infrastructure workers were struck by trains 2001/02 to 2010/11



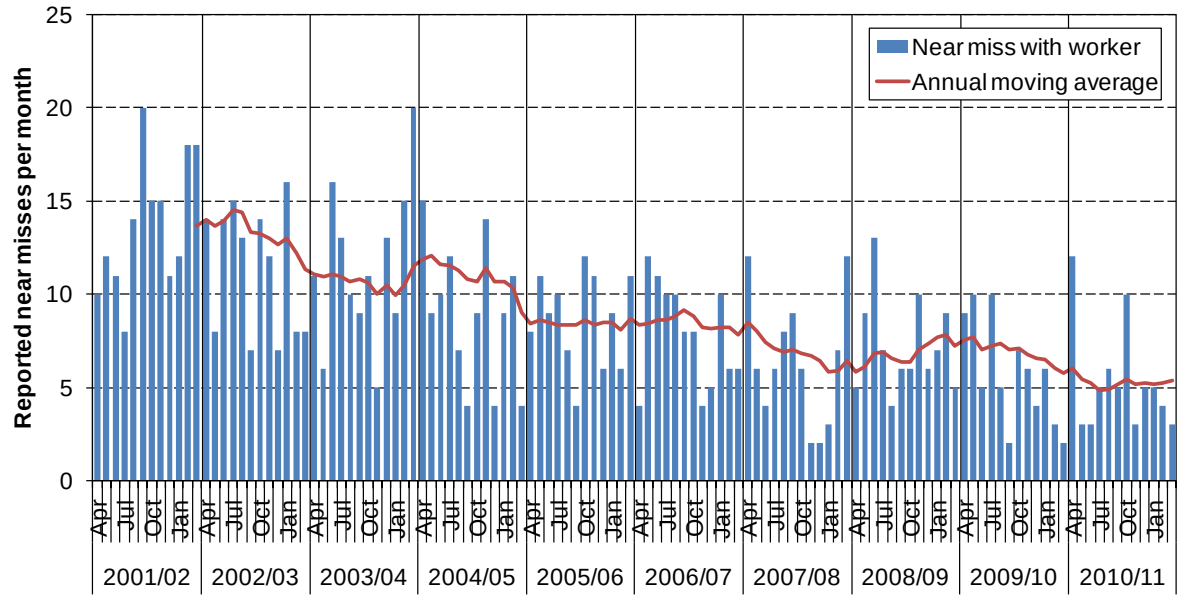
- The 49 events over the past 10 years have resulted in 62 injuries. Of these, 19 were fatal, 24 were major, 14 were minor, and 5 were shock/trauma. The total FWI since 2001/02 has been 21.5 FWI.
- The events are split roughly equally between those occurring to people working in a possession (23) and outside a possession (26). The 23 events in possessions resulted in 32 injuries, and the 26 events outside possessions resulted in 30 injuries.
- There were four incidents in 2010/11, all involving track maintenance work in possessions. Three of the incidents occurred completely in the possessions whereas the fourth occurred when the person moved out of the possession and was struck by a train.
- In the past ten years, only two years have been without fatalities to infrastructure workers who have been struck by trains: 2010/11 and 2006/07.

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

Infrastructure 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 infrastructure workers. Infrastructure worker near misses are an indicator of the risk from being struck by a train, which is the major cause of infrastructure worker fatality. In addition, near misses can be a cause of shock and trauma to drivers.

Chart 91. Near misses with the workforce



- The overall trend in recorded near-misses appears to be one of reduction. The number varies month by month, but not in any stable seasonal pattern. The trend in the annual moving average has been characterised by periods of decrease followed by plateaus.
- Most near misses are reported during the day-time period, from 08:00 to 17:00, with the peak times being between 19:00 and 12:00. The factors involved are likely to be visibility and times that certain types of track work are taking place.
- RAIB is carrying out an investigation into two near-miss incidents, which both occurred in the same area on 8 March 2011. In both cases, the gangs were involved in setting up a speed restriction following the discovery of a rail defect.

Table 15. 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	2	1	7	4	3	3	1	5	4	1	38
1	1	2	1	2	1	0	5	3	3	1	2	0	21
2	1	1	0	1	2	1	1	2	1	0	0	3	13
3	0	1	0	2	0	0	3	0	0	0	3	1	10
4	1	2	0	0	3	0	0	3	2	1	3	1	16
5	0	1	1	0	0	1	1	1	1	2	2	0	10
6	1	1	1	0	0	0	4	0	0	0	1	0	8
7	0	1	2	3	0	0	2	2	2	1	1	1	15
8	3	3	2	2	3	7	5	0	1	1	4	5	36
9	10	13	8	7	9	9	9	13	10	9	10	6	113
10	11	13	16	24	18	15	23	11	15	21	14	10	191
11	14	9	16	21	11	12	16	17	10	14	6	9	155
12	7	11	12	12	6	12	3	5	6	13	10	5	102
13	8	5	8	9	9	8	6	7	8	8	8	3	87
14	7	3	7	6	6	6	5	6	5	11	4	5	71
15	3	6	4	4	3	7	3	4	2	1	2	0	39
16	4	2	0	3	0	1	0	3	2	1	0	2	18
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	1	2	13
21	2	2	0	2	1	1	2	1	0	3	1	1	16
22	0	0	2	0	2	1	2	1	0	2	1	2	13
23	0	2	2	0	2	5	1	0	1	1	0	1	15
Total	86	87	90	100	86	96	96	84	74	98	82	63	1042

Irregular working

SMIS captures events in which a workforce error or violation has the potential to result in a serious accident even though, in many cases, no harm results. In 2010/11, 136 incidents involving infrastructure work were ranked as potentially significant or potentially severe[41] (in most cases because they had the potential to expose workers to moving rail vehicles or live traction supplies). Chart 92 shows the types of event, including whether the act of irregular working was primarily an error or a violation. The categories are based on a set of indicators that RSSB is developing with the Infrastructure Safety Liaison Group (ISLG) to improve understanding of the risk to infrastructure contractors. Protection irregularities (40%) and near misses (21%) were the most prevalent events, and errors are more common than violations.

Chart 92. Potentially significant or severe irregular working incidents in 2010/11

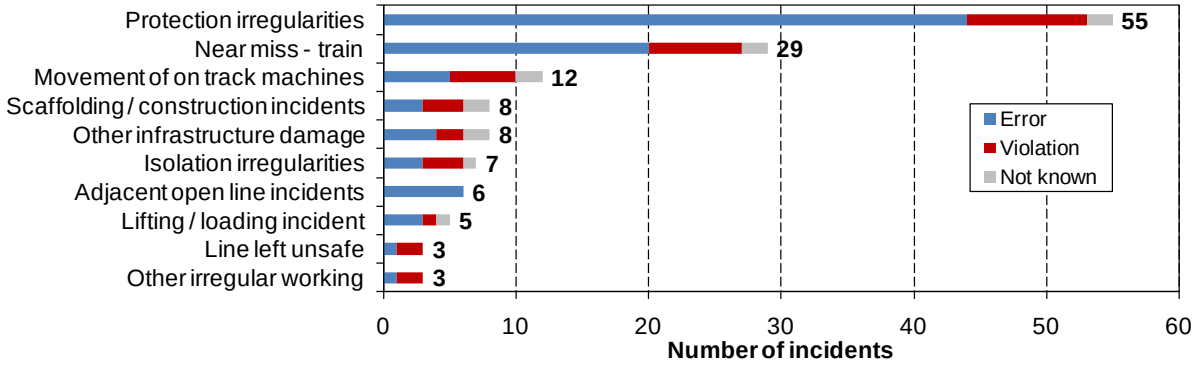
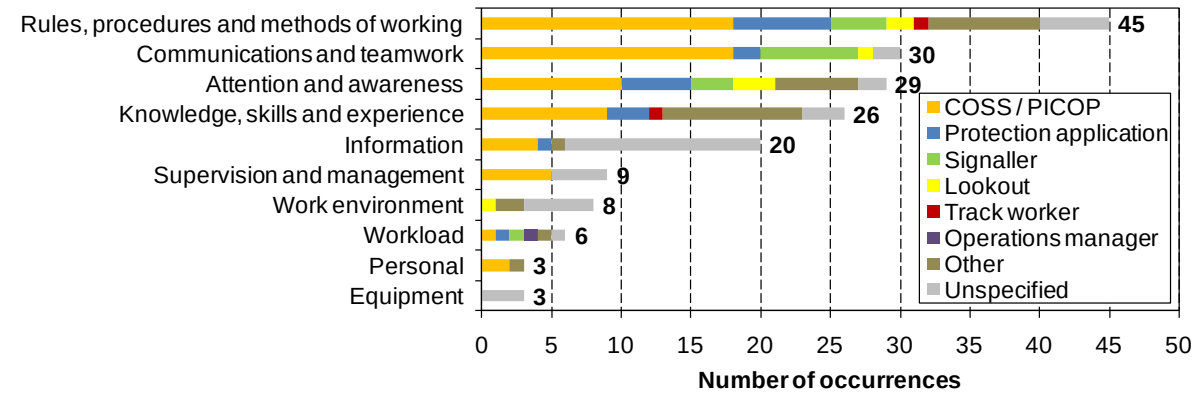


Chart 93 shows the 55 protection irregularities categorised according to Network Rail's 10 incident factors. Each incident can have multiple factors, hence there are more 'codings' than incidents. The data has also been broken down according to the role of the person involved. The COSS / PICOP category was associated with 37% of the causal factors. Weaknesses in or non-compliance with rules, procedures or methods of working was recorded as a factor in more than 80% of the event.

Chart 93. Protection irregularity causal factors by role in 2010/11

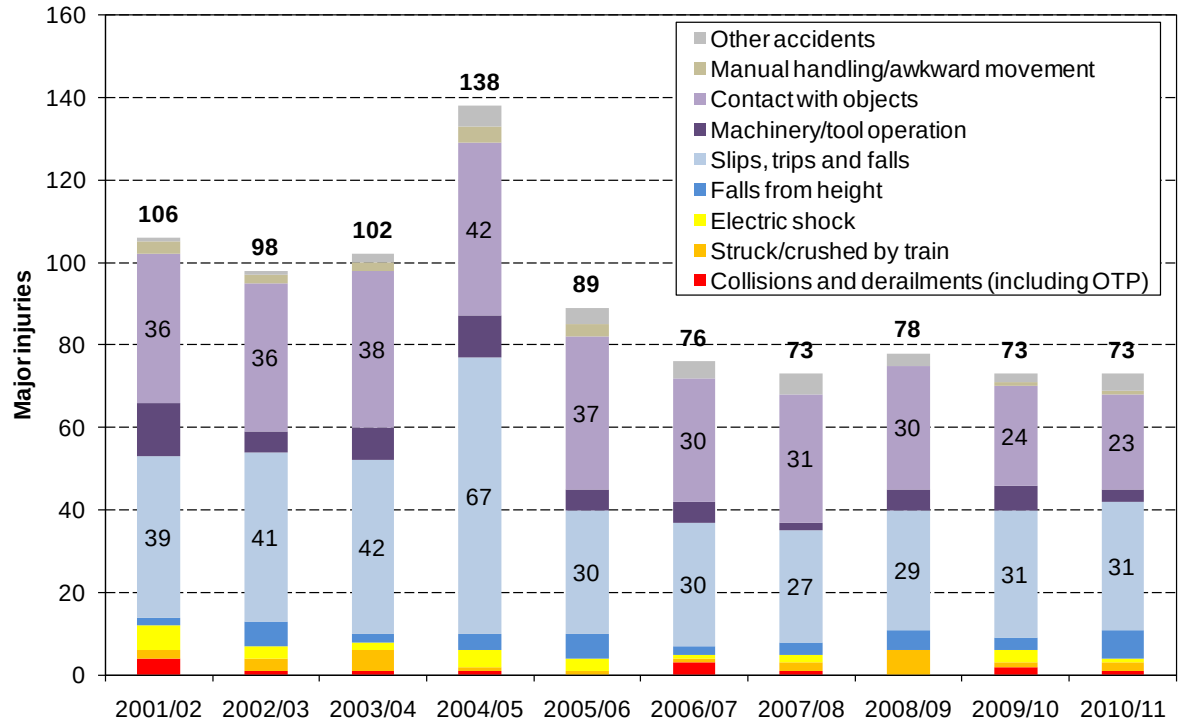


[41] Risk ranking of irregular working events is carried out by Network Rail. After an initial filter to remove those that carry no risk, the remaining events are risk ranked into one of four categories: negligible risk, low risk, potentially significant and potentially severe, based on the potential for the event to lead to an accident and the potential consequences of the accident if it had occurred.

Infrastructure worker major injuries

Since 2001/02, 65% of infrastructure worker harm has been due to major injuries.

Chart 94. Infrastructure worker major injuries by accident type

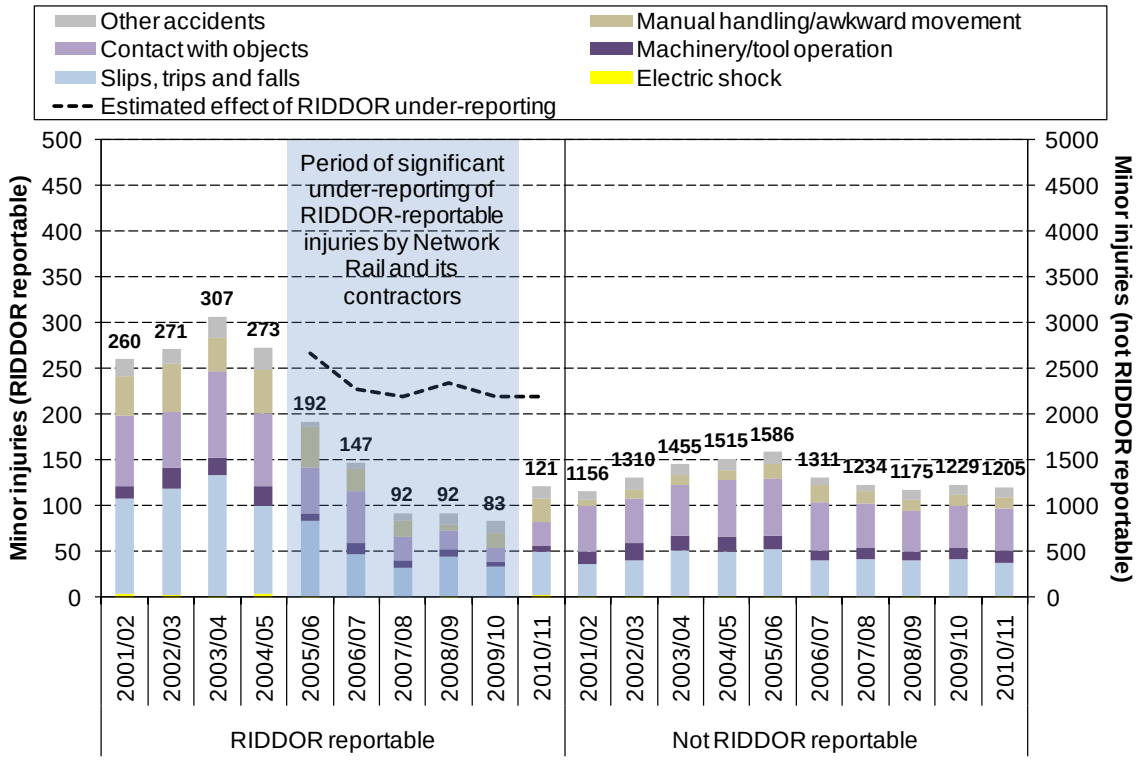


- The number of major injuries to infrastructure workers in 2010/11 is level with that of 2009/10, and continues the flat trend seen since 2006/07.
- The large peak in 2004/05 occurred around the time that Network Rail brought track maintenance in house. It is possible that when working during a time 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, 41% of infrastructure 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 – eg 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.

Infrastructure worker minor injuries

Since 2001/02, 16% of infrastructure worker harm has been due to minor injuries.

Chart 95. Infrastructure worker minor injuries by accident type

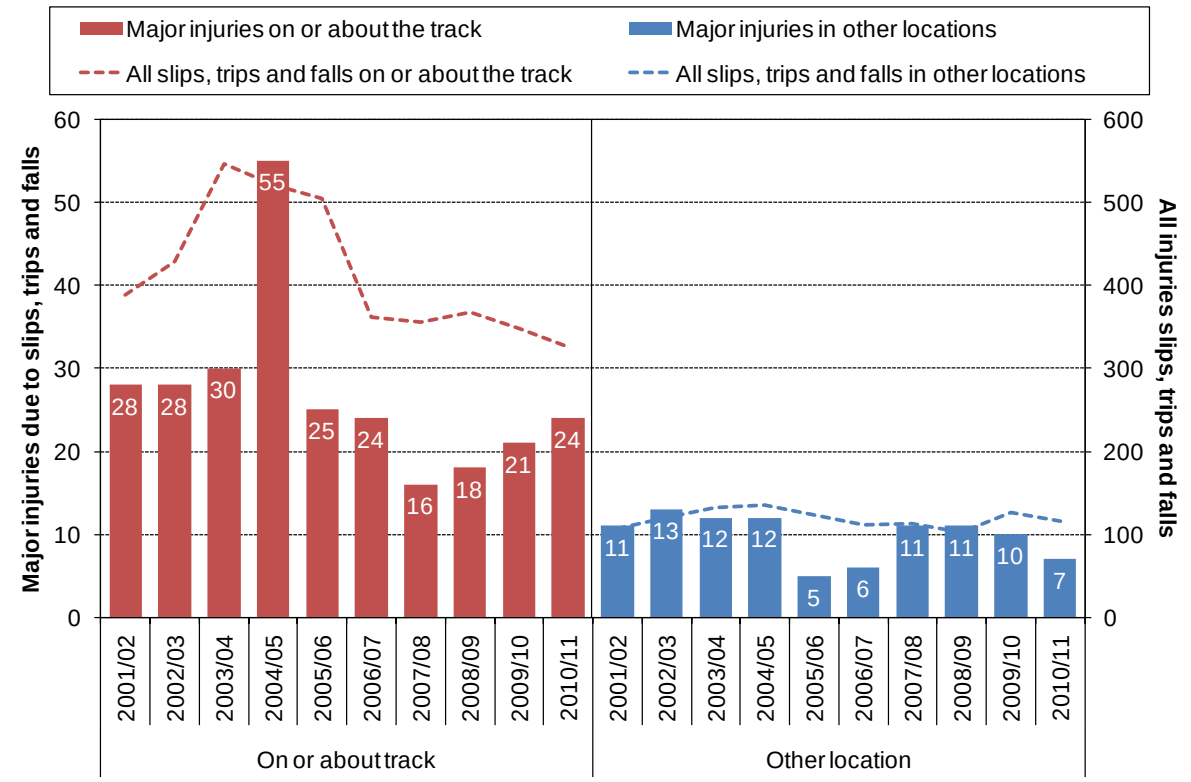


- RIDDOR-reportable and non-RIDDOR-reportable minor injuries show quite different trends in recorded number. RIDDOR-reportable minor injuries increased up until 2003/04, after which there was a rapid fall in number, and then a plateau. This was maintained until 2010/11, when a rise in recorded number occurred. In the review of RIDDOR-reporting by Network Rail and its contractors, it was found that there has been significant under-reporting and misclassification of RIDDOR-reportable lost time injuries during the 2005/06 to 2009/10. The black dotted line on the chart shows the estimated effect of the under-reporting. The line has been extended into 2010/11; although lost time injury reporting started to return to more expected levels during the year, the overall total recorded is still lower than the number of more serious injuries would suggest.
- Minor injuries that are not RIDDOR-reportable showed an increase in recorded number up until 2005/06. The trend over the following three years was downward; this reduction has been maintained since that time.
- The SRM estimated that risk to infrastructure workers has improved over the time of the under-reporting, with a reduction of around 14% in overall FWI between SRMv6.5 and SRMv7. (When the SRM estimates of unreported FWI is taken into account, the reduction is 12%.) Although the magnitude of the recorded reduction in RIDDOR-reportable injuries shown on the chart is known to be incorrect, it is likely that there has been an actual reduction in infrastructure risk in recent years.

Infrastructure worker slips, trips and falls: injuries by location

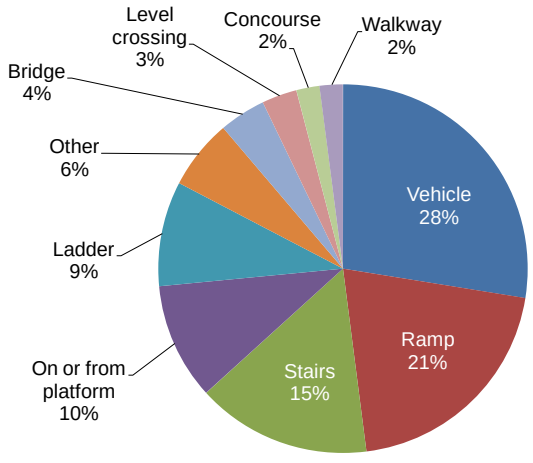
Within SMIS, infrastructure worker slips, trips and falls are classed by location. The category of *slips, trips and falls* does not include falls from heights greater than two metres, which are analysed separately, on page 100.

Chart 96. Infrastructure worker injuries due to slip, trips and falls



- At 442, the total recorded number of slips, trips and falls occurring to infrastructure workers was at its lowest level for the past 10 years. At 31, the recorded number of major injuries arising from slips, trips and falls was equal to 2009/10, and the joint highest since the peak in major injuries in 2004/05.
- A brief review of the total number of slips, trips and falls recorded on or about the track in 2010/11, reveals that the reasons for the event (when identified) include falling on loose or uneven ballast, tripping over obstacles – such as equipment, cables, sleepers and vegetation – and weather conditions.
- Since 2001/02, 28% of those slips, trips and falls that have not been on or about the track, have been from vehicles. Ramps and stairs are the next largest groups.

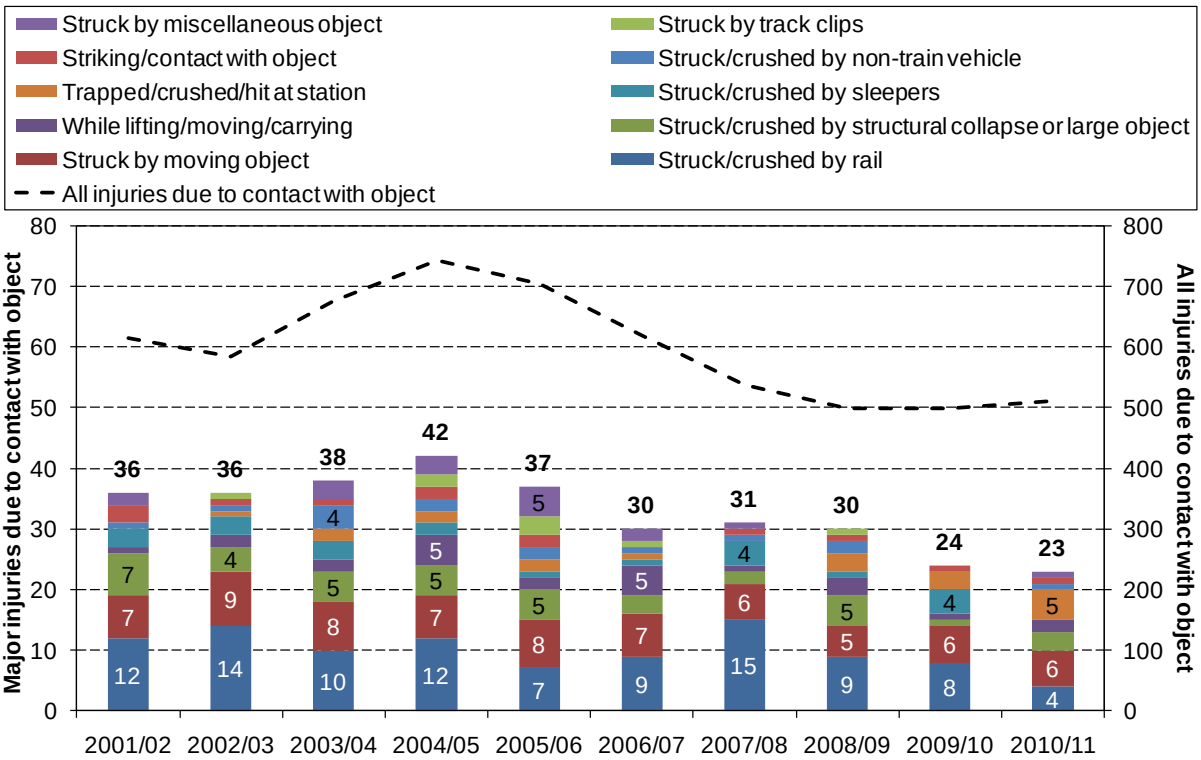
Chart 97. Slips, trips and falls major injuries at other locations since 2001/02



Infrastructure worker injuries due to contact with object: injuries by cause

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

Chart 98. Infrastructure worker major injuries due to contact by object



- Contact with object injuries have accounted for 29% of the total FWI occurring to infrastructure workers since 2001/02. This category of accidents is the next largest source of infrastructure worker FWI after slips, trips and falls.
- While the number of major injuries is at its lowest level over the period shown in the chart, the total number of contact with object injuries has risen slightly since last year.
- Major injuries from being *struck/crushed by rail* are at their lowest level for the past 10 years.

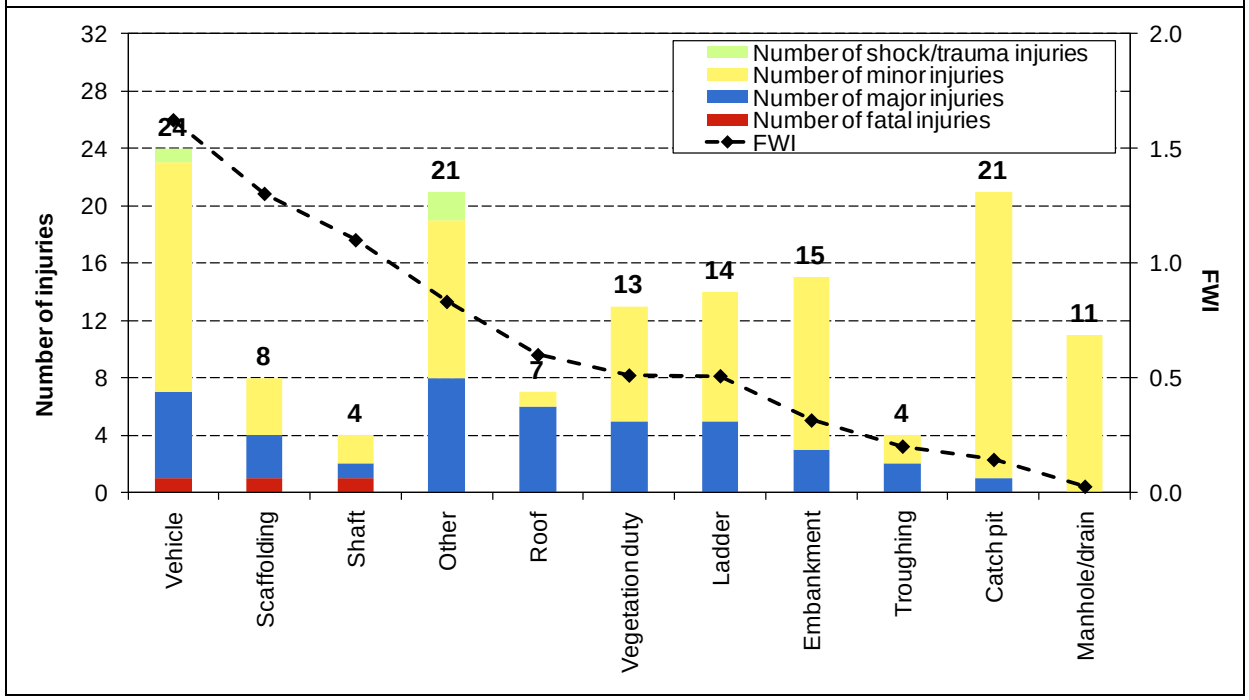
Table 16. Examples of contact with object injuries occurring in 2010/11

Precursor	Narrative
Crushed by large object	On 27 December, a crane operator sustained serious injuries to both legs while working within a possession at Pouparts Junction. He had been removing the straps from a steel bridge girder on a wagon. The girder rolled before a sling attached to the crane could take the strain. The operator became trapped, suspended upside down from the wagon. His injuries resulted in the amputation of both legs.
Struck by object in station	On 12 April, three workers were injured when a pipe for pouring concrete became blocked and lashed out, striking the staff. Injuries included a broken arm, a broken pelvis and facial and hand abrasions.
Struck by moving object	On 26 March, a contractor was carrying out rivet busting operations when the punch of the rivet buster got stuck in the hole. The injured person used a hammer on the underside to release it but a splint of steel flew up and hit him in his left eye.

Infrastructure worker injuries involving falls from height (>2m)

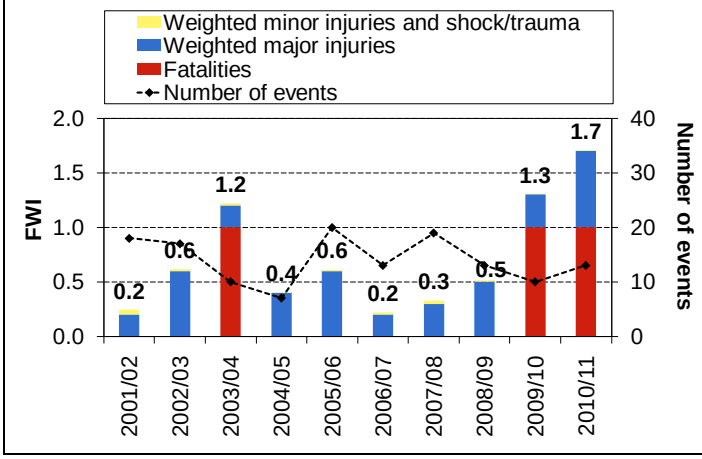
Since 2001/02, there have been 169 incidents classed as falls from heights greater than two metres, which have involved infrastructure workers.

Chart 99. Incidents involving falls from height (>2m) since 2001/02



- Of the 169 such events, three have been fatal. Infrastructure workers have been the only group involved in events with multiple injury outcomes.
- The most frequent types of event have been falls from vehicles; these have also resulted in the highest FWI outcome. This category covers the contractor fatality at Stewarton viaduct, described earlier.
- Falls involving scaffolding or shafts have the lowest levels in terms of number, but have the next highest levels of associated FWI, due to the magnitude of the drop that can be involved. Falls involving catch pits are the joint second highest number of events, but have a relatively low associated FWI.
- Over the past 10 years, the level of FWI from falls from height has varied, and is influenced by the occurrence or otherwise of fatal events. At 1.7 FWI, the level for 2010/11 was the highest of the period shown.

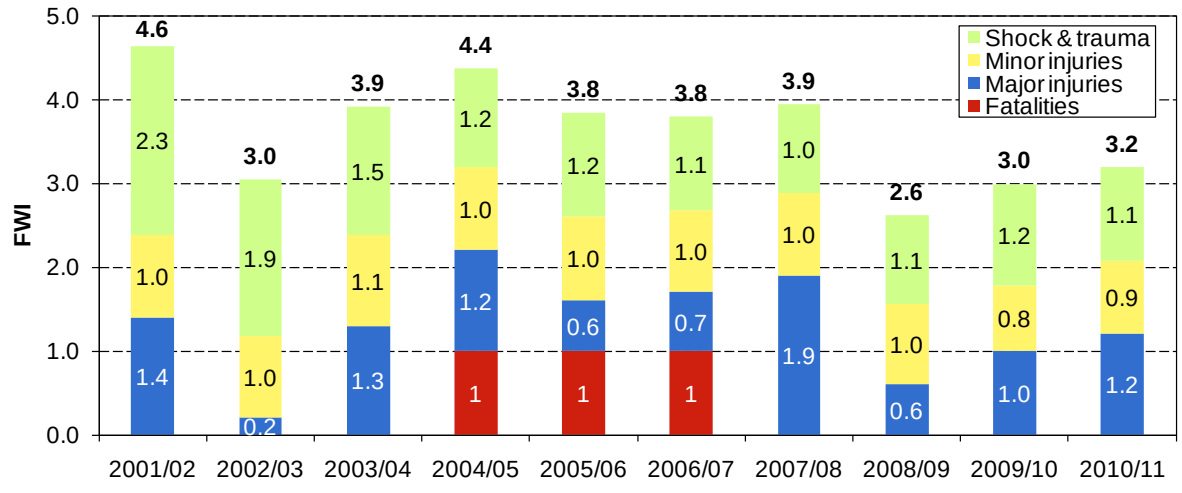
Chart 100. Infrastructure worker FWI from falls from height



6.5.2 Train drivers

Around 12.500[42] people are employed as train drivers. Since 2001/02, the average level of FWI per year for train drivers has been 3.6, and the average level of fatality has been 0.3 per year.

Chart 101. Trend in train driver FWI



- There has been a small increase in train driver harm in 2010/11 compared with the previous year, although the level remains below those generally seen prior to 2008/09.
- The largest contributor to train driver FWI is shock or trauma as a result of being affected by suicide and trespass incidents. 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.

Chart 102. Train driver FWI since 2001/02

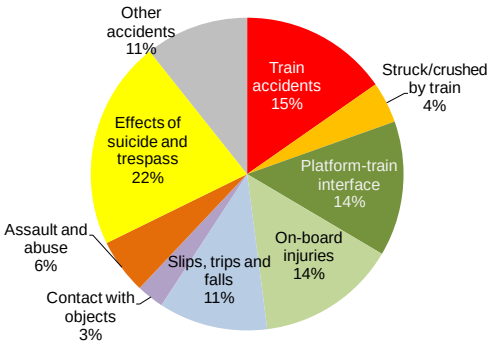


Table 17. Train driver fatalities since 2001/02

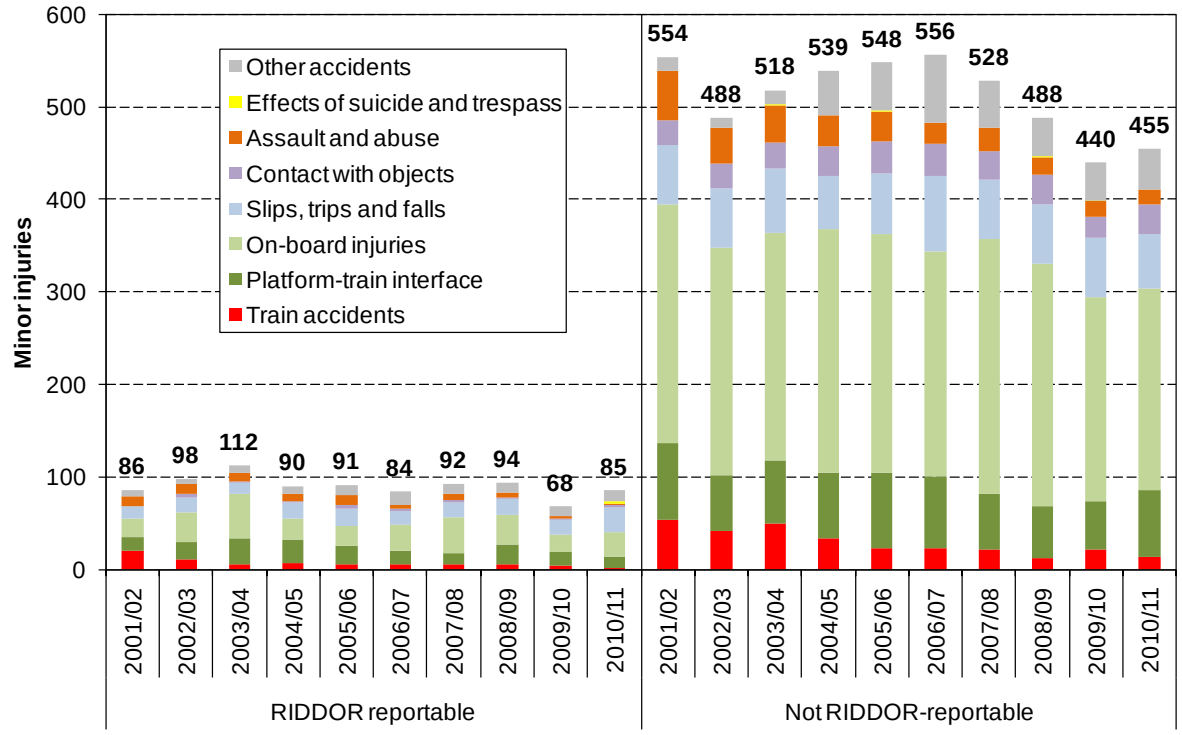
2004/05 Train accidents: collision with road vehicles at level crossings	The train driver and five passengers were killed as a result of a train collision with a car parked on a level crossing at Ufton Nervet. The car driver, who was also killed, had deliberately parked on the crossing to commit suicide.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

[42] Source: HLOS data collection 2010.

Train driver minor injuries

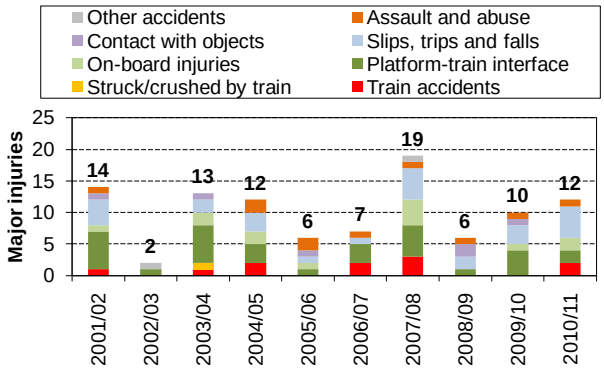
Since 2001/02, 26% of train driver FWI has been due to minor injuries.

Chart 103. Train driver minor injuries by type



- There were increases in both the number of RIDDOR-reportable and non-RIDDOR-reportable minor injuries in 2010/11 compared with 2009/10.
- On-board injuries have accounted for 32% of RIDDOR-reportable minor injuries, and 49% of non-RIDDOR-reportable minor injuries 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 28% of the total train driver FWI.

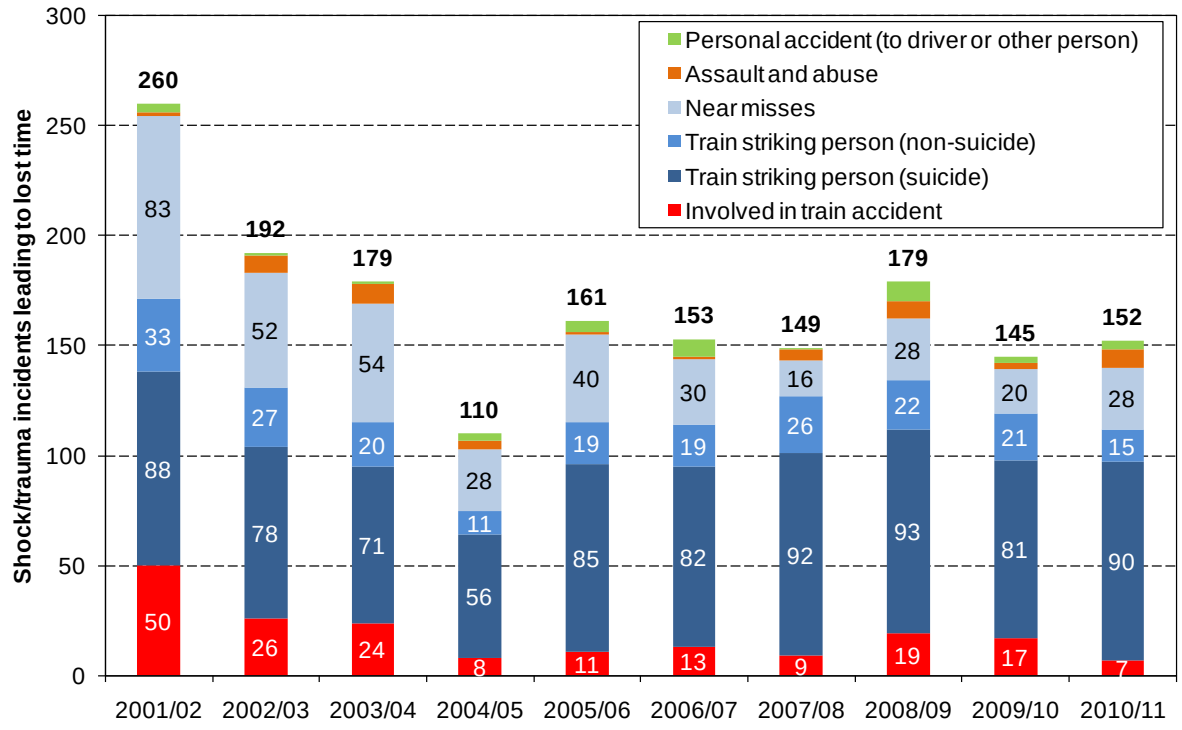
Chart 104. Train driver major injuries



Train driver shock and trauma

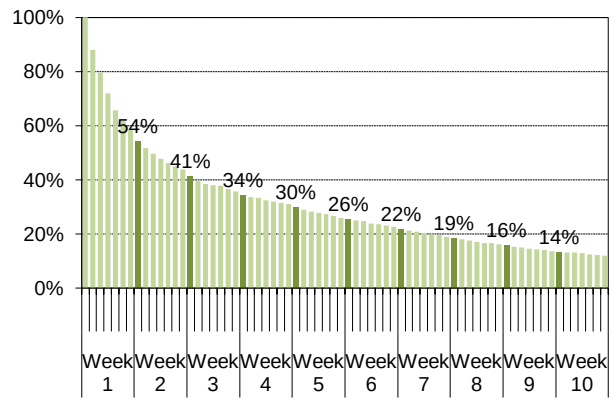
Relative to other worker types, train drivers experience a higher level of incidents resulting in shock or trauma. Since 2001/02, shock and trauma have accounted for 37% of train driver FWI. Fatalities and injuries to people involved in trespass or suicide are the main cause.

Chart 105. Train driver incidence of shock or trauma leading to lost time



- The number of recorded incidents of shock/trauma leading to lost time is quite variable. The level for 2010/11 is below average for the period shown.
- The most common cause of recorded shock/trauma to drivers is the train striking a person. In four out of five cases, the incident is a suicide or suspected suicide.
- At the start of the decade, a notably greater proportion of shock/trauma events resulted from train accidents. In 2001/02, around 1 in 5 were due to this cause; in 2010/11, the ratio was around 1 in 20. The main reason behind the change has been a decrease in the number of shock/trauma arising from trains been hit by missiles. Over the last decade, there have been improvements in the glass used for train windows.

Chart 106. Lost time durations since 2001/02

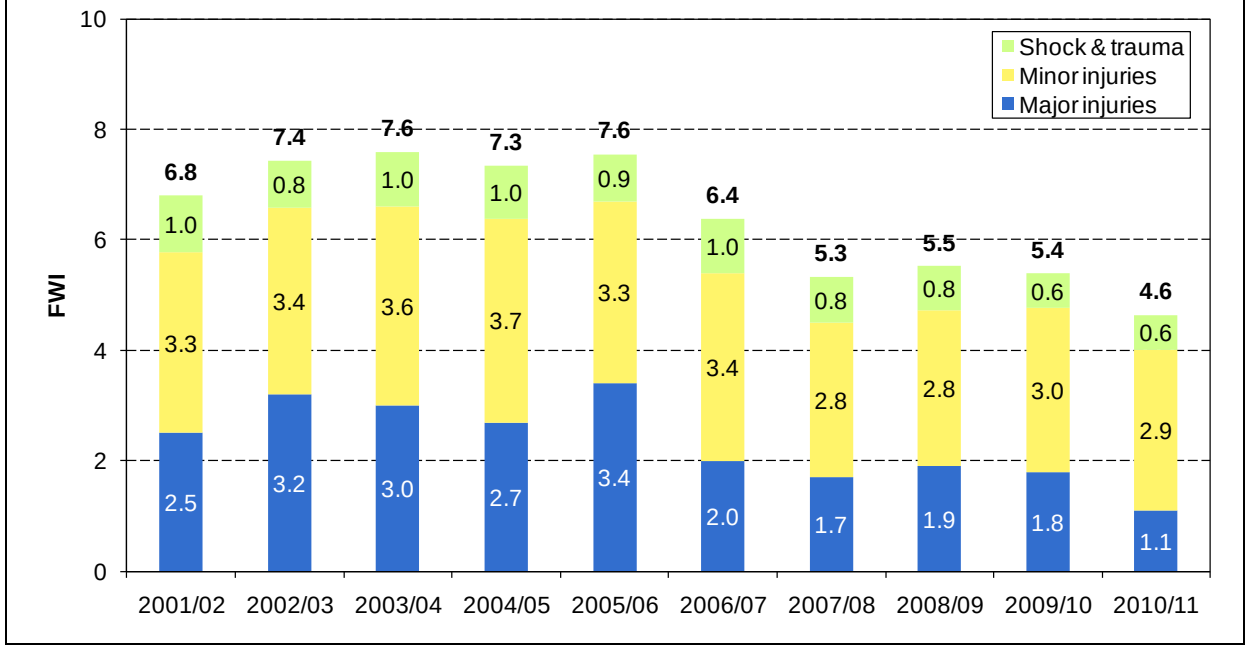


- Of those cases involving lost time, over half have resulted in the driver being absent from work for more than one week. One quarter involved more than five weeks off, and 14% involved more than 9 weeks absence.

6.5.3 Other on-board train crew

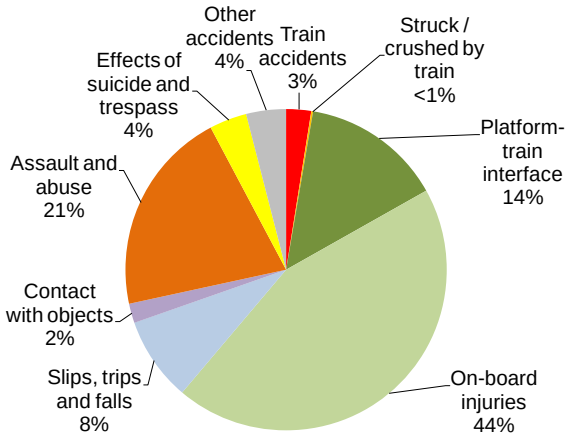
Around 10,800[43] people are employed as non-driving train crew. The majority (around 70%) work as guards or conductors, with train hosts or catering staff comprising most of the remainder. Since 2001/02, the average level of harm to other on-board train crew has been 6.4 FWI per year. There have been no fatalities.

Chart 107. Trend in other on-board train crew FWI



- Harm to on-board train crew has been at lower levels since 2006/07 than previously.
- The largest contributor to FWI is *on-board injuries*, which have accounted for 44% since 2001/02. The next largest contributor is *assault and abuse*, which has accounted for 21% of the total FWI over the same period.
- 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 a train guard and a member of catering staff (as well as two train drivers and six passengers) lost their lives.

Chart 108. Other on-board train crew FWI since 2001/02

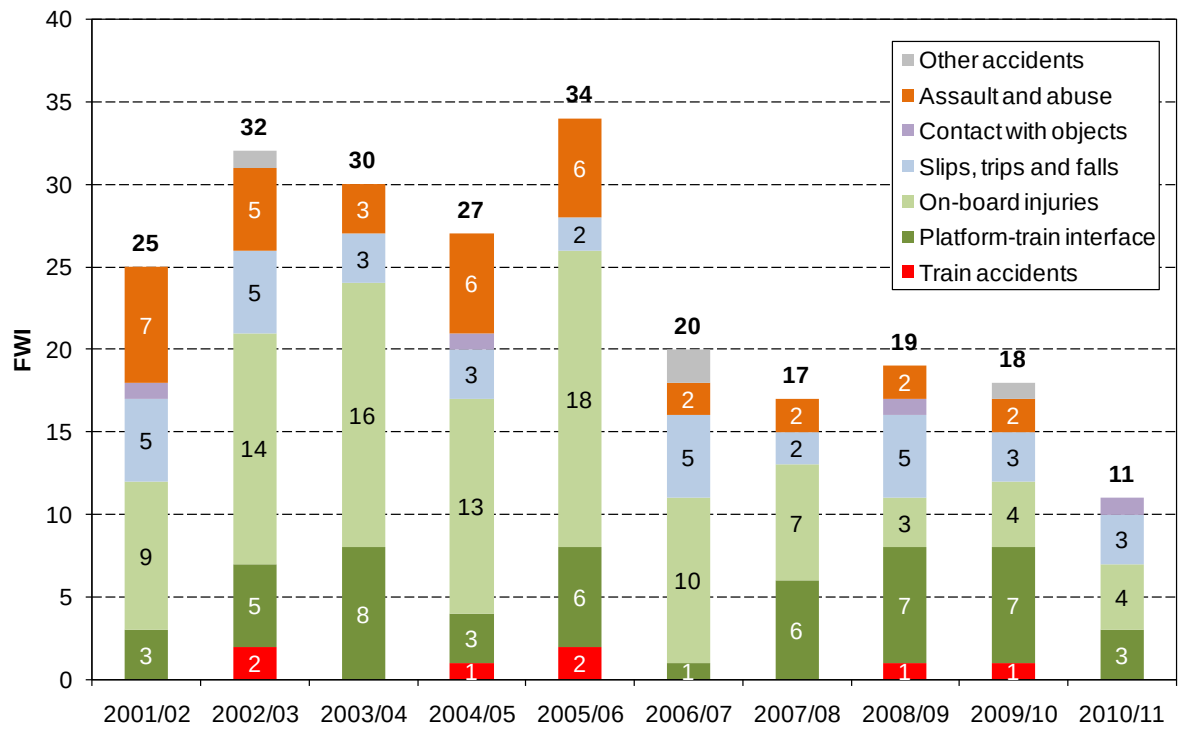


[43] Source: HLOS data collection 2010.

Other on-board train crew major injuries

Since 2001/02, 36% of the total FWI occurring to other on-board train crew has been due to major injuries.

Chart 109. Other on-board train crew major injuries

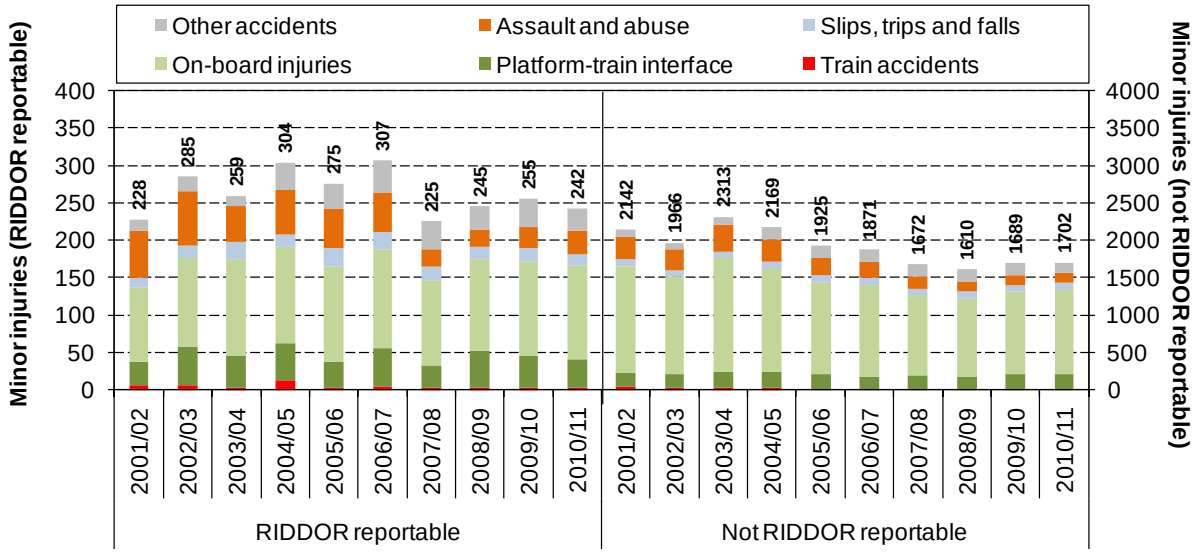


- The number of major injuries occurring to other on-board train crew has been notably lower since 2006/07. The number for 2010/11 was the lowest recorded.
- The main reason for the notably lower number of major injuries since 2006/07 has been a reduction in the number of on-board injuries. There have also been notably lower number of major injuries due to assault and abuse since this time. Other types of accident show less of a trend.

Other on-board train crew minor injuries

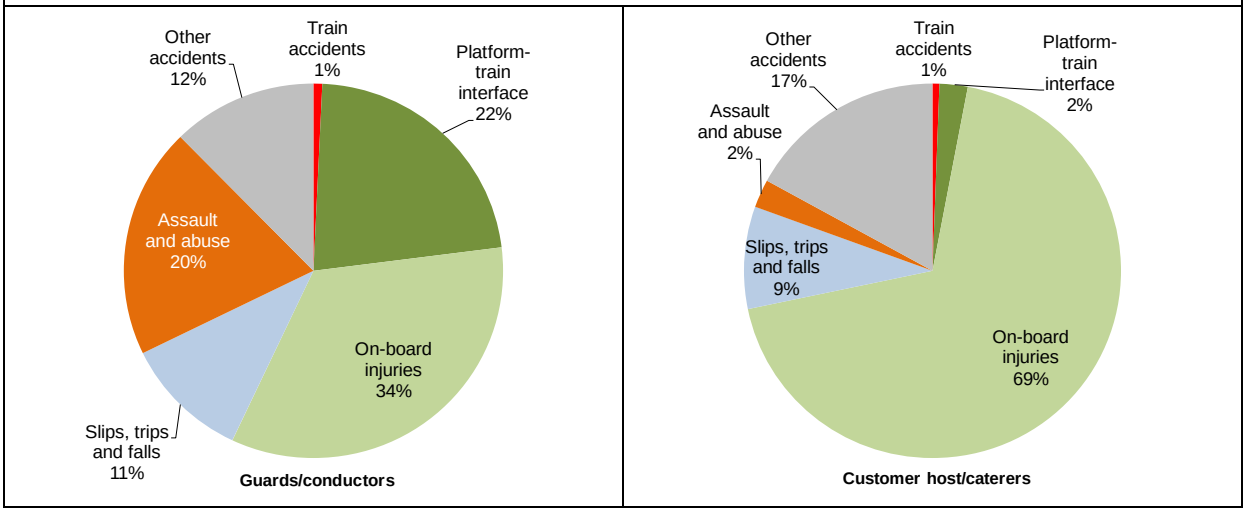
Since 2001/02, 50% of the total FWI occurring to other on-board train crew has been due to minor injuries.

Chart 110. 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. In contrast, the number of non-RIDDOR-reportable minor injuries has shown an improving trend up to 2008/09, since when there has been an increase in the recorded number.
- On-board injuries have accounted for 47% of RIDDOR-reportable minor injuries, and 65% of non-RIDDOR-reportable minor injuries over the period.
- 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.

Chart 111. Other on-board train crew FWI by role and accident type, 2010/11

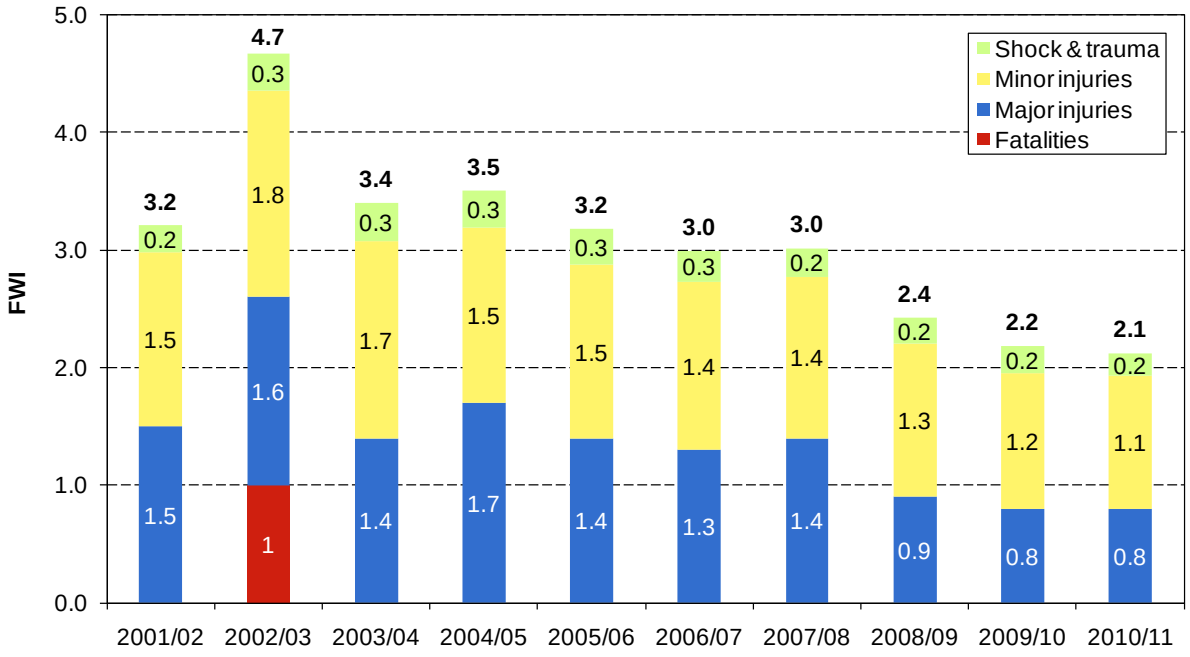


6.5.4 Station staff

There are around 13,000[44] 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, and customer management.

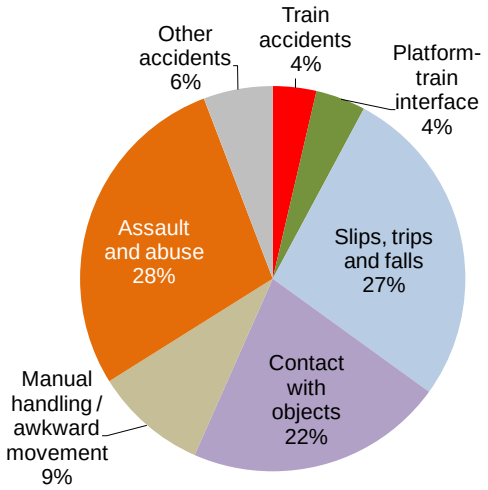
Over the period 2001/02 to 2010/11, the average level of harm per year to station staff has been 3.1 FWI, and the average level of fatality has been 0.1 FWI.

Chart 112. Station staff FWI



- The level of FWI to station staff has shown a gradual decrease since 2004/05.
- 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.
- Over the period 2001/02 to 2010/11 as a whole, the three largest contributors to station staff FWI have been *assault and abuse*, *slips, trips and falls*, and *contact with object*.
- One of the main drivers of the overall reduction has been a fall in the level of FWI from assault and abuse.

Chart 113. Station staff FWI by type since 2001/02

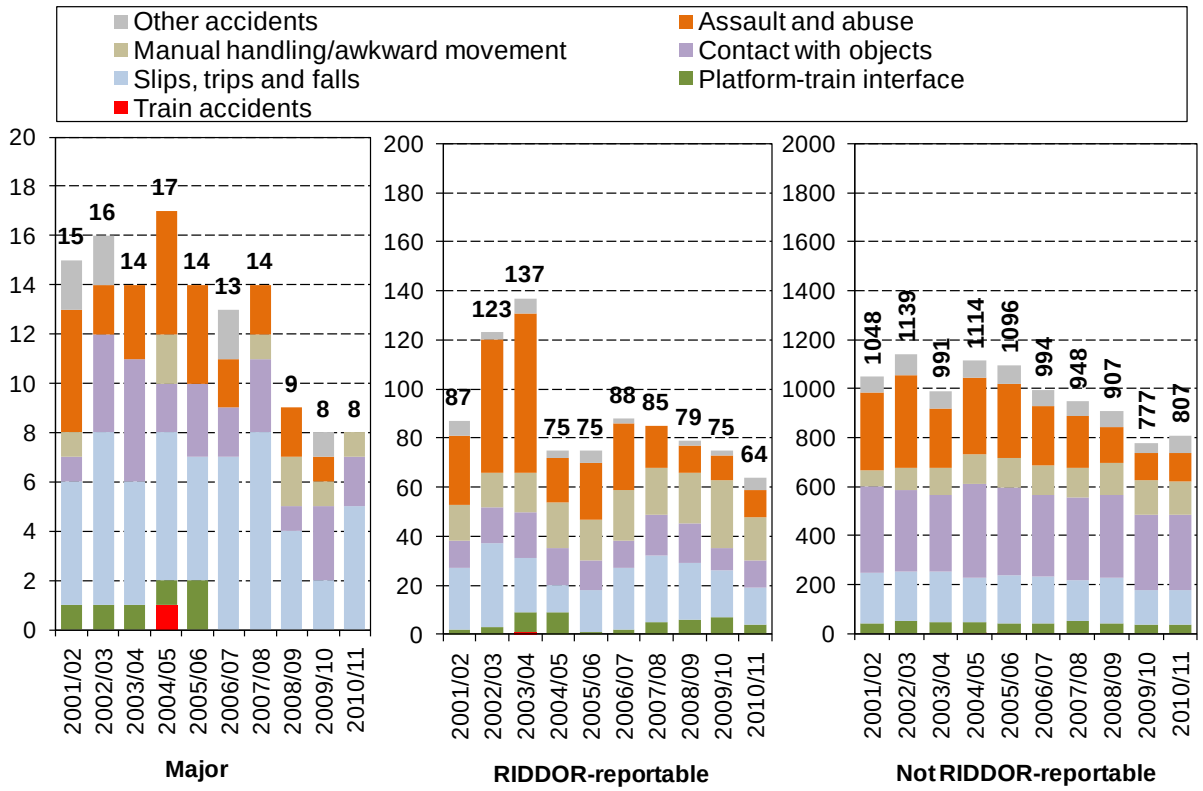


[44] Source: HLOS data collection 2010.

Station staff major and minor injuries

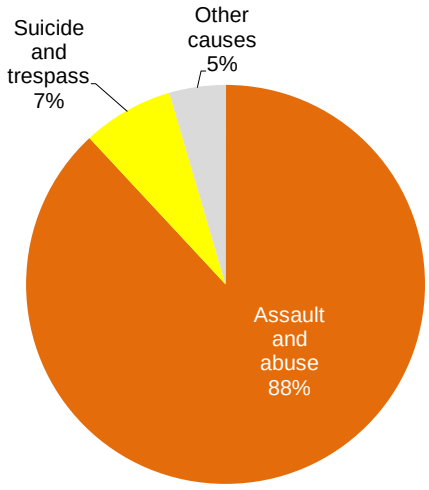
Since 2001/02, 42% of harm to station staff has been major injuries, and 46% has been minor injuries.

Chart 114. Station staff injuries by injury degree



- The number of major injuries occurring has been lower for the past three 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. Also since then, there has been a generally decreasing trend in the number of non-RIDDOR-reportable minors, due mainly to a reduction in events involving 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.

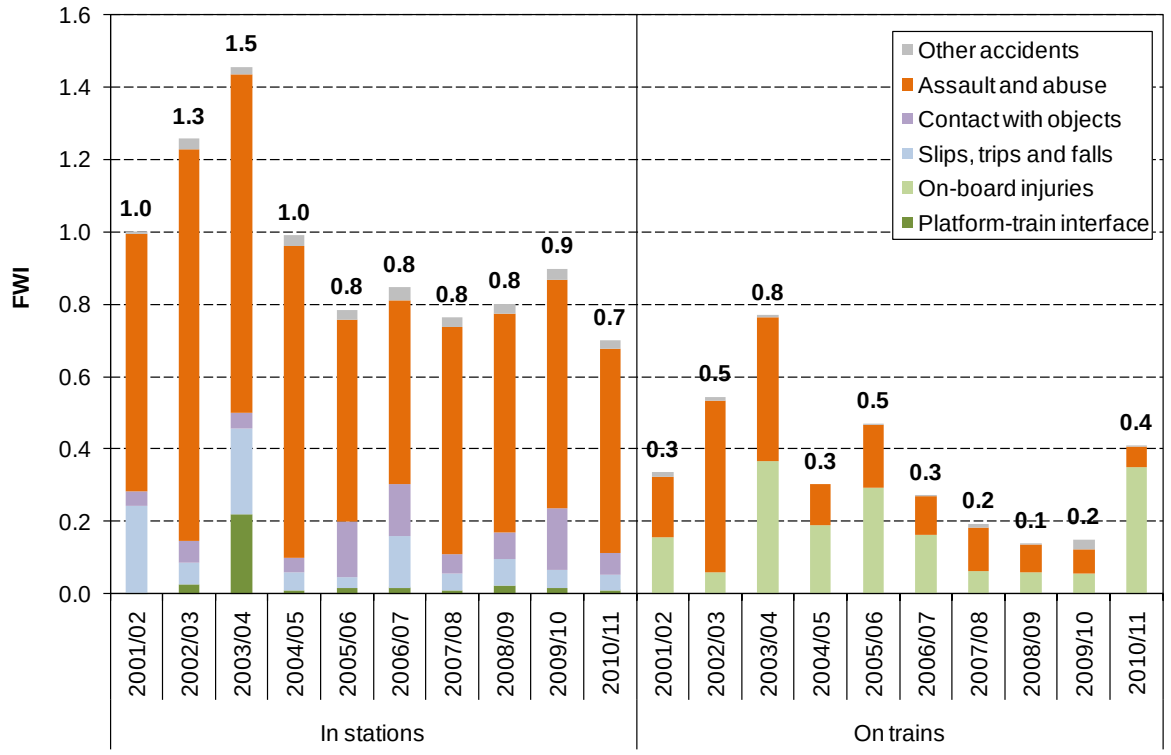
Chart 115. Station staff shock/trauma since 2001/02



6.5.5 Revenue protection staff

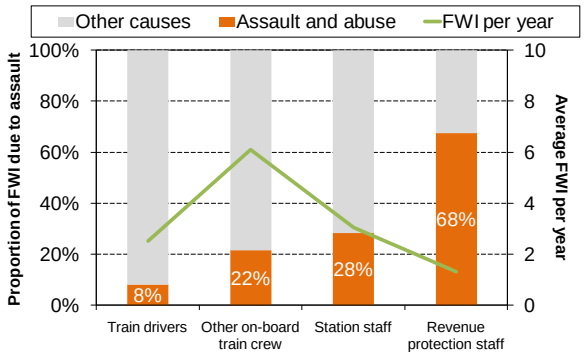
There are an estimated 2,500[45] revenue protection staff working in the rail industry, who work both in stations and on trains[46]. Over the period 2001/02 to 2010/11, the average level of harm to revenue protection staff has been 1.3 FWI. There have been no fatalities.

Chart 116. Revenue protection staff injuries by cause and site type



- Since 2001/02, 73% of the total FWI to revenue protection staff has 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, 49% have been due to assault or abuse.
- In stations, contact with object injuries and slips, trips and falls account for 9% and 10% of the injuries respectively. On trains, accidents due to either of these events will simply be classed as on-board injuries.
- When station and train locations are combined, assault and abuse injuries account for 68% of total FWI. This compares with proportions of 28% for station staff, 22% for on-board train crew, and 8% for train drivers. More analysis of workforce personal security issues is presented in section 6.6.

Chart 117. Assault proportions since 2001/02



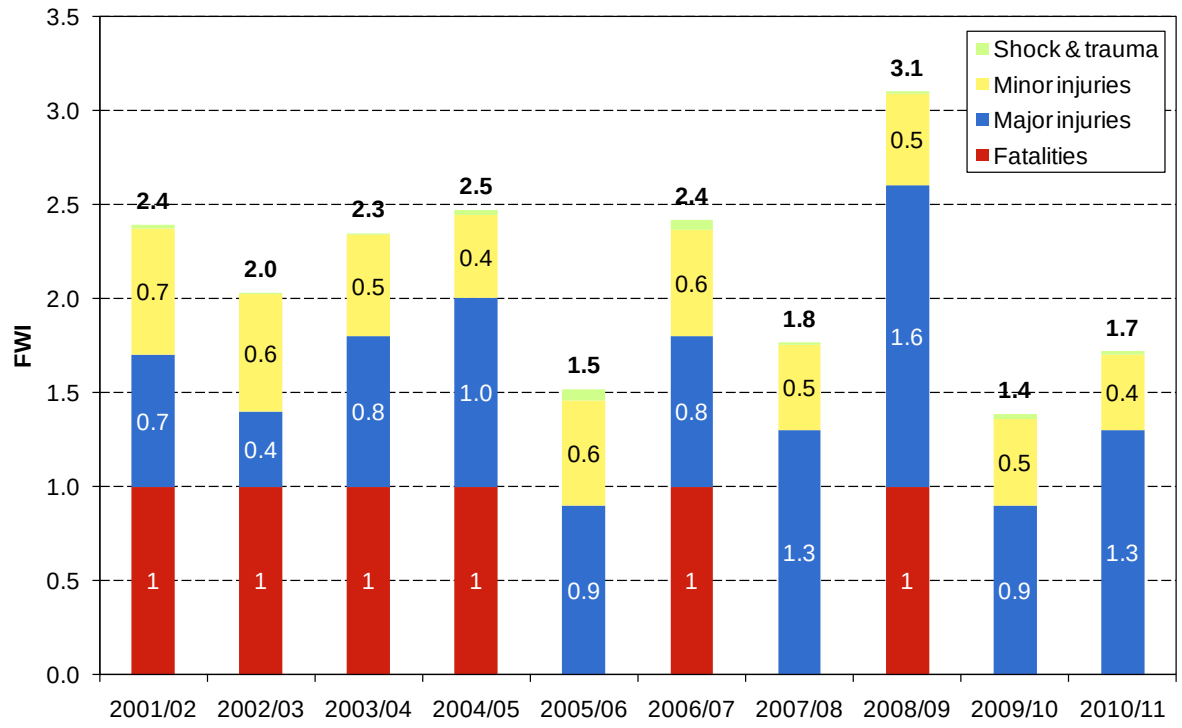
[45] Source: HLOS data collection 2010.
[46] It is not always clear in SMIS records if an incident has occurred to a member of revenue protection staff specifically, rather than a member of station staff or other train crew. Therefore some revenue protection staff may be included in the previous analyses for these two occupations.

6.5.6 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 2010/11, the average level of FWI for this combined group has been 2.1 FWI, and the average level of fatality has been 0.6 FWI.

Chart 118. Trend in FWI for other workforce groups



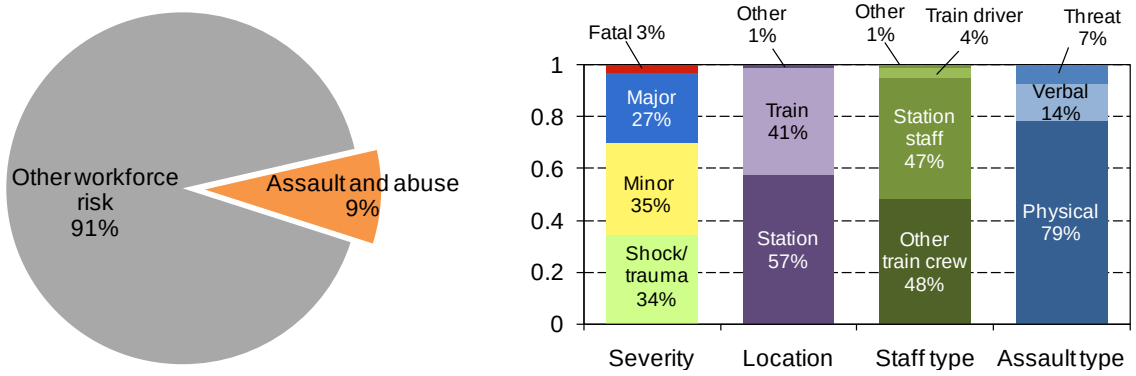
- Some of the locations where injuries occur to other workforce groups are outside the scope of the ASPR, unless such injuries are fatal. These locations are not subject to mandatory SMIS-reporting. However, passenger train operators have agreed to a voluntary reporting initiative, and so in the future it is likely that enough data will be recorded for analysis. In the meantime, the true level of FWI for other workforce groups is likely to be higher than shown on the chart.
- The six fatalities occurred to two shunters, two fitters, 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.[47]

[47] 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.

6.6 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 such as the NHS, staff assaults[48] 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 SRMv7.

Chart 119. Workforce assault risk (2.3 FWI per year) in the context of all workforce risk



Source: SRMv7

- The SRM estimates that 9% of all workforce risk is due to assaults. This equates to 2.3 FWI per year. Most workforce assault risk 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 infrastructure workers. In the SRM coding methodology, revenue protection risk is included in the *station staff* or *other train crew* categories, this is reflected in the chart.
- Nearly four fifths of the risk is from physical assaults. A physical assault may not necessarily lead to physical injury; the outcome may be shock or trauma. The remainder comprises mostly shock and trauma arising from verbal abuse and threats.
- The FWI risk is fairly evenly split between major injuries, minor injuries and shock/trauma.
- During 2010/11, there were three major injuries, 543 minor injuries, and 622 cases of shock/trauma as a result of assault, giving an overall FWI of 1.7. Details of the three major injuries are shown below.

Table 18. Workforce assault in 2010/11 resulting in major injury

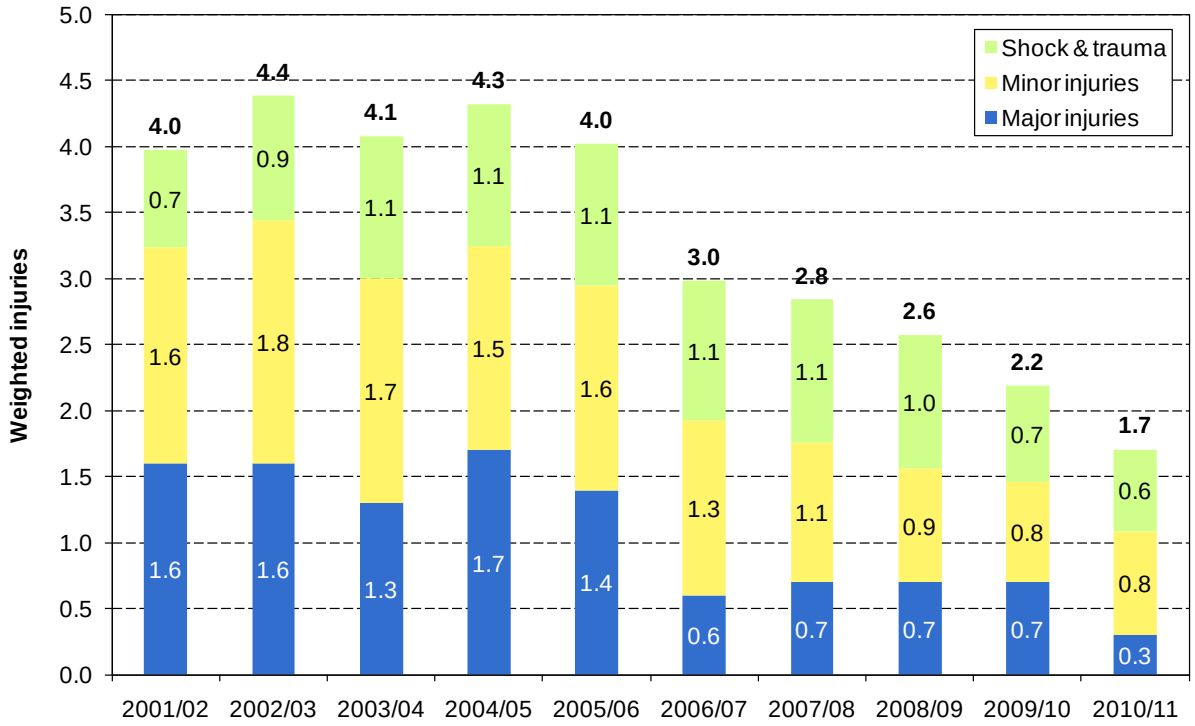
Revenue protection staff	A member of staff was punched in the face, causing him to lose consciousness, by a passenger who had been asked to show he had a valid ticket.
	Member of staff reportedly suffered a torn ligament as a result of an assault following a ticket dispute.
Train drivers	A driver was punched in the face, resulting in him requiring hospitalisation, by a person he had challenged about dropping litter in the station.

[48] Throughout this section, workforce assaults cover physical assaults, verbal abuse and threats.

6.6.1 Trend in harm from workforce assaults

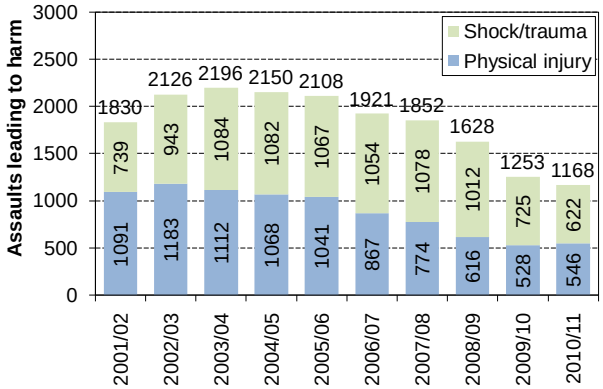
Trends in workforce harm due to assault are based on data from SMIS, rather than BTP data.

Chart 120. Harm from workforce assaults



- The overall harm suffered by members of the workforce fell by 22% in 2010/11 compared with 2009/10. The decrease is due mainly to a reduction in the number of major injuries.
- Since 2006/07, the number of major injuries per year has been in single figures.
- Since reaching a peak in 2002/03, the recorded number of assaults leading to physical injury has been showing a generally reducing trend, although the number for 2010/11 is an increase over the previous year.
- A similar decreasing trend has been seen in the recorded number of assaults leading to shock/trauma.
- The total number of recorded assaults leading to harm was at its lowest level in 2010/11, and almost half what it was at its 2002/03 peak.

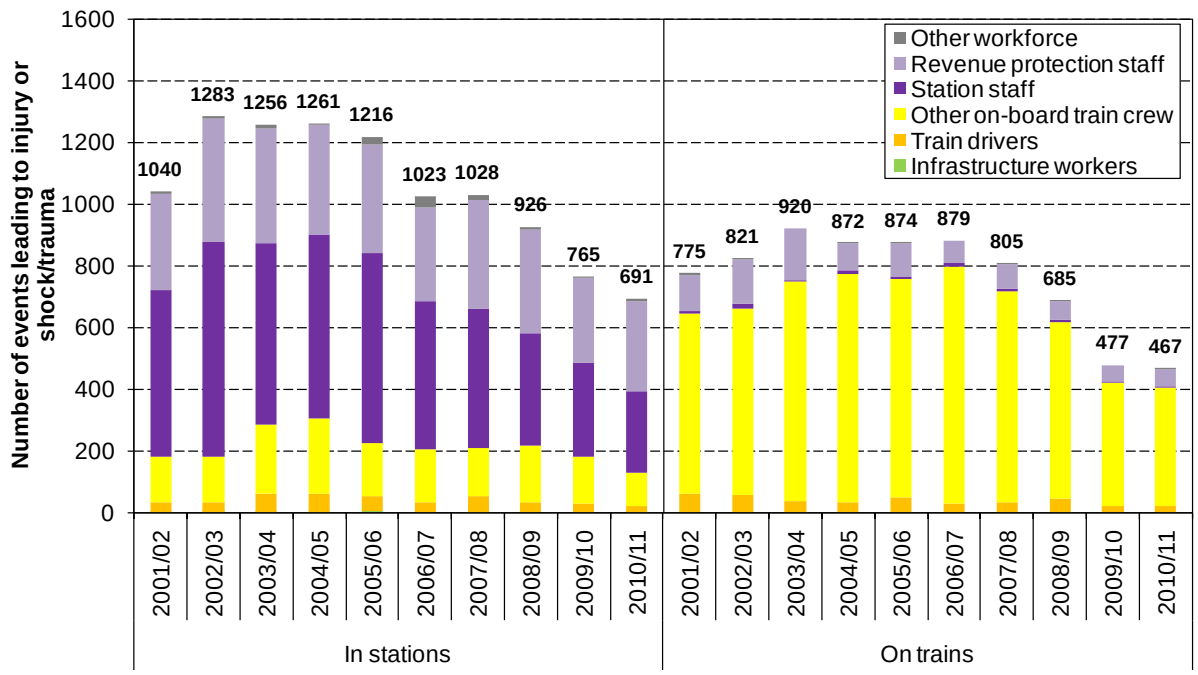
Chart 121. Assaults leading to harm



Trends in the location of workforce assaults that lead to harm

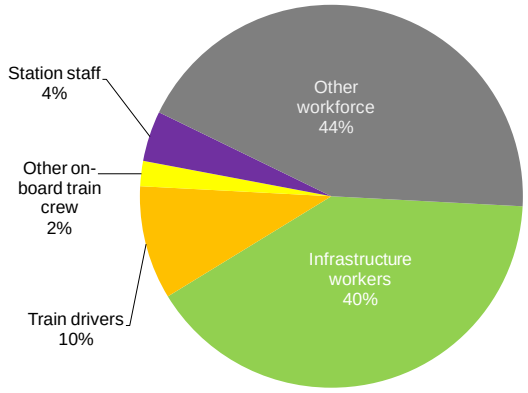
Most assaults leading to harm take place in stations. This may be because there are more station staff than customer-facing train crew, and more people congregate in stations than on board trains. It may also be related to revenue protection activity and attempts to prevent potential trouble-makers from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

Chart 122. Trends in workforce assaults by location



- The number of assaults leading to harm fell both in stations and on trains in 2010/11, continuing the decreasing trend that has been seen in recent years.
- As might be expected, the worker type profiles differ by location, with station staff generally predominating in stations, and train crew predominating 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 infrastructure workers and other workforce types are rare in stations and on trains. Since 2005/06 (when assault reporting trends became more stable – see Chart 124) there have been 94 assaults recorded at other locations. The mini-chart indicates that more than 80% involved infrastructure workers and other workforce types.

Chart 123. Assaults in other locations by person type, since 2005/06 (94 events in total)

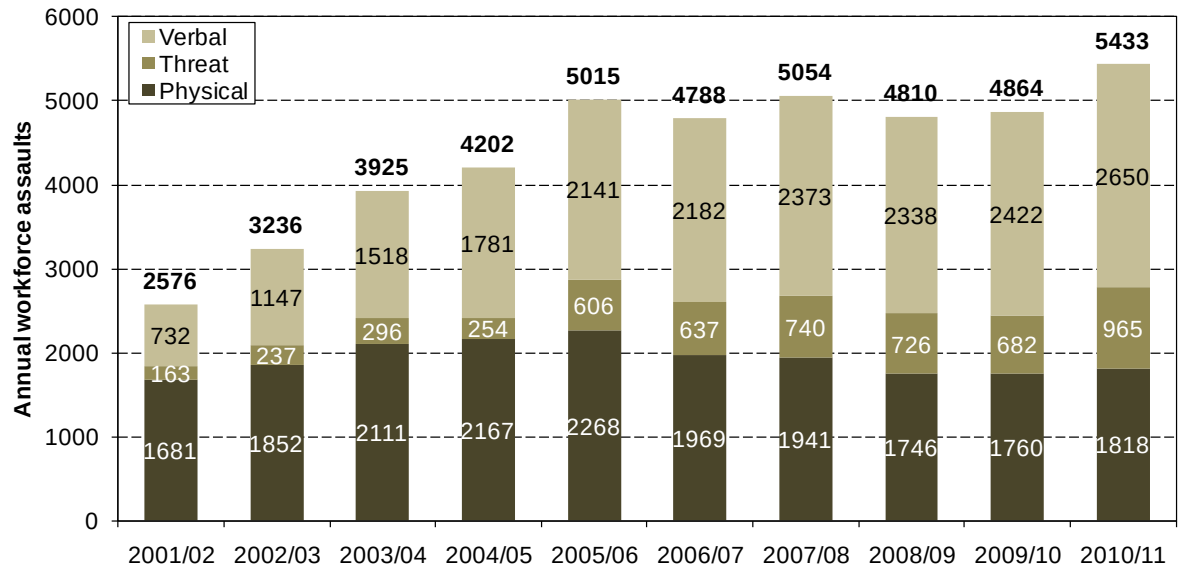


Trend in all workforce assaults, threats and cases of abuse

Not all workforce assaults lead to harm, even if the assault is classed as 'physical',– ie where actual contact is made between the perpetrator and the member of the workforce. Conversely, it is possible for harm to arise from a non-physical assault. Threats and verbal abuse may result in shock or trauma. In addition, although in a relatively small number of cases, physical injury may arise, for example if the threat causes the member of staff to react in such a way that they subsequently injure themselves by falling or banging into something.

Over the past ten years, the industry attempted to improve reporting of all types of workforce abuse through a number of industry initiatives. The effect of these initiatives can be seen in changes in the reporting rates for different types of event. Verbal abuse and threats account for an increasing proportion of reported attacks. The following analysis includes events that do not lead to bodily injury or shock/trauma.

Chart 124. Physical assaults, threats and verbal abuse against members of the workforce

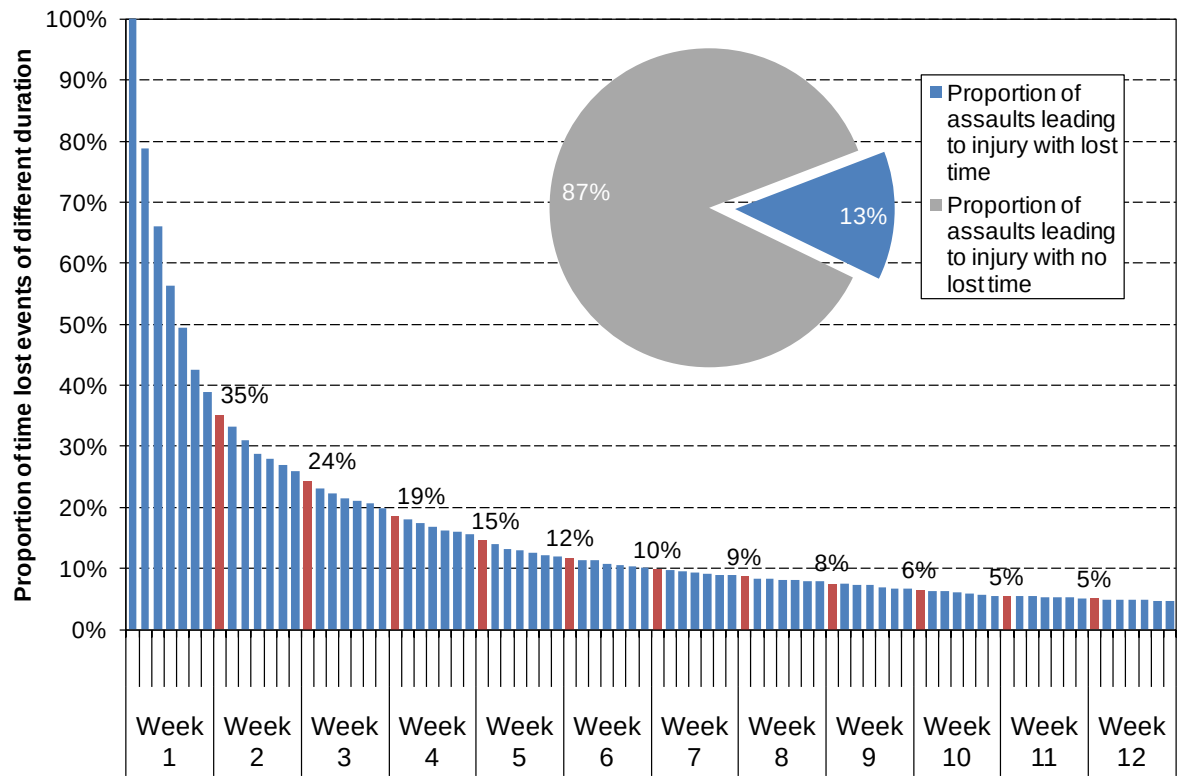


- The total number of recorded attacks showed a rise in 2010/11; this rise was reflected in all categories of assault – physical, verbal and threat.
- Prior to 2006/07, there were increasing numbers of incidents of all types, but particularly those classed as verbal or threat. This is believed to be due to industry drives to encourage staff to report all events. Since 2005/06, the reporting rate has been more stable.
- Because not all physical assaults lead to harm, the number of physical assaults shown in Chart 124 is generally higher than the number of assaults leading to injury, shown in Chart 121.

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

As well as leading to physical injury, assault 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 125. Time lost as a result of workforce assaults 2005/06 to 2010/11

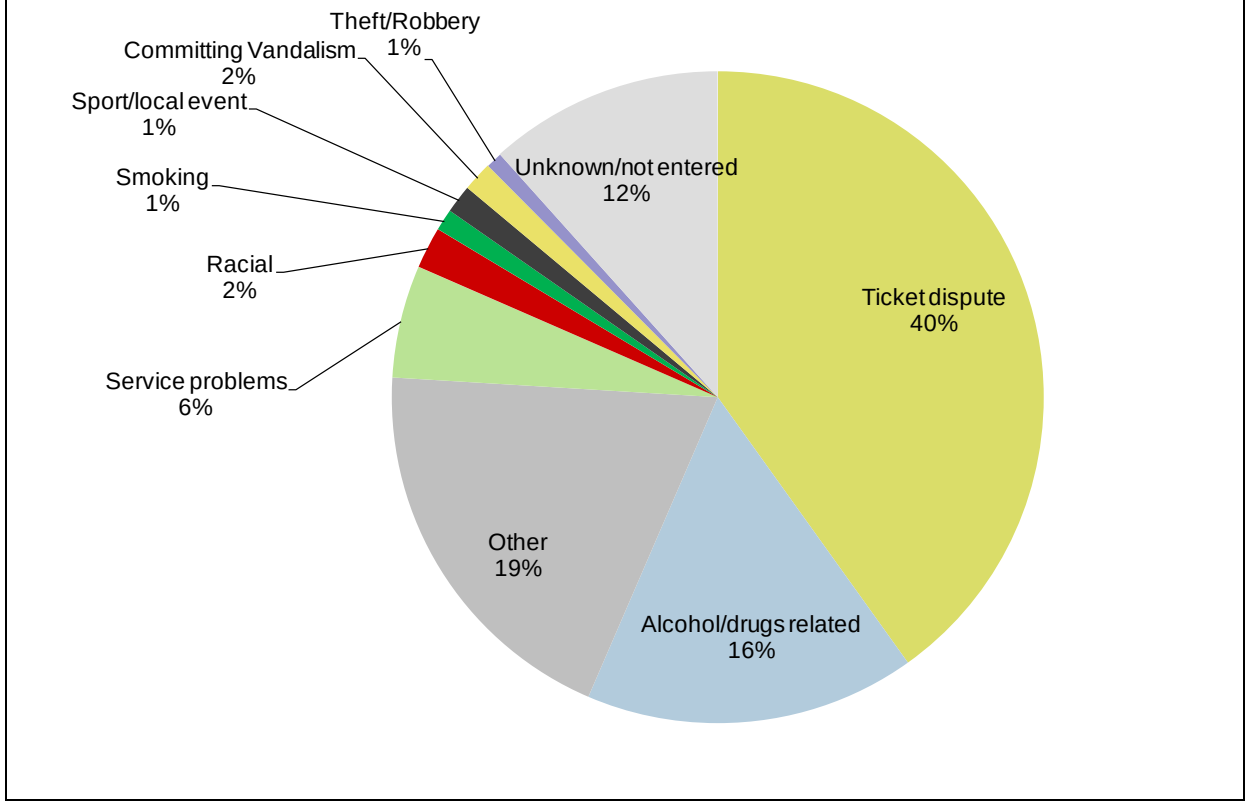


- Of the assaults that lead to injury (major, minor or shock/trauma) 13% result in a loss of time from work of at least one day. Based on 2010/11 data, the average week would see three such events.
- Of those resulting in absence, 35% will be for longer than a week. Based on 2010/11 data, the average week would see one such event.
- Around 12% of events will result in more than five weeks off. At 2010/11 levels of assault numbers; the average year would see around 18 of these events. Around 6% of events result in more than ten weeks off; this equates to around eight events per year, at current levels of assault numbers.

Workforce assault by instigating event

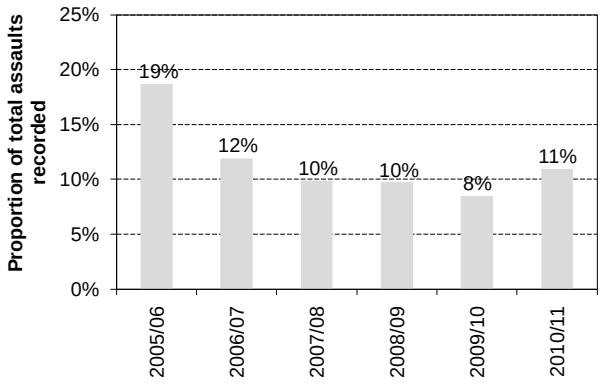
Since 2005/06, SMIS has recorded more detailed data on the types of event that cause or contribute to workforce assaults. The range of different causes highlights the challenge faced by the industry in managing risk from assault. The following analysis is based all physical assaults, verbal abuse and threats occurring since 2005/06, when workforce assault recording levels became more stable. The total number of assaults recorded during this period was approximately 30,000, just over one third of which were physical

Chart 126. Primary contributory factors to attacks on rail staff since 2005/06



- Since 2005/06, the biggest factor by far is a ticket dispute, which was identified as the primary contributory factor in 40% of all workforce assaults (45% when limited to where a cause was specified).
- The next highest single factor is alcohol/drugs, which were recorded as the primary cause in 16% of all cases (19% when limited to where a cause was specified).
- Through its data quality project (see Chapter 10), RSSB continues to promote the use of SMIS to capture as much information as possible about assaults. A reducing trend in the proportion of events with no cause specified was observed up to 2009/10, but the current year has seen a rise, as shown in Chart 127. Over the period as a whole, 12% of physical assaults have had no cause specified.

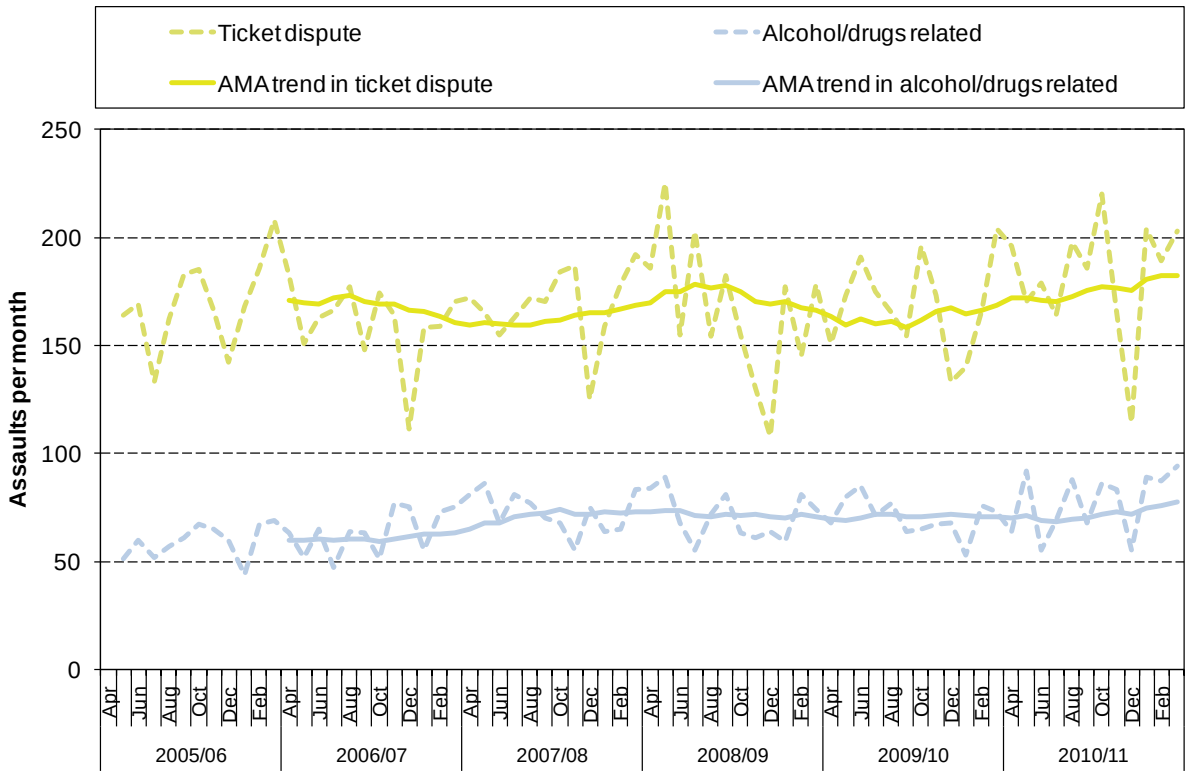
Chart 127. Trend in assaults with cause not specified



Trends in the main instigating events

The trends in two of the highest contributory factors to workforce assaults are illustrated in the chart below. The analysis looks at physical assaults, verbal abuse and threats.

Chart 128. Trends in the top contributory factors to workforce assault



- The average monthly number of assaults where alcohol or drugs was listed as the main instigating factor has shown a remarkably stable trend since the middle of 2008/09.
- While the average monthly number of assaults as a result of ticket disputes has shown more variation, there is no clear evidence of a generally increasing or decreasing trend over the period shown.

6.7 Workforce key safety facts

Workforce	2006/07	2007/08	2008/09	2009/10	2010/11
Fatalities	**2**	**2**	**3**	**3**	**1**
Infrastructure worker	0	2	2	3	1
Train driver	1	0	0	0	0
Other on-board train crew	0	0	0	0	0
Station staff	0	0	0	0	0
Revenue protection	0	0	0	0	0
Other workforce	1	0	1	0	0
Major injuries	**128**	**138**	**130**	**122**	**122**
Infrastructure worker	76	73	78	73	73
Train driver	7	19	6	10	12
Other on-board train crew	20	17	19	18	11
Station staff	13	14	9	8	8
Revenue protection	4	2	2	4	5
Other workforce	8	13	16	9	13
Minor injuries	**6202**	**5663**	**5455**	**5305**	**5335**
RIDDOR-reportable	711	566	589	555	571
Non RIDDOR-reportable	5491	5097	4866	4750	4764
Incidents of shock	**1450**	**1422**	**1335**	**1140**	**1101**
Class 1	264	219	223	273	255
Class 2	1186	1203	1112	867	846
Total FWI	**26.35**	**26.03**	**26.04**	**24.96**	**22.94**
Infrastructure worker	9.65	11.02	11.44	11.95	10.14
Train driver	3.79	3.94	2.62	2.99	3.19
Other on-board train crew	6.38	5.33	5.52	5.39	4.64
Station staff	3.00	3.02	2.42	2.18	2.12
Revenue protection	1.12	0.96	0.94	1.06	1.12
Other workforce	2.42	1.77	3.10	1.39	1.72

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.

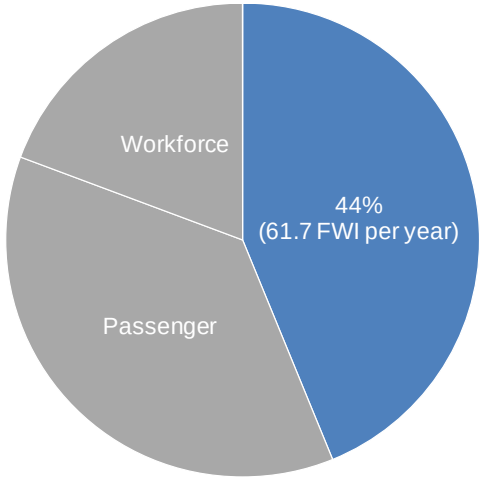
In the majority of cases, the risk to members of the public is the direct result of their own behaviour, either deliberate or accidental, rather than the operation of the railway. While most of the risk caused by public behaviour is borne by the public themselves, some types of behaviour, such as that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

2010/11 Headlines

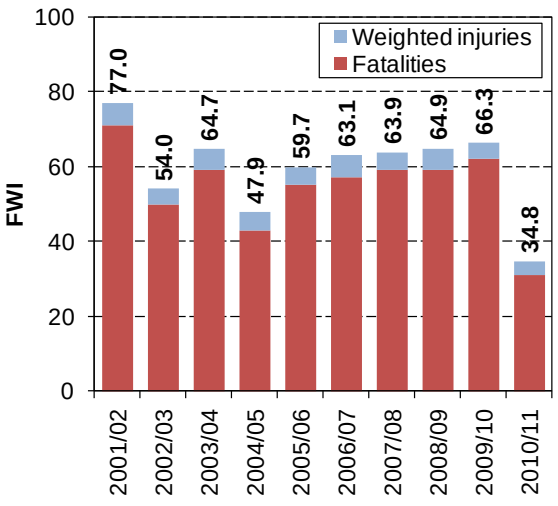
- There were no public fatalities as a result of road vehicle collisions with trains or any other type of train accident.
- Excluding suicides and suspected suicides, there were 31 fatalities to members of the public during 2010/11. When non-fatal injuries are taken into account, the total public FWI was 34.8, which is a decrease of 48%, compared with 66.3 FWI (62 fatalities) recorded for last year.
- The level of public FWI recorded for 2010/11 was the lowest since SMIS recording began.
- Of the 31 fatalities recorded for 2010/11, 27 occurred to trespassers and the remaining four occurred to pedestrians at level crossings. In 2009/10, there were 50 trespass fatalities, 11 level crossing fatalities, and one public fatality not involving trespass or level crossings.
- In addition to the accidental fatalities, there were 208 suicides and suspected suicides. This is a decrease of 25 compared with 2009/10.
- Public behaviour is estimated to cause around £70m in train delays and cancellations. RSSB are planning to work with Network Rail to provide more analysis on costs related incidents from this cause.

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

Public risk in context (SRMv7)



Trends in public harm

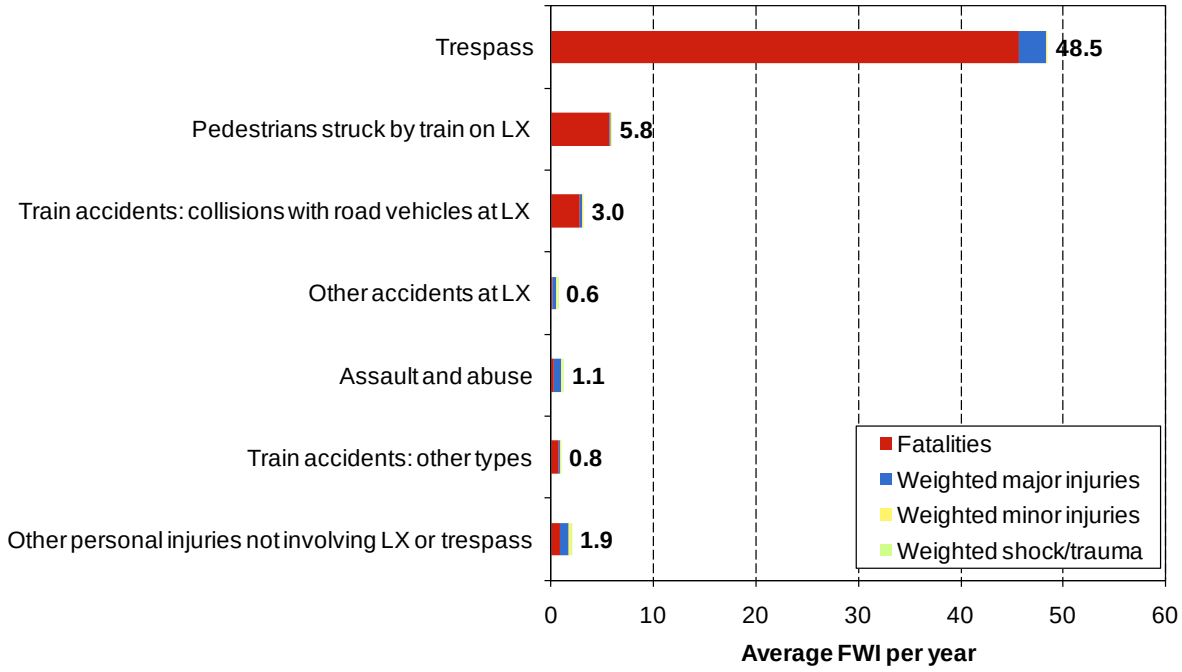


7.1 Public risk profile by accident type

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 6.

Chart 129. Risk to members of the public by accident type: 61.7 FWI per year



Source: SRMv7

- Trespass accounts for 79% of risk to members of the public.
- Accidents at level crossings account for a further 15%. Of these, more than half 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, being hit by level crossing equipment, or being involved in a road traffic accident at a level crossing.
- The category *train accidents: other types* mainly covers the risk from train collisions with road vehicles not at level crossings (ie 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 as a result of the Potters Bar train derailment, in May 2002, when a member of the public outside railway property was fatally injured by debris from the accident.
- Around 5% 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, as well as assault.

7.2 Public injuries in 2010/11

There were 31 accidental fatalities in 2010/11, 27 of which involved trespass. Of the four non-trespass fatalities, all were pedestrians struck by trains at level crossings.

- On 16 May 2010, at Old Gas House footpath crossing, a 16-year old female was struck by a train, after reportedly chasing after her dog, which had run on to the crossing.
- On 14 July 2010, at Sherrington footpath crossing, an 18-year old male was fatally injured after running onto the crossing reportedly in an attempt to retrieve his dog.
- On 9 August 2010, Enfield Lock MCB-CCTV crossing, one of a group of three men being pursued by police was fatally injured after trying to cross the crossing while the barriers were lowered. The incident occurred when Metropolitan Police were dealing with a failure to stop.
- On 14 February 2011, at Sharpenhurst No. 3 footpath crossing, a man was struck by a train, after jogging across the crossing while it was unsafe to cross. The person was reportedly wearing earphones and listening to a portable music device at the time of the incident.

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.

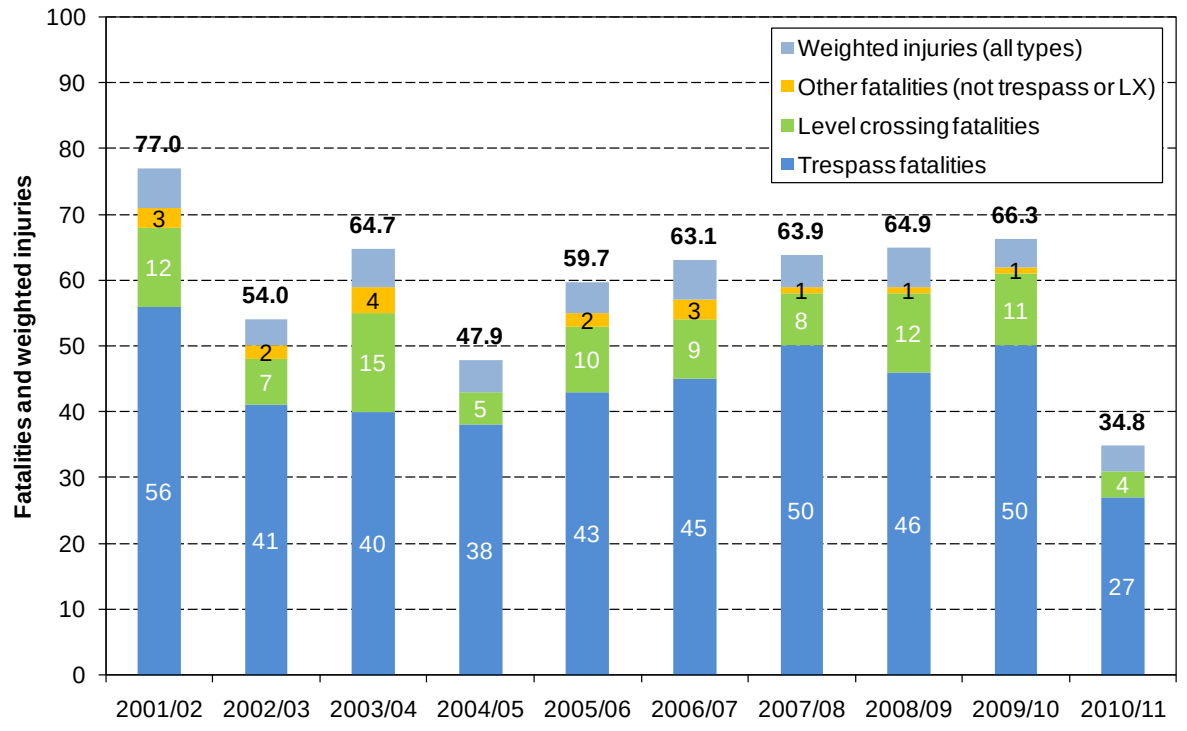
In order to generate timely statistics that are as accurate as possible (if a coroner has yet to return a verdict or has returned an open verdict), the industry applies rules known as the Ovenstone criteria (see Appendix 4) to determine *on the balance of probability* whether a fatality was the result 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 regularly contacts coroners' offices to obtain any missing coroners' reports from previous years; over time, this has led to the re-classification of a number of fatalities from suspected suicide to trespass, and vice versa.

7.3 Trends in harm to members of the public

Based on SRMv7, the risk to members of the public is estimated to be 61.7 FWI per year, of which 55.9 (91%) is fatalities. In any year, levels of actual harm may differ from the SRM estimate.

Chart 130. Trends in public FWI by accident type



- The average level of public FWI over the period 2001/02 to 2009/10 was 62.4. At 34.8 FWI, the level recorded for 2010/11 was significantly lower than average, and comes after a number of years of rising levels of public FWI.
- Both the number of trespasser fatalities and the number of level crossing fatalities were lower than average, contributing to the overall reduction.
- There were four level crossing fatalities, which is the lowest total over the period shown. All were pedestrian level crossings users.
- 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

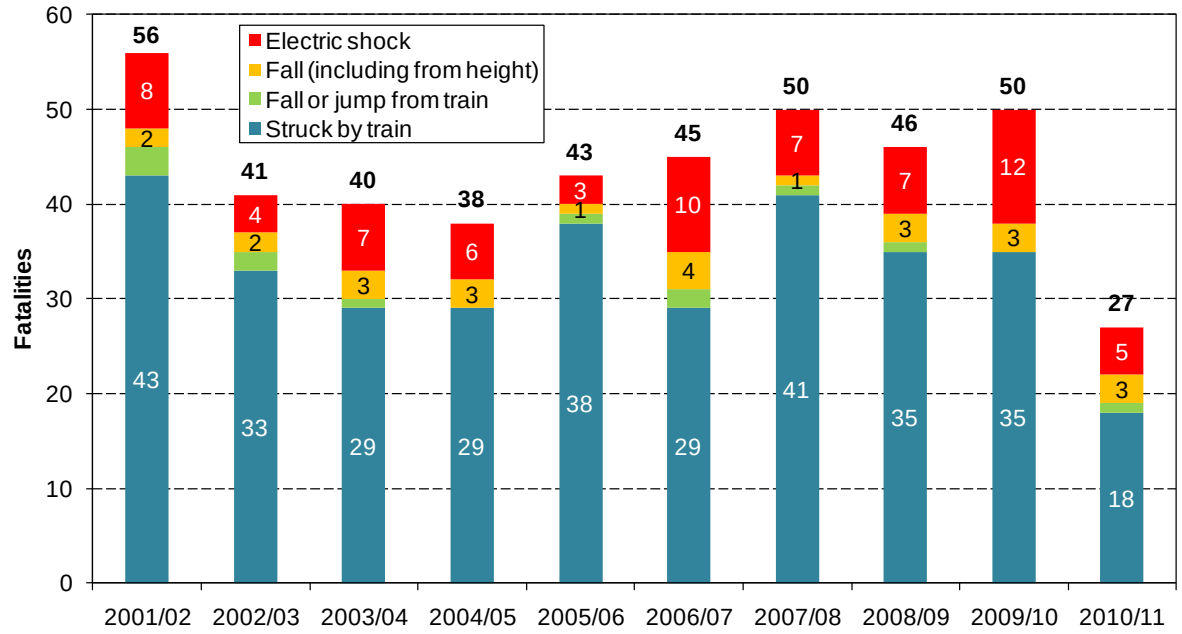
7.4.1 Trespass

A trespasser is someone who goes where they are never authorised to be (for example, someone who deliberately accesses the track from a station platform). The term is not applied to level crossing users, even if they are misusing the crossing. SRMv7 estimates trespasser harm to be 48.5 FWI per year, which is 79% of the total risk to members of the public.

Trespasser fatalities by cause

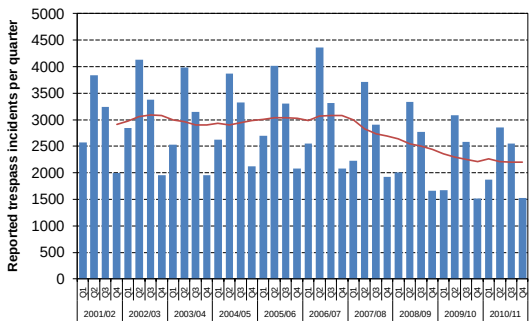
The railway represents a hazardous environment for trespassers. As well as being struck by trains, fatalities are caused by electrocutions, falls from height and persons jumping from moving trains. The majority of trespasser risk is fatality risk.

Chart 131. Trespass fatalities by cause



- The number of trespass fatalities for 2010/11 is almost half that of 2009/10, and well below average for the period shown. Over the period 2006/07 to the end of 2009/10, trends in reported trespass were reducing; 2010/11 showed a flatter trend.
- Electrocution and being struck by trains account for around 92% of all trespasser fatalities over the last ten years. Both categories showed reductions in 2010/11.
- Most trespass fatalities occur in single fatality incidents, although the potential for multiple fatalities exists where groups of people are trespassing. In June 2010, in Spain, 12 people lost their lives when they were hit by a train while taking a short-cut across railway lines.

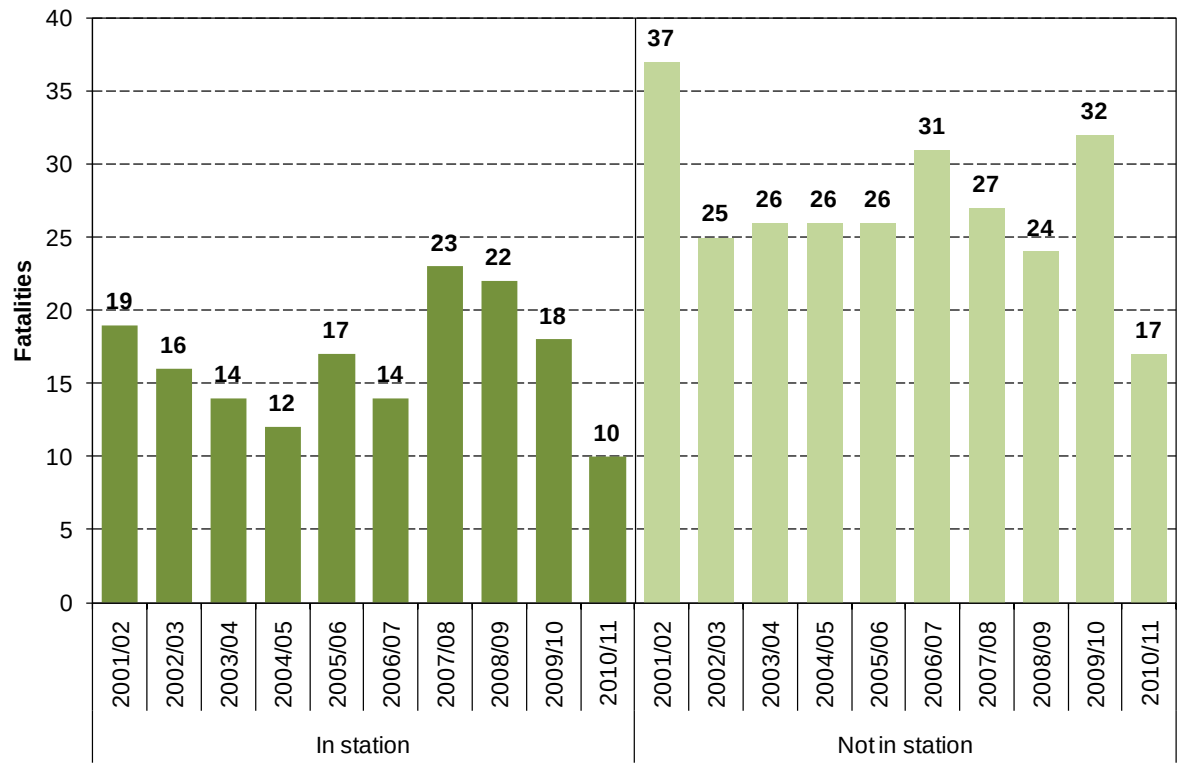
Chart 132. Trends in reported trespass



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 133. Trespass fatalities by location

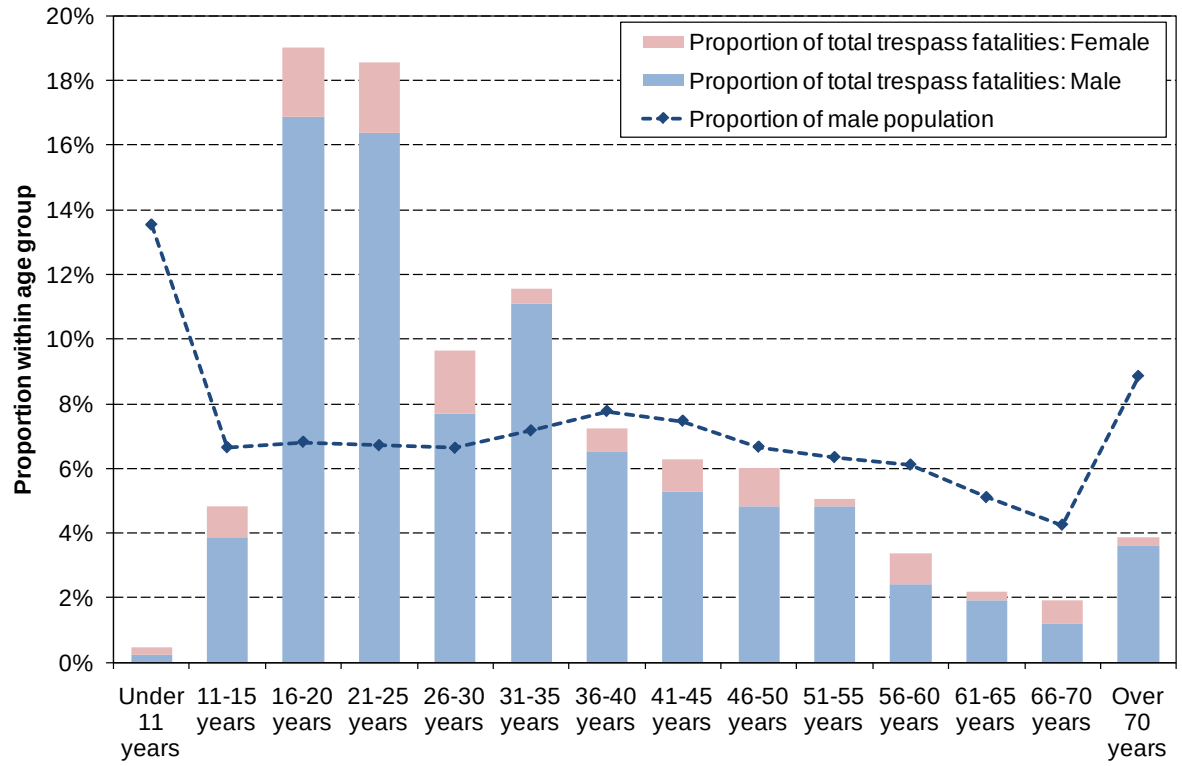


- The majority of trespass fatalities occur away from stations. This has been the case in each of the last ten years. Nearly all of these occur to people trespassing on the running line, but the category also includes the small number of people who have died as a result of train-surfing, jumping from trains in running, or falling from height.
- While fatality numbers in both categories show no clear trend, the chart shows that the reduction in overall number for 2010/11 was fairly equally split between stations and other locations.

Trespass fatalities by age and gender

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

Chart 134. Breakdown of trespass fatalities by age and gender 2001/02 to 2010/11



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

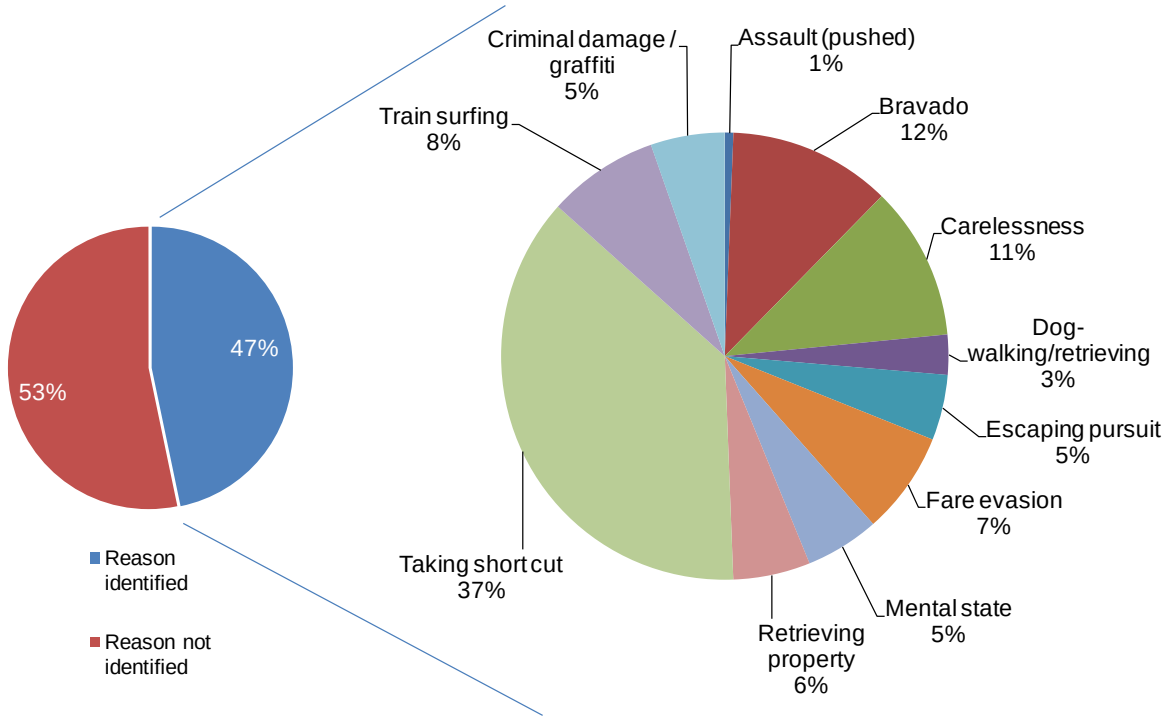
- A disproportionately high number of trespass fatalities involve males aged between 16 and 35.
- The peak ages for trespass fatalities are the later teens and earlier twenties.
- The percentage of male trespass fatalities is disproportionately high compared to their level of the overall population; although males make up just less than 50% of the total population, they have accounted for 88% of trespass fatalities over the past ten years.
- The chart is based on 415 trespass fatalities occurring between 2001/02 and 2010/11, where the age and sex were known. In addition, there were a further 21 trespass fatalities where the age was not recorded: 17 of these were male, one was female, and three records did not specify the gender.

Trespass: analysis of the motivation behind the trespass

People commit trespass for a variety of reasons. For some, it may be convenience – taking a short cut along the tracks or walking the dog. For others, it may be a spur of the moment decision – for example if something has been mistakenly dropped from the platform edge. In other cases, where people are engaged in criminal activity such as cable theft or graffiti, or risk-taking behaviour such as playing 'chicken', trespass is a means to an end.

The following analysis is based on all accidental injuries due to trespass.

Chart 135. Trespass injuries by motivation, 2001/02 to 2010/11 (1,040 events in total)

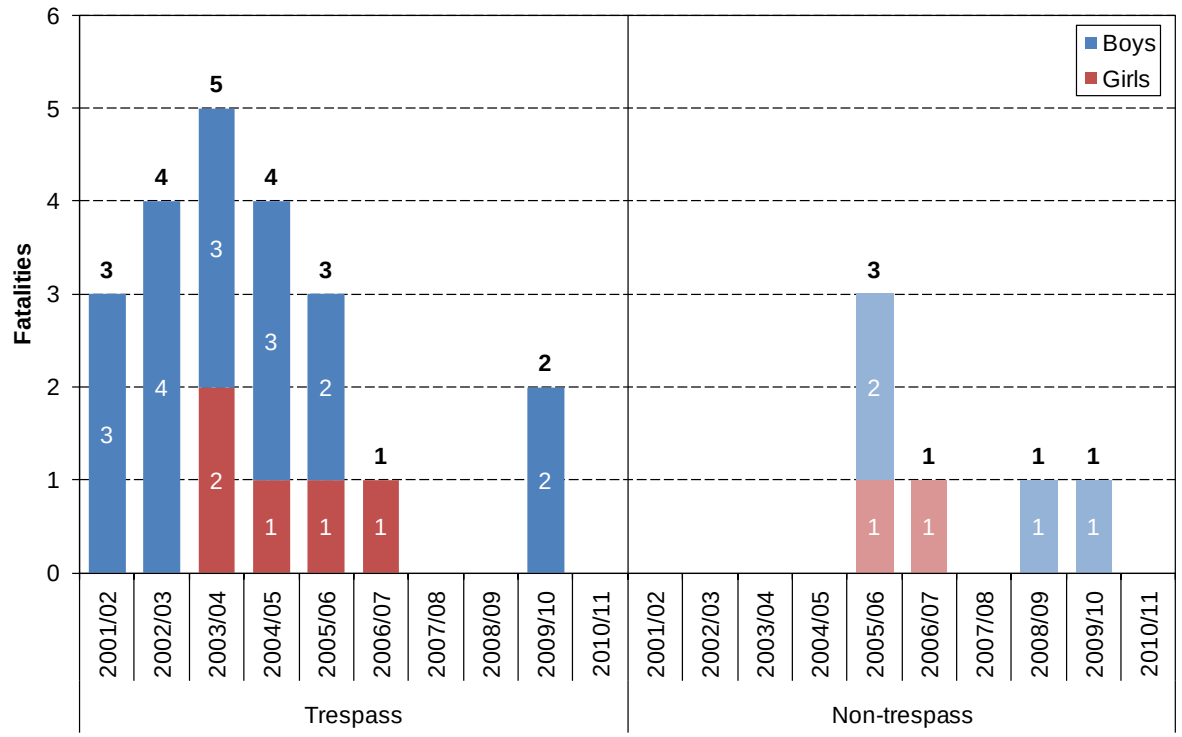


- In more than half of incidents, the reason for the trespass is not known or not identified.
- In those events where the motivation for the trespass is identifiable, the most common reason is for the purposes of taking a short cut. Other reasons where the trespass is a means to an end include retrieving property, walking dogs, fare evasion, and committing criminal damage or graffiti.
- Bravado and train-surfing are more in the category of trespass as an end in itself, ie for the purpose of thrill-seeking behaviour.
- For events involving dog retrieval or escaping pursuit, distraction is likely to play a part.
- There is some evidence of a reducing trend in the trespass injuries where the motivation for the trespass was taking a short-cut. Numbers per year for other motivation categories are too small for trends to be identified.

Public fatalities to children

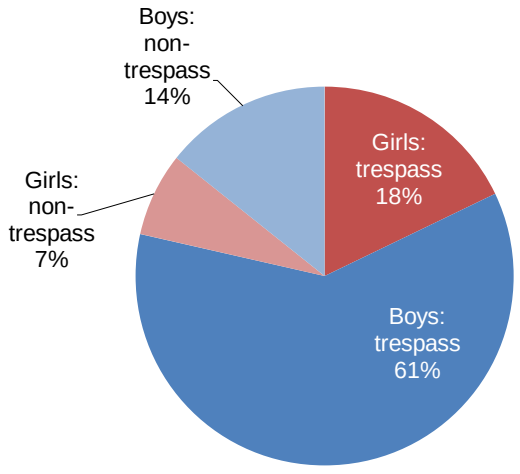
Fatalities to children are relatively rare. Since 2001/02, around 5% of all the accidental fatalities to members of the public have involved persons under the age of 16. However, due to their distressing nature, child fatalities receive a greater degree of media focus.

Chart 136. Public fatalities occurring to children



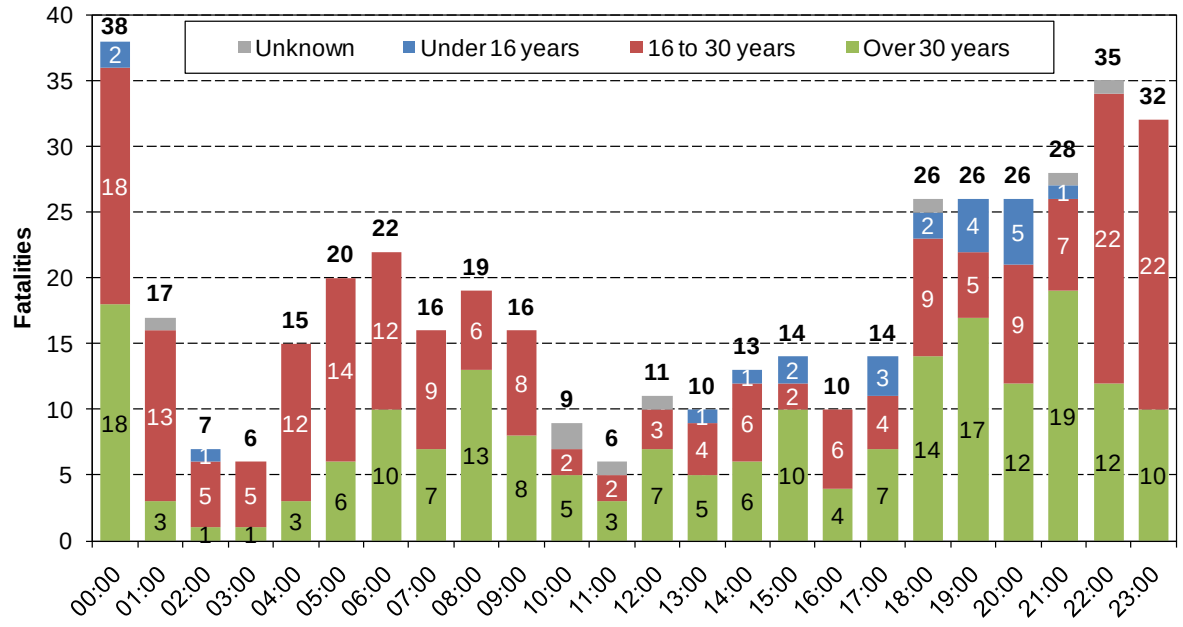
- There were no fatalities during 2010/11 involving children; this is the first year with no child fatalities since 2007/08.
- In the last ten years, the ratio of boy to girl trespass fatalities has been approximately 3:1. The ratio of male to female trespass fatalities for those 16 and over is closer to 7:1.

Chart 137. Child fatalities since 2001/02



Trespass fatalities by time of day, week and month

Chart 138. Trespass fatalities by time of day and age, 2001/02 to 2010/11



- The majority of the under-16 fatalities have occurred in the late afternoon to early evening. 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 ten 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.

Chart 139. Trespass fatalities by day since 2001/02

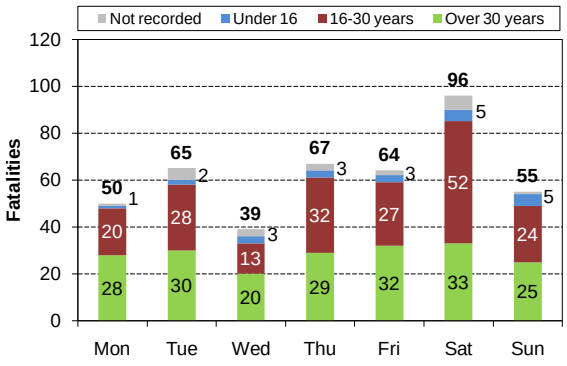
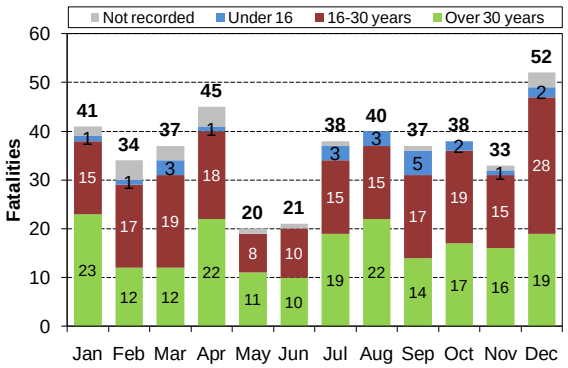


Chart 140. Trespass fatalities by month since 2001/02

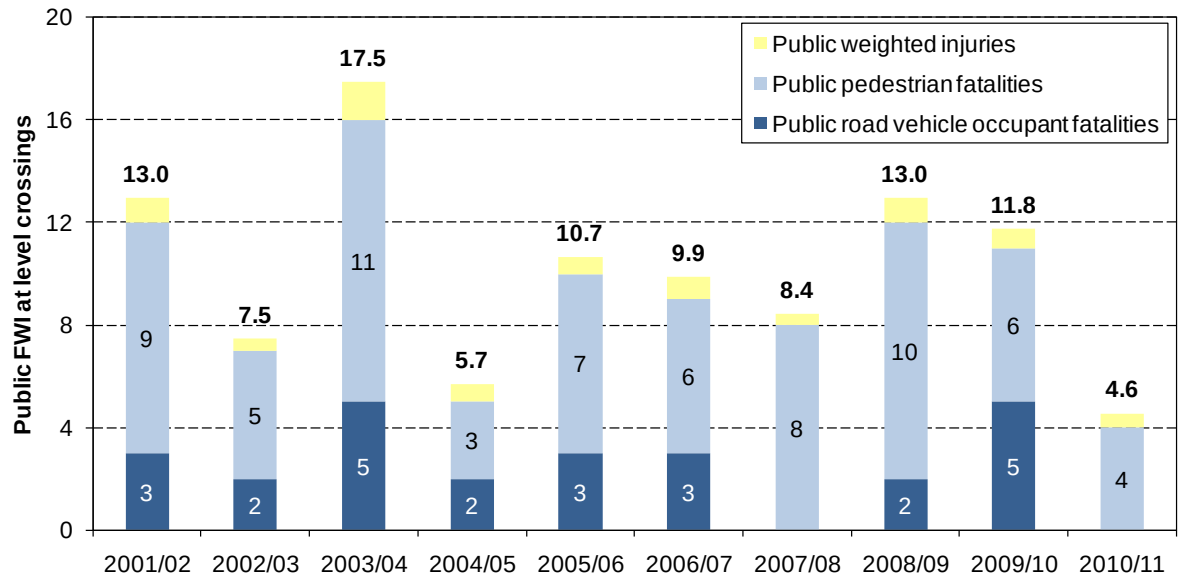


Level crossing users

SRMv7 estimates that 8% (10.6 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, eg injuries due to workforce error or equipment failure.)

Of the total level crossing risk of 10.6 FWI, 9.4 FWI occurs to members of the public.

Chart 141. Trend in public injuries at level crossings



- At four, the number of public fatalities for 2010/11 is well below the average of ten occurring over the previous nine years. All four fatalities occurred to pedestrians. In two of the cases, the people involved were running after their dogs, who had strayed on to the crossing. In a third case, the person was wearing headphones, and in the last event, the person involved was trying to evade apprehension by the police. All four cases involved people potentially distracted from focusing on proper use of the crossing.
- The statistics indicate that fatalities involving dog-walkers occur relatively frequently. Since 2001/02, there have been 12 such occasions, which is 17% of all public pedestrian fatalities at level crossings.

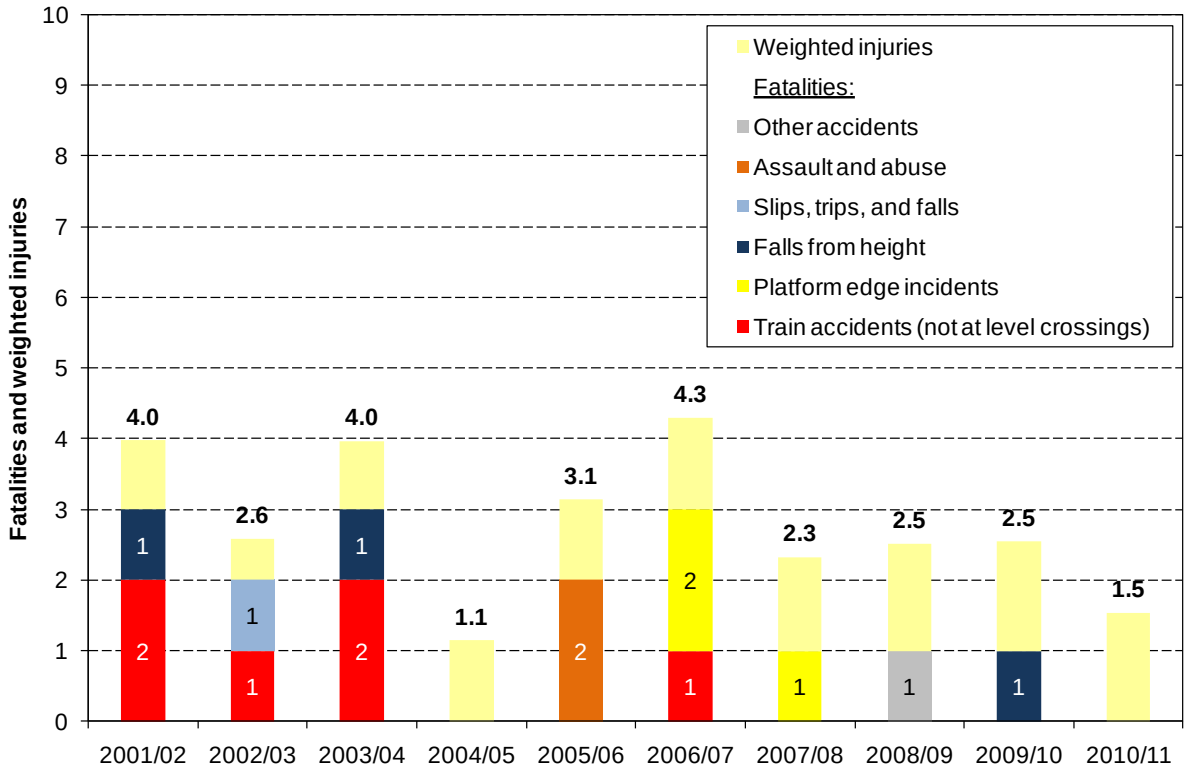
Not shown in the chart are level crossing fatalities involving passengers or workforce. Over the period, there has been one train accident that resulted in fatalities to train occupants: the train collision with a road vehicle at Ufton in November 2004, which resulted in the deaths of five passengers and the train driver. There have also been six fatalities to passenger users of station crossings. There were no passenger or workforce fatalities at level crossings in 2010/11. For more detailed analysis of level crossings, see section 9.2.

Suicides by level crossing users are also not shown in the chart. Since 2001/02, there have been more than 200 suicides at level crossings, seven of which were road vehicle drivers (one of which was the incident at Ufton, described above). For analysis of suicide by location, see section 7.6.

7.4.2 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 142. Public harm not involving trespass or level crossings

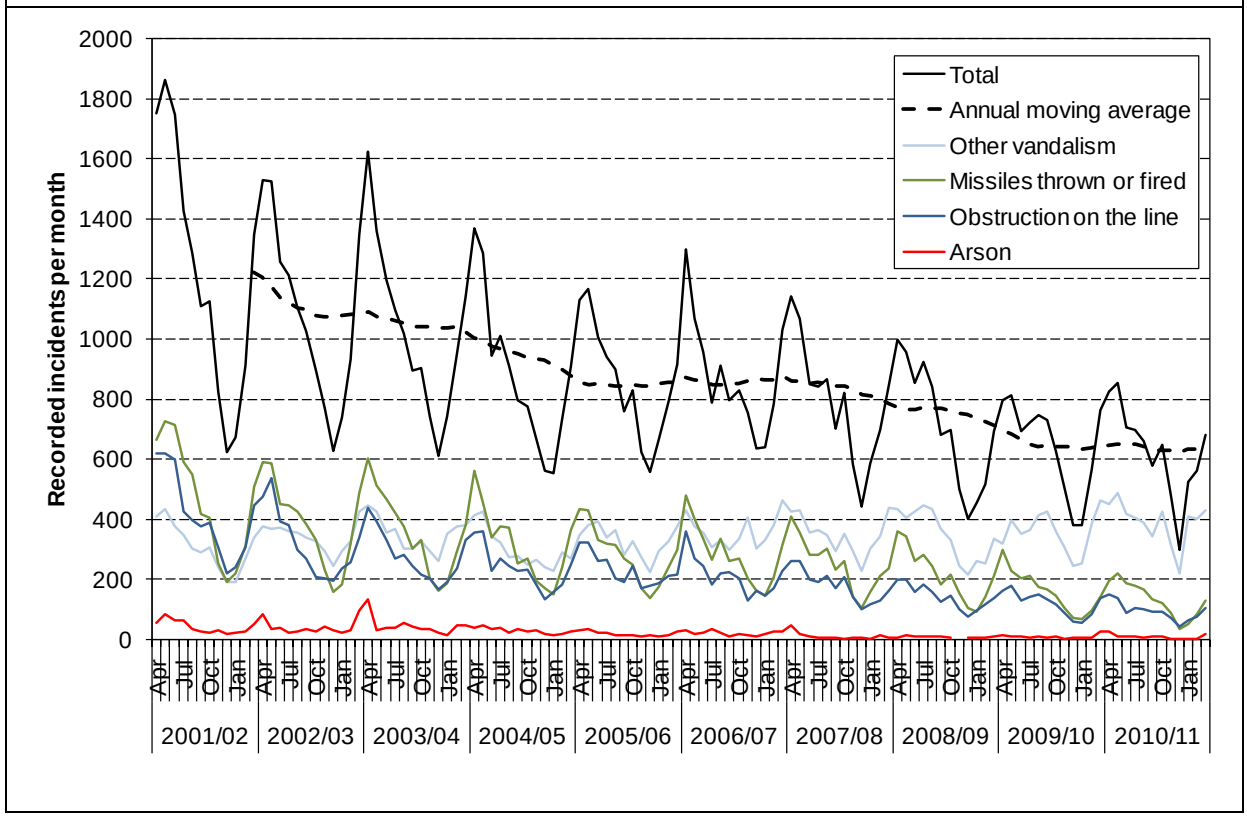


- In 2010/11, there were no public fatalities that did not involve trespass or level crossings.
- The set of accidents shown in Chart 142 now differs from the corresponding chart in the 2009/10 edition of the ASPR (Chart 95). In moving from SRMv6 to SRMv7, a review and reclassification of public injuries has taken place. Public injuries occurring as a result of falls from height are now classed as trespass in cases where the incident was a result of improper use of railway property. If the incident involved a substandard condition of railway property then it is not classed as trespass. Examples of events now classed as trespass include cases where members of the public were climbing on parts of railway structures where they should not, such as the sides of overbridges, and accidentally fell off.
- 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.

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. '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 143. 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.
- Over the period 2001/02 to early 2009/10, reported vandalism fell by around 45%. Since then, the AMA number of recorded incidents has remained essentially stable.
- The 45% reduction in the overall total was due mainly to falls in the incidence of missiles thrown or fired at trains, and obstructions placed on the line. Arson also decreased, but its contribution to the total number is relatively small. Improvements in rolling stock have meant that train windows are now more resistant to breakage, and train materials are less flammable.
- The trend in other forms of vandalism has been slightly increasing over the period shown in the chart. This category of vandalism covers events such as interference with equipment or trains, including theft and malicious damage, such as that involved in cable theft.

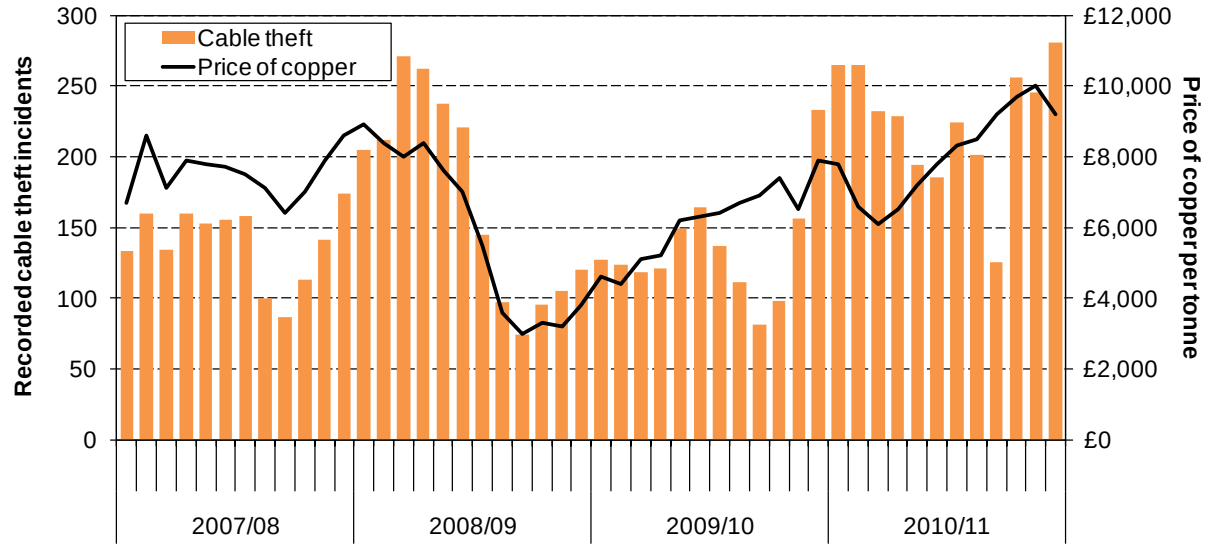
7.5.1 Cable theft

The theft of lineside cable causes significant operational delay, creates reinstatement cost and necessitates criminal investigation. Where the cables that are cut or damaged are either live, or near to other live sources of electricity, there is serious potential for injury or death.

In July 2009, a trespasser sustained an electric shock after coming into contact with a live cable while attempting to steal conductor cables, and died later from his injuries. At the inquest in September 2010, the jury returned a verdict of accidental death. The deceased's accomplice was arrested for attempted cable theft, and after pleading guilty was given a 12-month community order involving 150 hours of community service.

In March 2011, six men were convicted of cutting cabling at a number of sites. Their criminal activity caused nearly £1m worth of repair costs and 322 hours of train delays.

Chart 144. Incidents of cable theft and trends in copper price



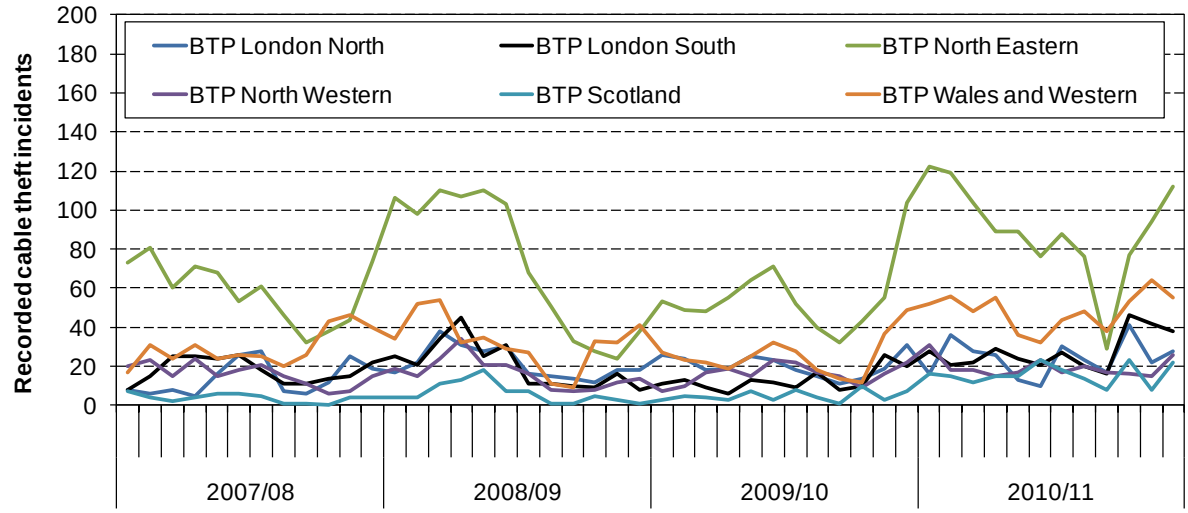
Sources: BTP for data on incidence of cable theft; London Metal Exchange for data on copper prices

- The incidence of cable theft shows a close correlation with the trend in copper price over the same period.
- Winter months generally show the fewest incidents, even at times when the copper price continues to be high. It is possible that perpetrators are dissuaded by more severe weather conditions.
- Network Rail reported that in 2010/11, £16.5m was lost nationwide through cable theft attacks on essential rail systems, which includes delays to passenger services totalling more than 6,000 hours. BTP recorded some 3,000 related crimes and made more than 900 arrests. In its attempt to address cable theft, the industry is undertaking a number of initiatives, including:
  - A dedicated BTP task force, with increased patrols and intelligence led policing.
  - Working in partnership with the Serious Organised Crime Agency (SOCA).
  - Use of the Network Rail helicopter, CCTV, forensic marking, trembler alarms and other devices to protect the cable.
  - Introduction of a new type of cable that is easier to identify and harder to steal.

7.5.2 Cable theft by BTP area

BTP is divided into seven territorial areas, six covering mainline rail operations, and one covering London Underground and the Docklands Light Railway. More than 4,000 police officers, special constables, police community support officers and police staff provide a specialist policing service across these areas.

Chart 145. Incidents of cable theft by BTP mainline areas

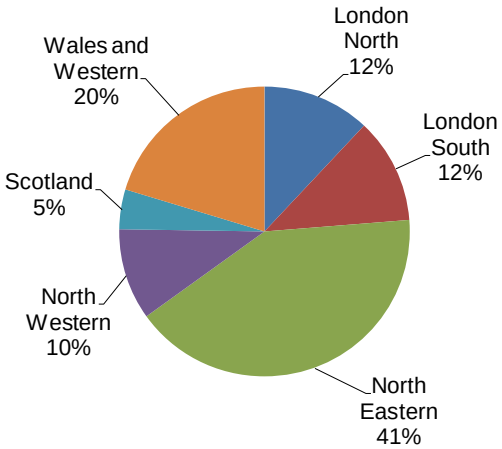


Source: BTP

- BTP North Eastern Area and BTP Wales & Western area have the highest rates of cable theft, on average.
- All areas shown a similar pattern of increasing and decreasing trend, in line with the national picture and trends in copper price.
- Areas differ in their size and operational characteristics, such as length and type of track, as well as other factors such as population density and demographics. All of these factors are likely to influence the occurrence of cable theft.

Figure 1. BTP mainline rail areas

Chart 146. Cable theft by area

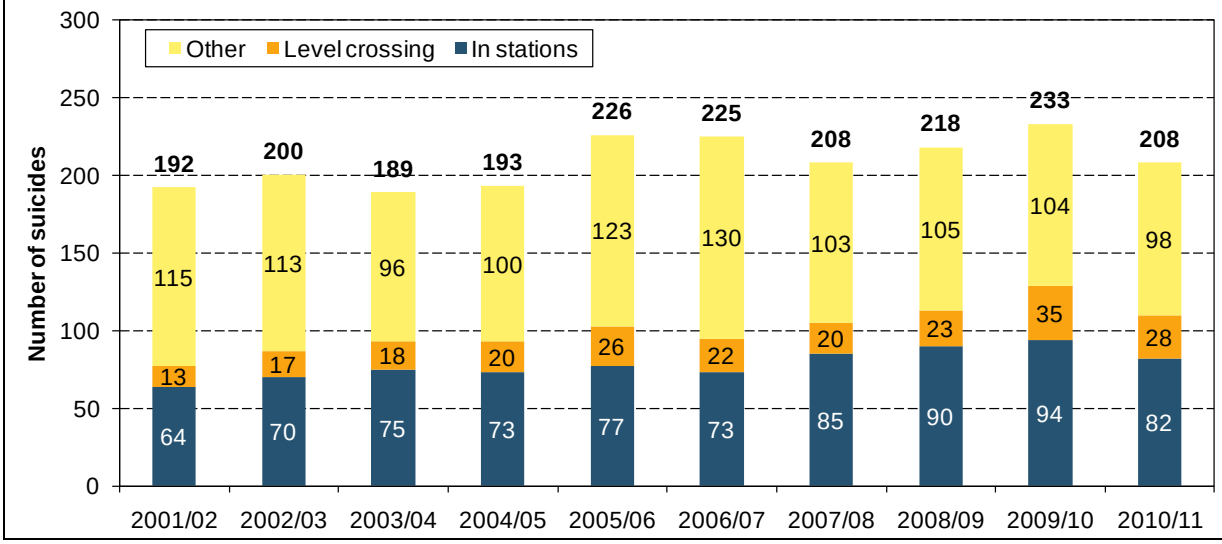


Source: BTP

7.6 Suicide

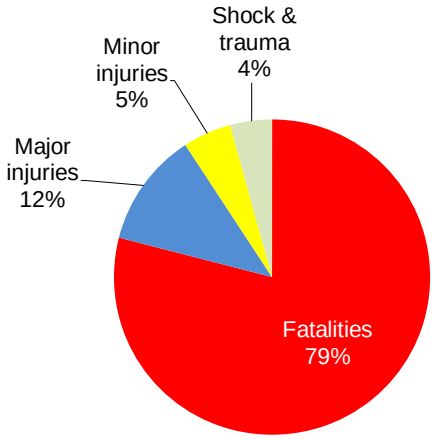
The railway uses the Ovenstone criteria to differentiate between suicides and accidental fatalities (see Appendix 4 for criteria details). Any passengers who committed suicide are classed as members of the public for the purposes of this report, and are included in the analysis in this section.

Chart 147. Suicides and suspected suicides by location



- After a peak in suicide numbers in 2009/10, the level in 2010/11 has shown a reduction, and is around average for the previous nine years.
- Compared with the previous year, there were reductions in numbers at all types of location. The category *other* mostly comprises suicides on the running line, but also includes a small proportion (less than 3%) occurring at other railway locations, eg bridges.
- Nearly 80% of recorded suicide attempts have a fatal outcome. Of those that do not, more than half will be left with major injury, many of which will be severe and life-affecting.
- Network Rail and the Samaritans have completed the first year of their long-term programme to reduce the number of suicides. 2010/11 saw the launch of the programme's publicity campaign: 'Men on the Ropes', which is targeting the key demographic group that use the railway to end their lives. Over 800 frontline railway staff attended a training course on how to manage suicidal contacts and over 170 initial outreach working meetings have taken place between priority locations and Samaritans branches across the country. RSSB is undertaking research (T845) alongside the programme, to support the development of these interventions and to assess their effectiveness as they are rolled out.

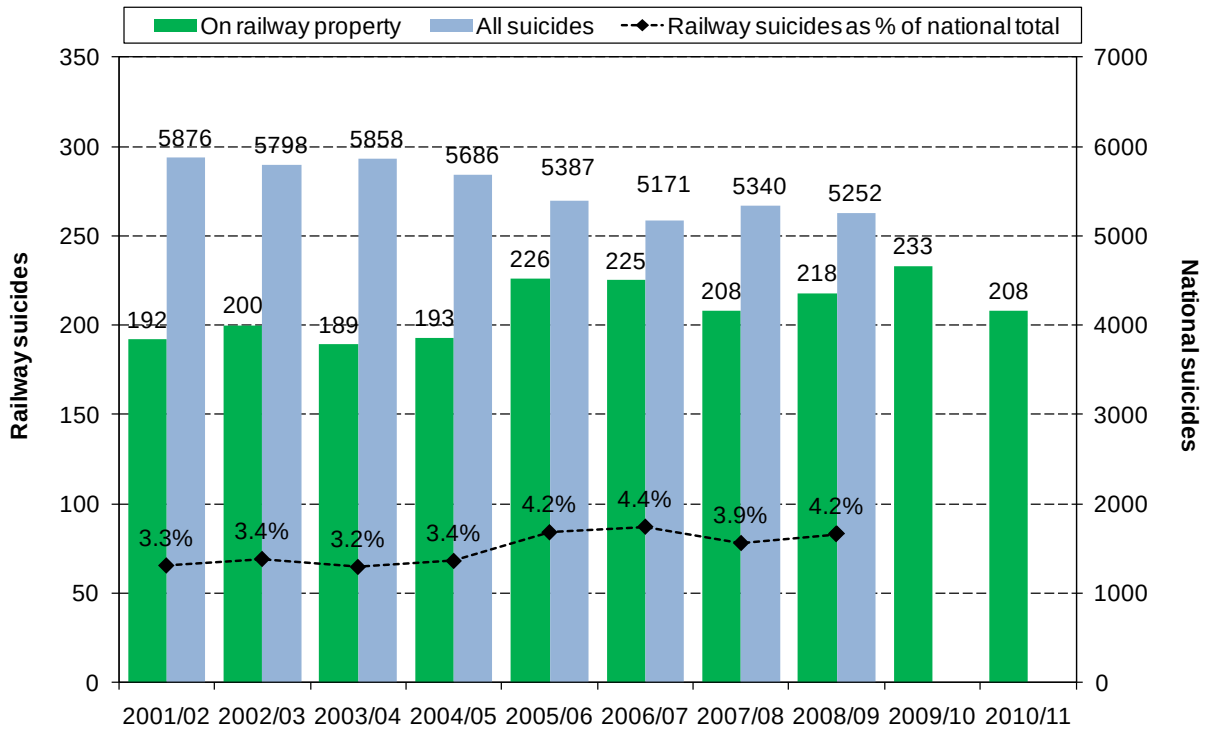
Chart 148. Suicide attempts by outcome since 2001/02



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.

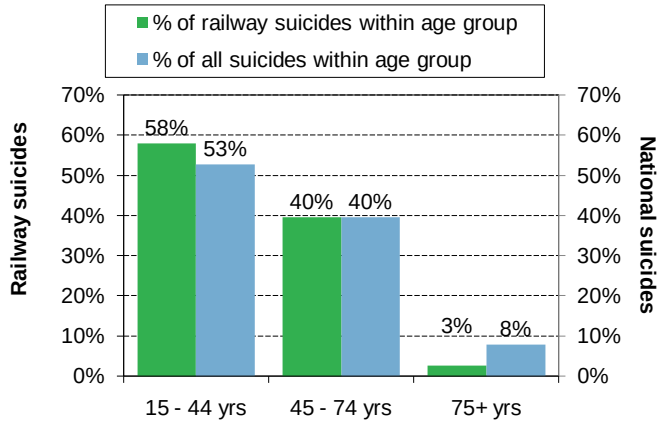
Chart 149. Railway suicide trends in the wider context



Source: SMIS data for railway suicides; Office of National Statistics for national suicides. Data covers all of Great Britain.

- Between 2001/02 and 2008/09, the number of national suicides has been generally falling. The number of railway suicides shows no such reducing 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 2008/09 has been 3.7%
- The age demographics of railway suicides varies somewhat from national suicides. Compared with the national profile, a greater proportion of railway suicides are in the 15 – 44 years age group, and a smaller proportion is within the 75+ years age group. The same proportions are in the 45-74 years age bracket,

Chart 150. Suicides by age 2001/02 to 2008/09

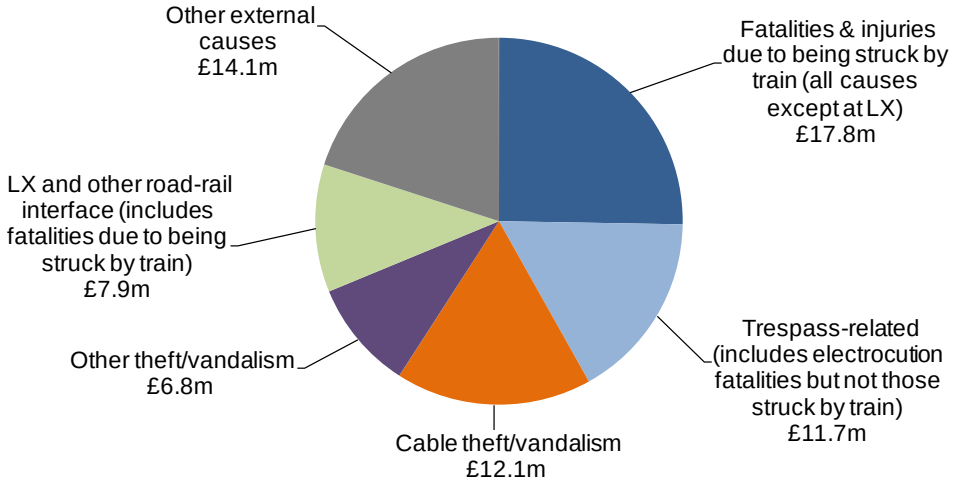


7.7 Delays and costs arising from public behaviour[49]

Train delays and cancellations are sometimes caused by various events on the rail network. Data relating to these events is collected by Network Rail and assigned a financial value through a process agreed by Network Rail and train operators. The information is kept in the Network Rail TRUST database system.

Each event in TRUST is assigned a cause type by Network Rail. The majority of cause types lie within the industry's area of responsibility. However, a considerable amount of disruption arises from causes that fall within the category of public behaviour. The amount of cost assigned to each event in TRUST is an estimation, based a number of factors, such as type of incident, amount of delay, type of trains involved, and time of day. In 2010/11, the total estimated costs from all causes was in the region of £900m. The costs associated with public behaviour was estimated to be around £70m.

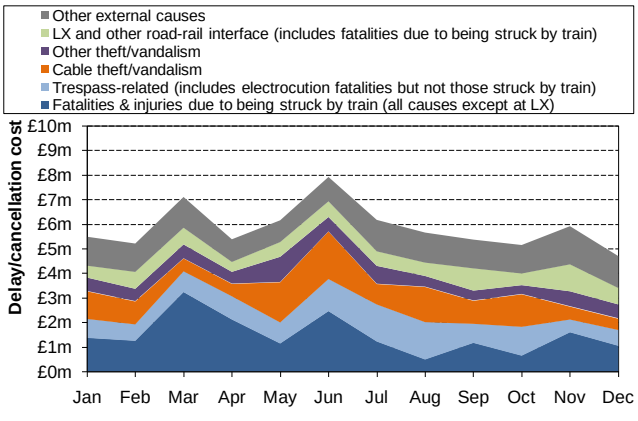
Chart 151. Delay and cancellation costs from areas outside industry control, 2010/11



Source: TRUST

- Of the events types shown, fatalities/injuries due to being struck by train result in the greatest cost, at £17.8m. Of these, the majority are suicide or trespass related.
- Cable theft/vandalism and other theft/vandalism account for £18.9m when combined. The figures do not include other associated costs, such as repair replacement.[50]
- Over the past year, suicide and other fatality/injury costs showed notable variability, peaking in March and June. Trespass costs were higher during the summer months.

Chart 152. Delay/cancellation costs by month, 2010/11



[49] The analysis in this section will also include any similar injuries/events involving passengers.
[50] The cable theft costs quoted in Section 7.5.1 include costs in addition to those resulting from delay/cancellation.

7.8 Public key safety facts

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

Public	2006/07	2007/08	2008/09	2009/10	2010/11
Trespass					
Fatalities	45	50	46	50	27
Major injuries	38	30	33	20	16
Minor injuries	33	25	20	34	29
Shock/trauma	1	0	1	0	0
Total trespass FWI	**48.91**	**53.09**	**49.38**	**52.13**	**28.71**
Level crossings					
Fatalities	9	8	12	11	4
Major injuries	8	4	9	7	5
Minor injuries	34	18	19	24	19
Shock/trauma	0	1	3	2	1
Total level crossings FWI	**9.89**	**8.44**	**12.97**	**11.75**	**4.56**
Non-trespass non-LX					
Fatalities	3	1	1	1	0
Major injuries	11	11	13	13	12
Minor injuries	92	97	87	128	137
Shock/trauma	2	6	3	1	2
Total non-trespass non-LX FWI	**4.29**	**2.33**	**2.51**	**2.55**	**1.54**
Total public accidental FWI					
Fatalities	57	59	59	62	31
Major injuries	5.70	4.50	5.50	3.90	3.30
Minor injuries	0.39	0.34	0.34	0.41	0.49
Shock/trauma	0.00	0.01	0.02	0.01	0.01
Total accidental FWI	**63.09**	**63.86**	**64.86**	**66.33**	**34.80**
Suicide					
Fatalities	225	208	218	233	208
Major injuries	33	27	34	25	36
Minor injuries	9	9	18	13	15
Shock/trauma	1	0	0	1	0
Total suicide FWI	**228.34**	**210.74**	**220.48**	**235.57**	**210.67**

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8 Risk from train accidents

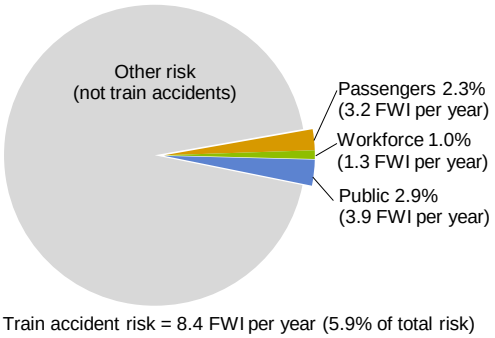
This chapter covers the risk from all types of train accident, from collisions and derailments to those with typically less serious consequences, such as trains being struck by stones.

2010/11 Headlines

- There were no fatalities in train accidents in 2010/11. Years without passenger or workforce fatalities in train accidents are now the norm. The last train accident with an on-board fatality was the derailment at Grayrigg in February 2007.
- The total harm from train accidents in 2010/11 comprised ten major injuries (six passengers, three members of the workforce and one road vehicle occupant) and 87 minor injuries or cases of shock/trauma. This equates to 1.3 FWI.
- There were 18 potentially higher-risk train accidents (PHRTAs). This is a significant reduction on the previous year's total of 42, which, at the time, was the lowest number on record. The total number of RIDDOR-reportable train accidents fell from 581 to 523.
- There were five collisions between trains and road vehicles at level crossings – the lowest total for at least a decade. The collision between a train and a lorry at Sewage Works Lane level crossing derailed the train and five people on board received major injuries.
- A further accident involving a road vehicle occurred when a lorry fell from a bridge and landed on a passing train, derailing it and causing major injuries to two passengers.
- There were two collisions between trains: two passenger trains collided at low speed during permissive working in a station; and a road-rail vehicle ran away and collided with a stationary freight train, derailing both.
- There were eight other derailments, six of which involved passenger trains. This compares with 20 derailments (eight involving passenger trains) in 2009/10. The number of freight train derailments has fallen dramatically over the past decade.
- The PIM indicator, which measures changes in risk by tracking train accident precursors, stood at 50.4 at the end of the year, compared with 44.0 at the end of 2009/10. The change reflects increases in high-risk irregular working events, weather-related incidents at level crossings, reported rolling stock failures and the estimated risk from SPADs.
- Overall, the picture is mixed. The PIM suggests that underlying train accident risk rose during the year (albeit from an historically low level), despite an exceptionally low number of potentially high risk accidents.

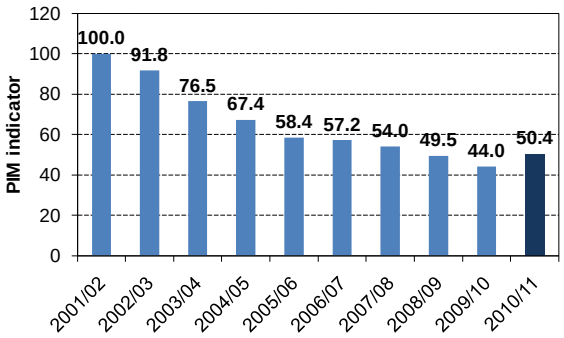
Train accident risk at a glance

Train accident risk in context (SRMv7)



Train accident risk = 8.4 FWI per year (5.9% of total risk)

Trends in train accident risk (PIM)



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 a train 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 the events, which are set out in Table 19.[51] The scope is generally limited to RIDDOR-reportable accidents. 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 7.

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.

The train accident at Oxshott in 2010/11, in which a lorry fell from a bridge onto a passing train, prompted a review of the PHRTA category. This resulted in the addition of two new accident types: trains struck by large falling objects and train explosions. Such events have a relatively high average consequence but, because they occur very infrequently, account for a small proportion of train accident risk.

The PHRTA category now comprises RIDDOR-reportable derailments, trains striking road vehicles, buffer stop collisions, collisions between trains (excluding roll backs and open doors), large objects falling onto trains and train explosions.

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 140.9 FWI per year, train accidents account for 8.4 FWI (5.9%).

Train accidents have the potential to result in a large number of casualties, but accidents with on-board fatalities now occur very infrequently. The SRM contains detailed models of the causes and consequences of train accidents, encompassing 18 hazardous events and 1,587 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 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.

[51] The term *train* covers a wide range of rail vehicles, including on-track plant. See Appendix 7 for more detail.

Table 19 shows the categories of train accident covered in this report, 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 19. Types of train accident and their associated risk (SRMv7)[52]

	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)	✓	✓	1.8	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	3.0	HET-10, HET-11
Collisions with road vehicles at other locations (excluding derailments)	✓	used as a precursor	<0.1	<0.1	0.4	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	0.2	<0.1	Part of HET-04
Struck by large falling object	✓	×	<0.1	<0.1	<0.1	HET-21, HET-22
Train fire	×	✓	0.1	<0.1	<0.1	HET-17, HET-20
Train explosion	✓	×	<0.1	<0.1	0.1	HET-23, HET-24
Train division	×	×	<0.1	<0.1	0	HET-25

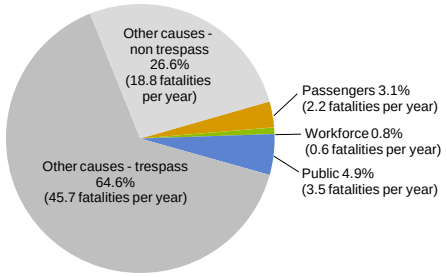
- Most of the risk to passengers arises from train derailments, which account for 1.8 passenger FWI per year. The total risk for all person types from train derailments is 2.5 FWI per year. These figures include the risk from collisions or fires following a derailment.
- Collisions with road vehicles at level crossings is the second-largest risk area, with members of the public incurring most of the risk (3.0 public FWI per year).
- PHRTAs cover 94% of all train accident risk (7.8 FWI per year).
- The PIM covers 86% of all train accident risk (7.2 FWI per year).

[52] 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. In all cases, events that are not reportable under RIDDOR are generally omitted from the analysis in this chapter.

8.2 Train accident risk

The SRM estimates the risk from train accidents to be 8.4 FWI per annum, which is around 5.9% of total risk (excluding suicide). Of this, fatality risk is 6.2 per year, which is around 8.8% of the total fatality risk.

Chart 153. Train accident fatality risk in context

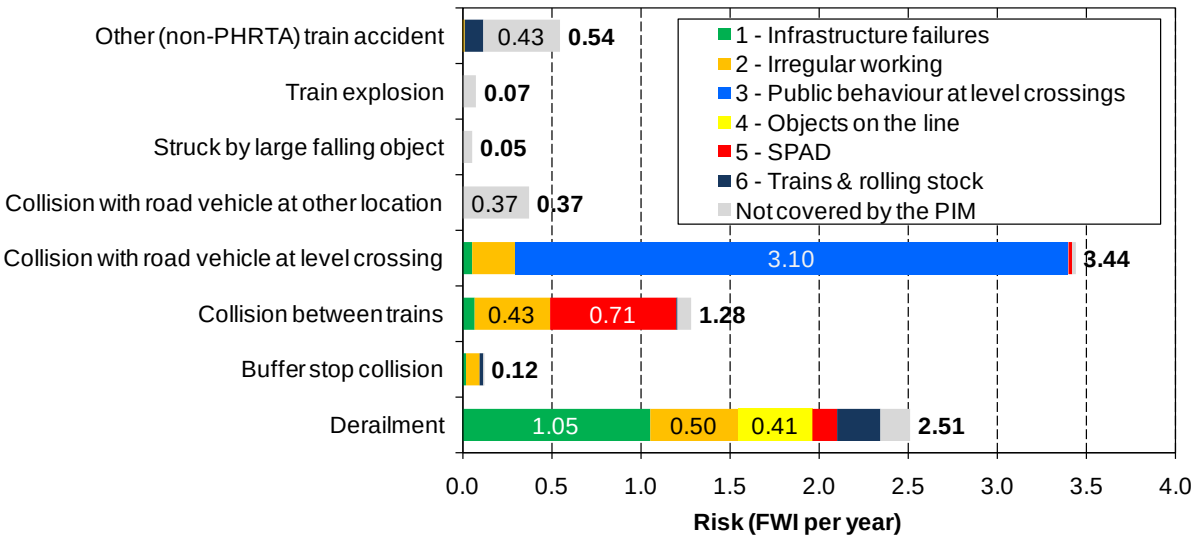


Train accident risk 6.2 fatalities per year (8.8% of total fatality risk)

- The group with the highest fatality risk (3.5 per year) is members of the public. The greatest risk arises from collisions between trains and road vehicles at level crossings.
- The next highest risk group (2.2 fatalities per year) is passengers. The greatest risk to this group arises from train derailments.

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 154 shows train accident risk broken down by accident type and PIM group.

Chart 154. Train accident risk by accident type and cause (PIM group)[53]



- 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 around 40% 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).

Data source: SRMv7

[53] Train accidents in possessions are outside the scope of the PIM. This explains the small proportion of risk that is not covered by the PIM for the categories *collision with road vehicle at level crossing*, *collision between trains*, *buffer stop collision* and *derailment*.

8.3 Fatalities and injuries in train accidents

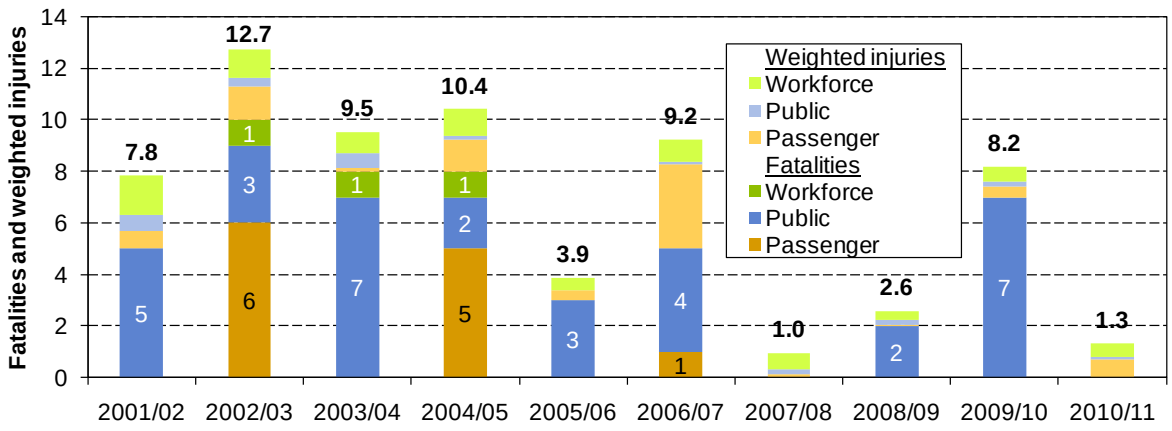
Two train accidents caused multiple major injuries in 2010/11.

- Four passengers and the train driver received major injuries when a train collided with a tanker on Sewage Works Lane user-worked level crossing on 17 August 2010 (each of the other 16 occupants of the train received minor injuries).
- Two passengers received major injuries when a lorry crashed through a bridge and fell onto the sixth and seventh carriages of a train near Oxshott on 5 November 2010.

Train accidents caused major injuries to three other people during the year: a driver whose train struck a fallen tree at 90mph, the operator of a road-rail excavator that ran away down a gradient and collided with a freight train, and a boy in a road vehicle that was hit by a train on a level crossing.

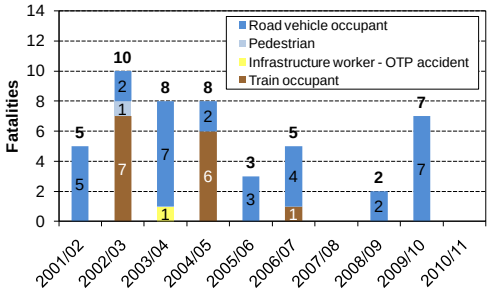
There were 52 reports of minor injuries as a result of train accidents in 2010/11. These arose from collisions with objects (34),[54] trains struck by missiles (15) and train fires (3).

Chart 155. Fatalities and weighted injuries from train accidents (excluding suicides)



- The level of harm from train accidents was relatively low in 2010/11, largely because there were no fatalities. It remains rare to experience a year in which no road vehicle occupants are killed in collisions with trains.
- The mini chart shows that, since 2001/02, 14 train occupants, 32 road vehicle occupants, one pedestrian[55] and one infrastructure 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 155: major train accidents occurred in 2002/03 (Potters Bar), 2004/05 (Ufton) and 2006/07 (Grayrigg).

Chart 156. Train accident fatalities

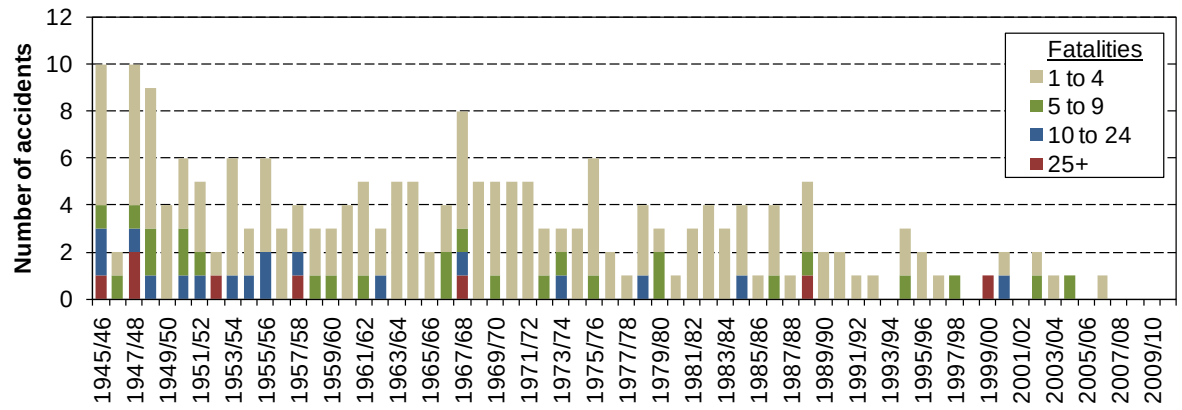


[54] The total of 34 includes people injured in any subsequent derailment, and injuries from the incident at Oxshott, where the vehicle fell onto the train.
[55] A woman was struck by masonry that fell from a bridge as a result of the derailment at Potters Bar in May 2002.

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 157. Train accidents leading to passenger or 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 rare; the last 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 18 years.

Table 20. SRM estimated frequency of train accidents by severity[56]

		SRM v1 / v2	SRM v3	SRM v4	SRM v5 / v5.5	SRM v6	SRM v7
Average number of years between events with...	5 or more fatalities	1.4	2.4	3.8	5.3	5.4	5.8
	10 or more fatalities	3.1	5.6	7.9	9.1	15.3	18.3

- 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 rolling stock removal and improvements in track quality following the Hatfield train accident.

Data sources for Chart 157: ORR for historic data; SMIS for recent statistics.

[56] Elsewhere in the report, SRMv6.5 is used in preference to SRMv6. Version 6.5 is based on the same data as version 6, but incorporates the modelling improvements that were introduced for version 7. However, the figures shown in Table 20 are based on FN-curves, which have not been calculated for SRMv6.5.

Causes of historic train accidents

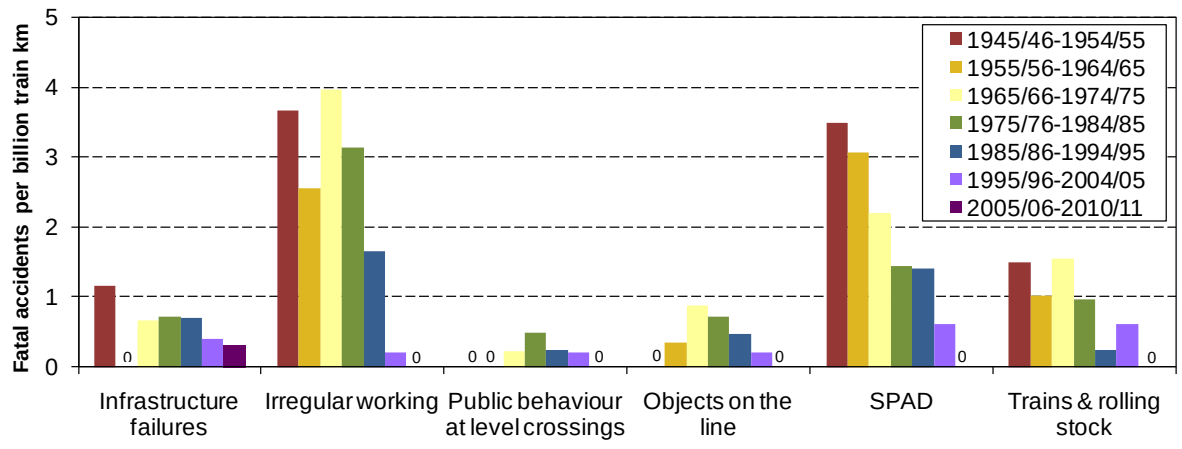
Since 1945/46, there have been eight train accidents in which 25 or more people died. There have been five train accidents with passenger or workforce fatalities in the past ten years.

Table 21. Historic train accidents[57]

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 158. 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 less clear for causes over which the industry can exert some influence, but which are often not under its direct control: public behaviour at level crossings 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.

[57] The public fatality at Ufton (identified by square brackets) was a road vehicle occupant who had parked on the crossing with the intention of taking his own life. Suicides and attempted suicides are generally excluded from the fatality and injury statistics presented in this report.

8.4.1 Potentially higher-risk train accidents in 2010/11

Table 22 and Table 23 list the 18 PHRTAs that occurred in 2010/11.

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 2010*, which is available from the RSSB website: http://www.rssb.co.uk/LEARNING/OPFeedbackSumm/Pages/AnnualReports.aspx.

Table 22. Passenger train PHRTAs

Derailments (excluding level crossings)				5
Date	**Location**	**Territory**	**Train Operator**	**Description**
06/06/2010	Falls of Cruachan	Scotland	First ScotRail	Derailed after striking a boulder on the line due to a landslip. The train was prevented from falling into the road below by trees on the embankment.
28/08/2010	Guildford (Woking Line)	South East	South West Trains	Derailed on points at low speed after passing a signal at danger.
24/11/2010	Welshpool	Western	Arriva Trains Wales	One bogie derailed at low speed as the train was setting back over partially trailed points.
28/12/2010	Summit Tunnel	London North Western	First Transpennine Express	Derailed after running into a large block of ice that had fallen from a tunnel ventilation shaft.
05/02/2011	Bankhouse Tunnel	London North Eastern	Northern Rail	Derailed after running into debris from a collapsed retaining wall.
Collisions between trains				**1**
Date	**Location**	**Territory**	**Train Operators**	**Description**
29/04/2010	Manchester Airport	London North Western	Northern Rail / First Transpennine Express	Low-speed collision with another passenger train during permissive working.
Buffer stop collisions				**2**
Date	**Location**	**Territory**	**Train Operator**	**Description**
23/04/2010	Skipton	London North Eastern	Northern Rail	Low-speed buffer stop collision through misjudged brake application.
24/06/2010	Liverpool Lime Street	London North Western	Northern Rail	Low-speed buffer stop collision.
Trains struck by large falling objects				**1**
Date	**Location**	**Territory**	**Train Operator**	**Description**
05/11/2010	Oxshott	South East	South West Trains	A cement mixer lorry crashed through a bridge and fell onto a passing train, causing extensive damage and derailing it.
Collisions with road vehicles on level crossings				**5**
Date	**Location**	**Territory**	**Train Operator**	**Description**
03/07/2010	Wrights No. 19 LC (Beccles)	South East	National Express East Anglia	Collision with a road vehicle at a user worked crossing.
23/04/2010	Sewage Works Lane LC (Sudbury)	South East	National Express East Anglia	Derailed after striking a sewage tanker on a user worked crossing (with telephone).
23/04/2010	Lime Kiln Quay LC (Woodbridge)	South East	National Express East Anglia	Collision with a road vehicle at an automatic open crossing.
23/04/2010	Morfa Main LC (Kidwelly)	Western	Arriva Trains Wales	Collision with a tractor and trailer at a user worked crossing (with telephone).
23/04/2010	Halloon LC (St. Columb Road)	Western	First Great Western	Collision with a road vehicle at an automatic open crossing.
Collisions with road vehicles not at level crossing (excluding derailments)				**0**
Total passenger train PHRTAs				**14**

Table 23. Non-passenger train PHRTAs

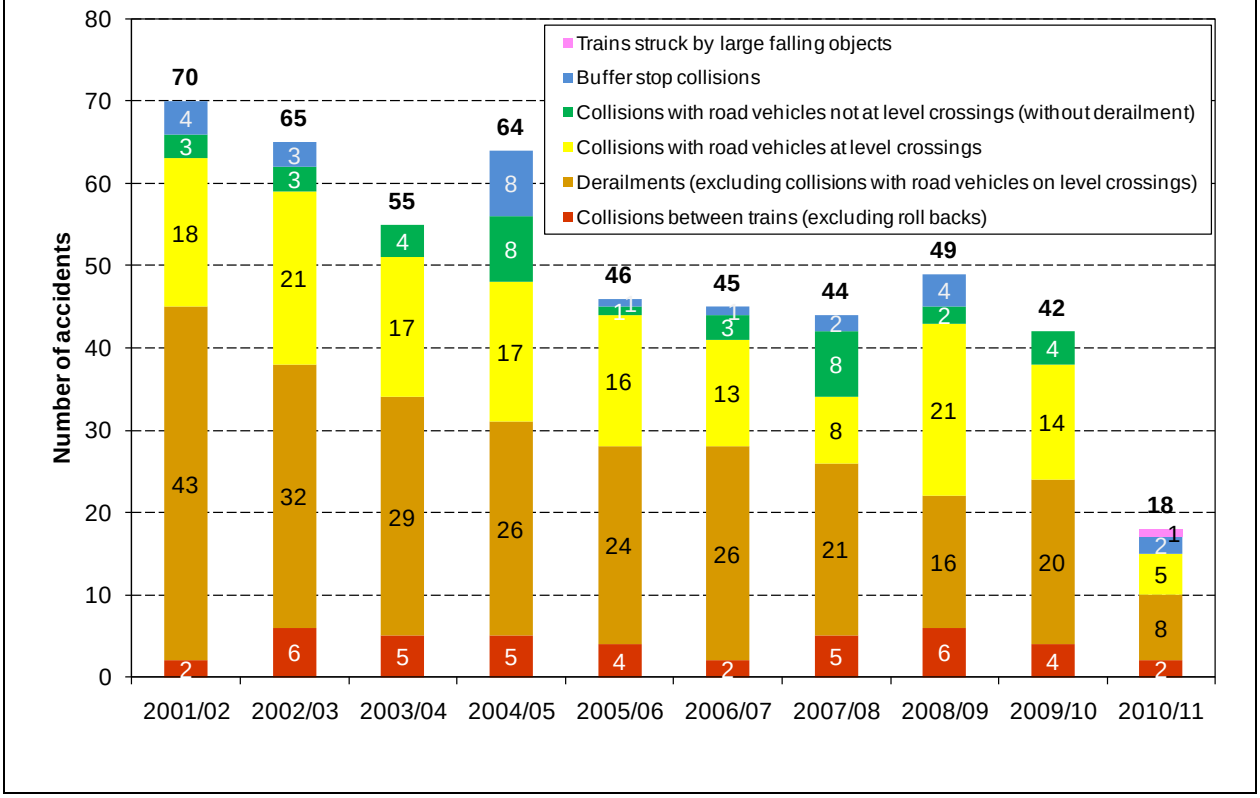
Derailments (excluding level crossings)					3
Date	**Location**	**Territory**	**Train Operator**	**Train Type**	**Description**
11/09/2010	Great Chesterford	South East	DB Schenker	Freight	Derailed after a category A SPAD.
03/12/2010	Grimsby Garden Street	London North Eastern	DB Schenker	Snow plough	Derailed on compacted ice on a level crossing.
23/02/2011	Dalchalm LC	Scotland	DB Schenker	Freight	Derailed in running after the brake assembly came loose on a wagon. The train rerailed itself but caused extensive track damage.
Collisions between trains					**1**
Date	**Location**	**Territory**	**Train Operators**	**Train Type**	**Description**
20/07/2010	Tomatin	Scotland	Hydrex / DB Schenker	RRV / Freight	A road-rail excavator ran away, colliding with a stationary freight train and derailing both.
Buffer stop collisions					**0**
Trains struck by large falling objects					**0**
Collisions with road vehicles on level crossings					**0**
Collisions with road vehicles not at level crossing (excluding derailments)					**0**
Total non-passenger PHRTAs					**4**

- There were 14 passenger train and four non-passenger train PHRTAs in 2010/11. Of the non-passenger train PHRTAs, two involved freight trains, one a snow plough, and one was a collision between a road-rail vehicle and a freight train.
- Six of the PHRTAs were subject to a RAIB investigation.
- RAIB also launched investigations into one other train accident on Network Rail managed infrastructure in 2010/11, as well as a derailment in sidings and three incidents that had the potential to cause a train accident on the main line. These are listed below.
  - On 4 May 2010, five freight wagons ran away from a siding and derailed on trap points at Ashburys, Manchester. The wagons had defective hand brakes and ended up close to (but not fouling) the down goods line, which was closed as a precaution.
  - On 10 July 2010, a passenger train ran into a tree that had fallen onto the track at Lavington. The 90mph collision caused extensive damage to the train cab; the driver suffered a broken wrist.
  - On 8 November 2010, a passenger train encountered poor adhesion conditions and overshot Stonegate station, its intended stop, by almost two-and-a-half miles.
  - On 17 February 2011, a freight train rolled backwards for more than two miles near Shap summit. It appears that the incident was caused by driver fatigue.
  - On 23 March 2011, a train ran over a manually controlled barrier level crossing at Lydney with the barriers in the raised position.

8.5 Trends in potentially higher-risk train accidents

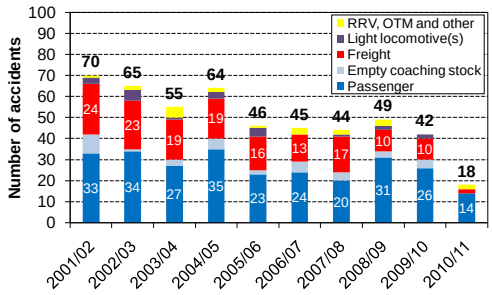
The risk from PHRTAs equates to around 7.8 FWI per year (SRMv7). While PHRTAs comprise the types of train accident that have the greatest potential to result in casualties, the majority result in no injury.

Chart 159. Trends in the numbers of PHRTAs



- The number of PHRTAs in 2010/11 was by far the lowest recorded for any year. Numbers had previously been fairly steady for five years after a period of improvement in the early part of the decade.
- The numbers of derailments, collisions at level crossings, collisions with road vehicles at other locations, and collisions between trains were all at historic lows.
- The number of events in the derailments category reduced to eight,[58] down from 20 in 2009/10.
- There were two collisions between trains – a low-speed collision between passenger trains, and a collision between a runaway road-rail vehicle and a freight train – and two low-speed buffer stop collisions.
- The number of freight train PHRTAs was exceptionally low in 2010/11. There has been a significant long-term reduction in accidents involving freight trains.

Chart 160. PHRTAs by train type



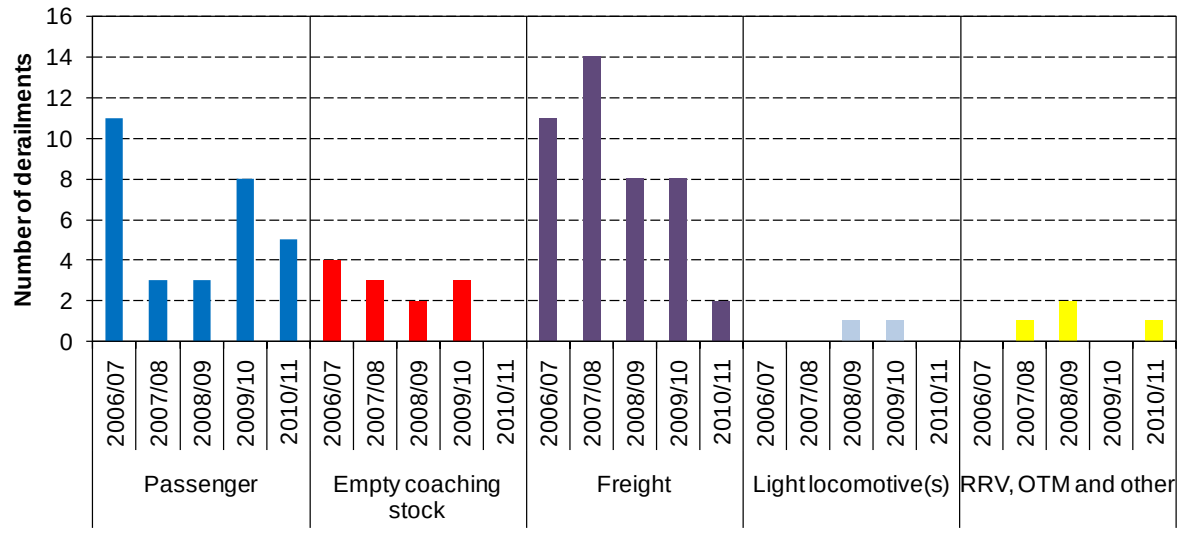
[58] Three events in other categories also resulted in derailments in 2010/11: the accidents at Sewage Works Lane level crossing (*Collisions with road vehicles at level crossings*), Tomatin (*Collisions between trains*) and Oxshott (*Trains struck by large falling objects*).

8.5.1 Derailments

The risk from derailments is estimated by SRMv7 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.[59]

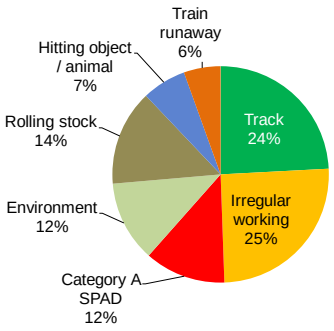
There were eight[60] derailments in 2010/11, which is very low by historical standards.

Chart 161. Trends in derailments by train type over the last five years



- The number of freight train derailments (two) was exceptionally low in 2010/11. Freight train derailments have reduced from a typical rate of around 40-50 per year in the late 1990s. A combination of factors – including improvements in the quality of both track and rolling stock – has contributed to this success.
- Over the last five years, track faults and irregular working have been the main causes of derailment.
- Three of the derailments in 2010/11 resulted from environmental causes:
  - A boulder from a landslip at the Falls of Cruachan (6 June 2010).
  - Compacted ice on Grimsby Garden Street level crossing (3 December 2010).
  - A block of ice that had fallen from a shaft in Summit Tunnel (28 December 2010).

Chart 162. Causes of train derailment (2006/07–2010/11)



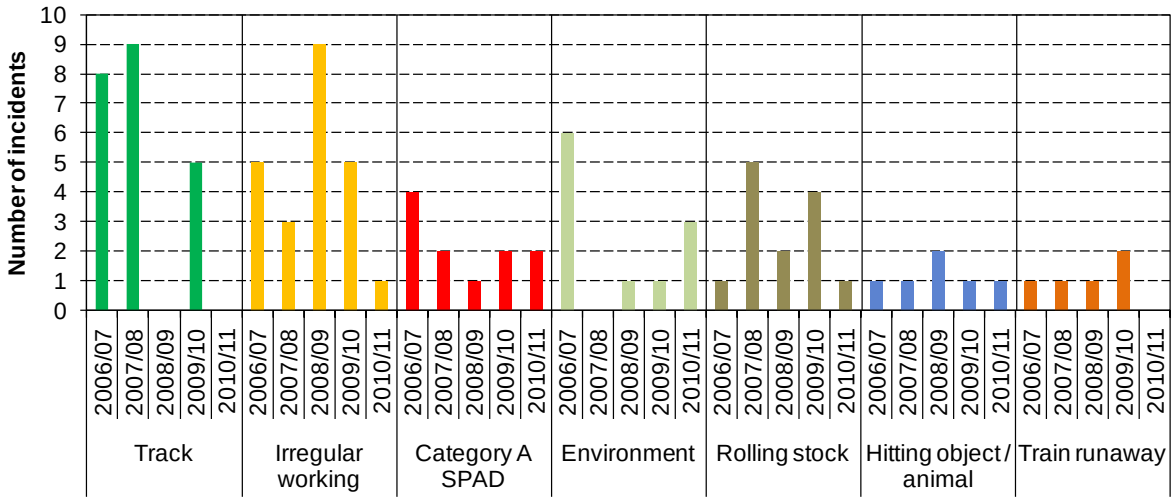
[59] The accident at Ufton, in which the train derailed, does not feature in the analysis in the *Derailments* section because it is classified as a collision with a road vehicle at a level crossing, which was the initiating event. The risk estimate presented at the top of the page similarly excludes the risk from derailments following collisions with road vehicles at level crossings, collisions between trains, and trains being struck by large falling objects.

[60] Like the Ufton accident in 2004/05 (see the above footnote), the accidents at Sewage Works Lane level crossing, Tomatin and Oxshott in 2010/11 do not feature in the analysis in the *Derailments* section because – in accordance with their initiating events – they are classified under different categories.

Causes of derailments

Chart 163 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 163. Trends in derailments by cause



- A wide range of causes contributes to derailment risk.
- The number of track-related derailments has fallen over recent years. There were no track-related derailments in 2010/11 compared with five in 2009/10.
- Around 40% of track-related derailments over the past five years have occurred 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. There was one such event reported in 2010/11. This occurred on 24 November 2010 at Welshpool, when the signaller and a driver carrying out a reversing move failed to reach a clear understanding as to the position of the train relative to a set of self-operating points.
- The most common cause of irregular working-related derailments is signaller error (for example, authorising movements over points that have not been correctly set or moving points underneath the train).

Chart 164. Track-related derailments (2006/07–2010/11)

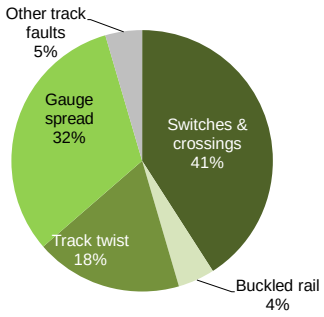
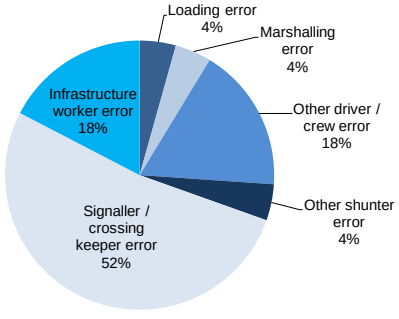


Chart 165. Irregular working derailments (2006/07–2010/11)

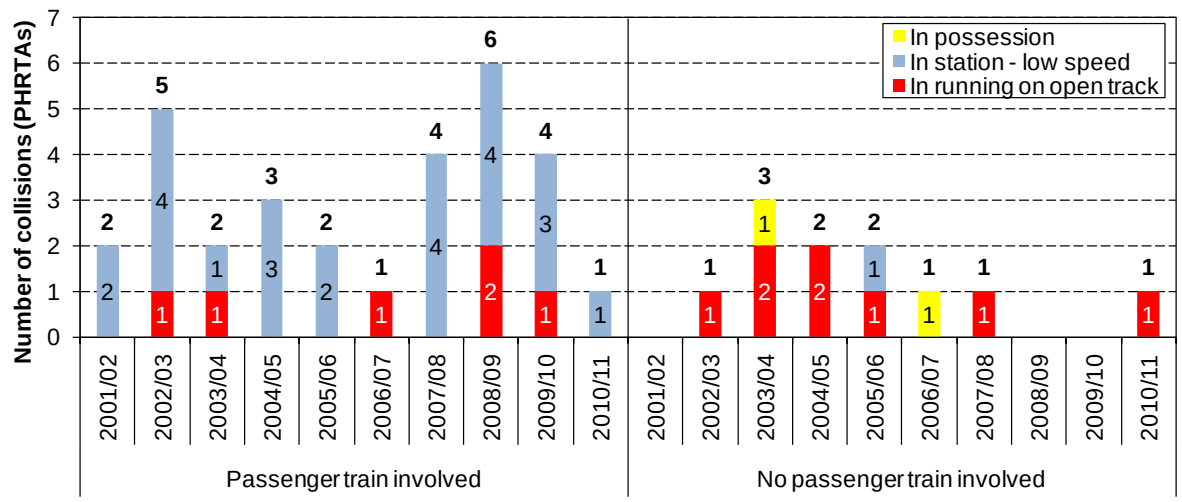


8.5.2 Collisions between trains

The risk from collisions between trains is estimated by SRMv7 to be 1.3 FWI per year. Roll back and open door collisions (each of which accounts for a risk of less than 0.01 FWI per year) are excluded from this section, but are covered in section 8.6.

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 the last decade significantly reduced the risk from collisions caused by SPADs, but the potential for a serious accident remains.

Chart 166. Trends in collisions between trains by collision type and location



- There were two collisions in 2010/11. This is fewer than the previous year, and below the annual average (4.1) for the period shown on the chart.
- One collision occurred at low speed during permissive working in a station:
  - On 29 April 2010, the driver of a Class 142 unit misjudged the required braking and collided at low speed with a train already in the platform at Manchester Airport. Conditions were damp but not exceptional. There were no reported injuries other than shock to the driver.
- The other collision was between a road-rail vehicle and a freight train:
  - On 20 July 2010, a road-rail excavator ran away after being placed on the track at Tomatin (near Raigmore). Its operator remained on board, attempting to use the machine's jib to stop it, but it continued for three-quarters of a mile on a downward gradient, passing a signal at danger and leaving the possession. It eventually collided with the rear wagon of a stationary freight train. Both the excavator and wagon derailed, and the road-rail machine's operator was thrown out of the cab and sustained major arm and head injuries.

8.5.3 Collisions between trains and road vehicles

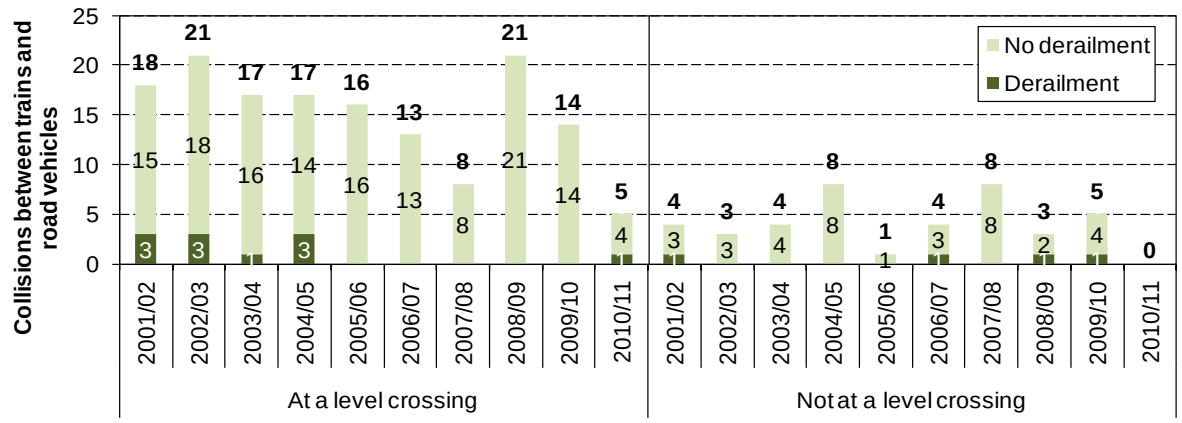
The risk from collisions between trains and road vehicles is estimated by SRMv7 to be 3.8 FWI per year.[61] Accidents at level crossings account for 90% of this. Most of the risk is to road vehicle occupants rather than to people on the train.

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).

There were no fatalities from accidents of this type in 2010/11, but collisions between train and road vehicles at level crossings caused six major injuries.[62]

- On 17 August 2010, five train occupants suffered major injuries (and all remaining 16 people on board received minor injuries) when a passenger train derailed after striking a sewage tanker at Sewage Works Lane user-worked level crossing near Sudbury.
- On 3 July 2010, a boy suffered major head injuries when the road vehicle he was in was struck by a train at Beccles user-worked crossing.

Chart 167. Trends in trains striking road vehicles



- The train involved in the accident at Sewage Works Lane level crossing was the first to derail following a level crossing accident since December 2004.
- Over the past ten years there have been 150 collisions with road vehicles at level crossings (15.0 per year on average) and 40 collisions at other locations (4.0 per year).
- The numbers of collisions with road vehicles both at and away from level crossings were very low in 2010/11. Because the annual numbers are fairly small, it is not easy to differentiate trends from statistical fluctuations. However, there is some evidence that the underlying rate of level crossing collisions has reduced. For example, there were 61 accidents from 2006/07 to 2010/11 compared with 89 in the previous five-year period.
- For more detailed analysis see Chapter 9, *Risk at the road-rail interface*.

[61] This excludes the risk from derailments that result from trains striking road vehicles at locations other than level crossings, which are covered under the *derailment* category. It also excludes the risk from road vehicles falling onto trains (as opposed to running into the side of them or being struck by them): these events are covered under the category *struck by large falling object* – see the footnote below.

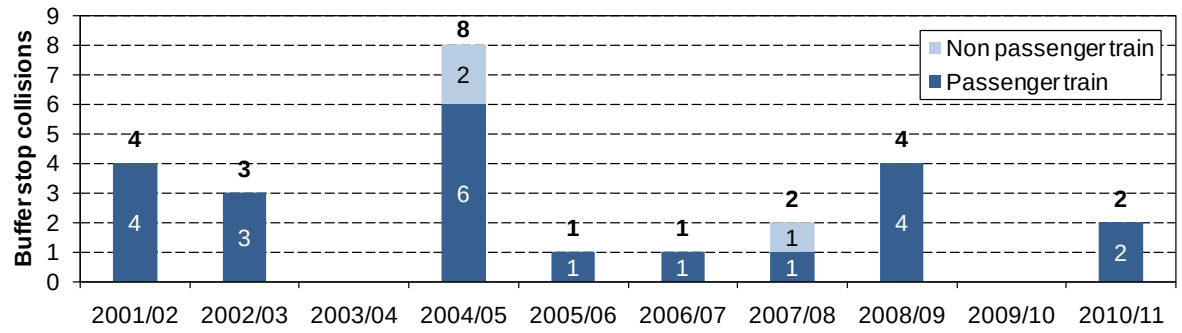
[62] The accident at Oxshott, in which a cement lorry fell from a road-over-rail bridge on top of a passing train, also resulted in two major injuries to passengers. However, because the lorry landed on top of the train rather than the train running into it, it is categorised as *struck by large falling object* and not covered in this section.

8.5.4 Buffer stop collisions

The risk from buffer stop collisions is estimated by SRMv7 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 168. Buffer stop collisions



- There were two RIDDOR-reportable buffer stop collisions in 2010/11:
  - On 23 April 2010, a driver left his final brake application too late and collided with the buffer stops at Skipton. The impact speed was between one and two mph.
  - On 24 June 2010, a train driver arriving at Liverpool Lime Street applied emergency braking from a low speed and contacted the buffer stops as the train came to a stand. It was alleged the service brake was unresponsive but testing revealed no fault.
- Neither accident resulted in injury.
- The main cause of buffer stop collisions is driver error, usually involving 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. Britain's most recent RID-reportable[63] 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 2010/11, and no potentially higher-risk train accidents involving dangerous goods trains.

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 risk.

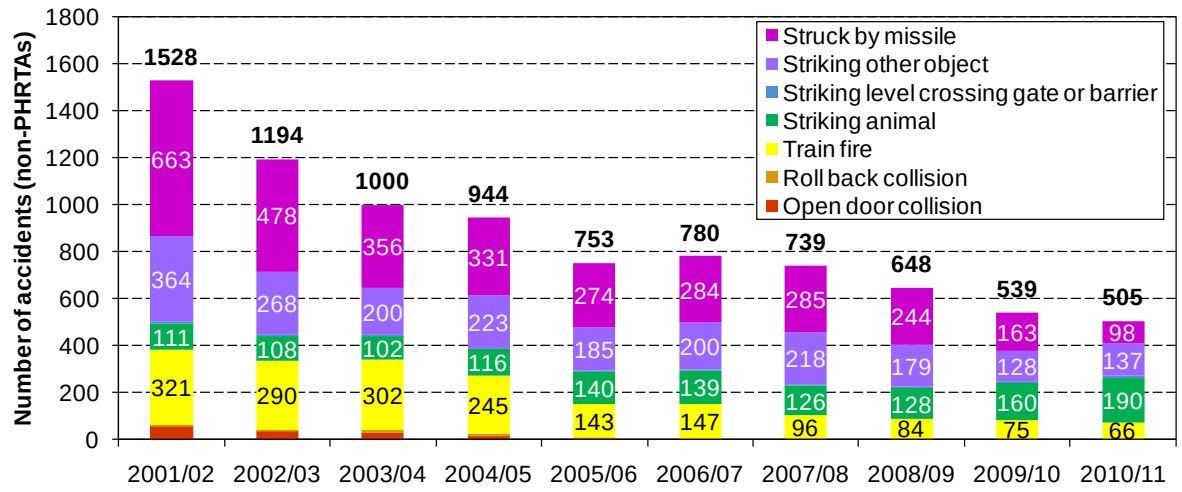
[63] RID refers to the Regulations Concerning the International Carriage of Dangerous Goods by Rail.

8.6 Other train accidents

SRMv7 estimates the risk from types of train accident other than PHRTAs to be relatively low, at 0.5 FWI per year. Trains struck by missiles account for around 40% 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. The risk from fires has reduced significantly in recent years, largely because of the increased use of fire-resistant materials.

Chart 169. 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 85% since 2001/02, and fell again last year. This reflects a general reduction in vandalism (see section 7.5) and the laminated glass that is used on modern rolling stock.[64]
  - There were 15 minor injuries as a result of missiles thrown at trains in 2010/11. Some of these had the potential for serious harm, including a stone slab that smashed a train windscreen after being pushed from a bridge near Bradford Interchange, and an exploding object that was thrown at a train near Bidston, partially deafening the driver.
- Along with missile strikes, 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. There were no open door collisions in 2010/11, compared with 54 in 2001/02.
- The only category of non-PHRTA train accident not to show a downward trend is collisions with animals on the line, which increased again in 2010/11. There were four cases of driver shock after animal or bird strikes in 2010/11, but train occupants are rarely physically injured in such accidents. However, in 1984, a collision with a stray cow on the line at Polmont resulted in a derailment that caused 13 passenger fatalities.

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

8.7 Trends in train accident precursors

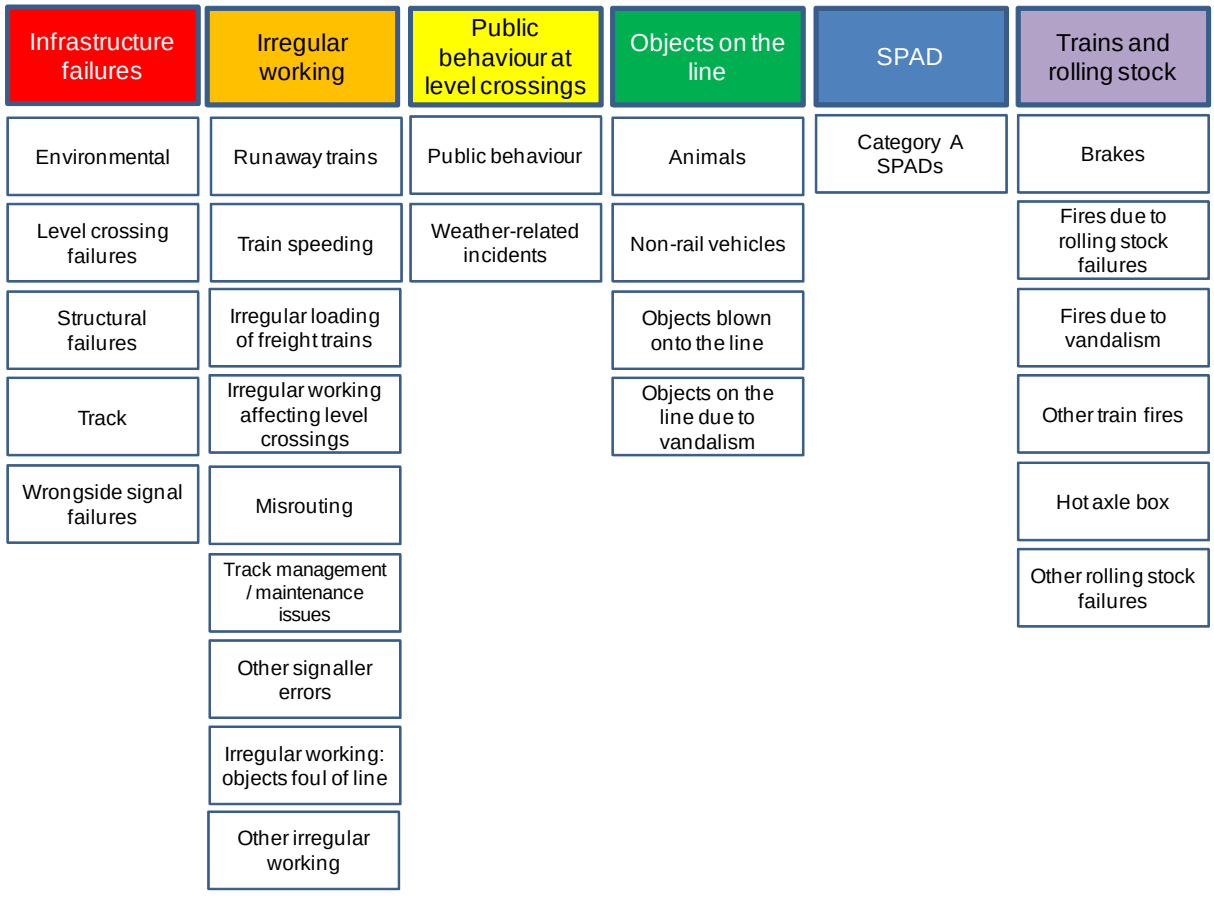
8.7.1 The Precursor Indicator Model

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 fires and train collisions, including those with other trains, buffer stops and road vehicles (both at and not at level crossings). The precursors covered by the PIM fall into six main groups, encompassing 27 separate subgroups and 45 lower level groups. The irregular working and SPAD components of the PIM model were updated in early 2010 to incorporate risk ranking information, and the PIM has now been realigned to SRMv7.

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

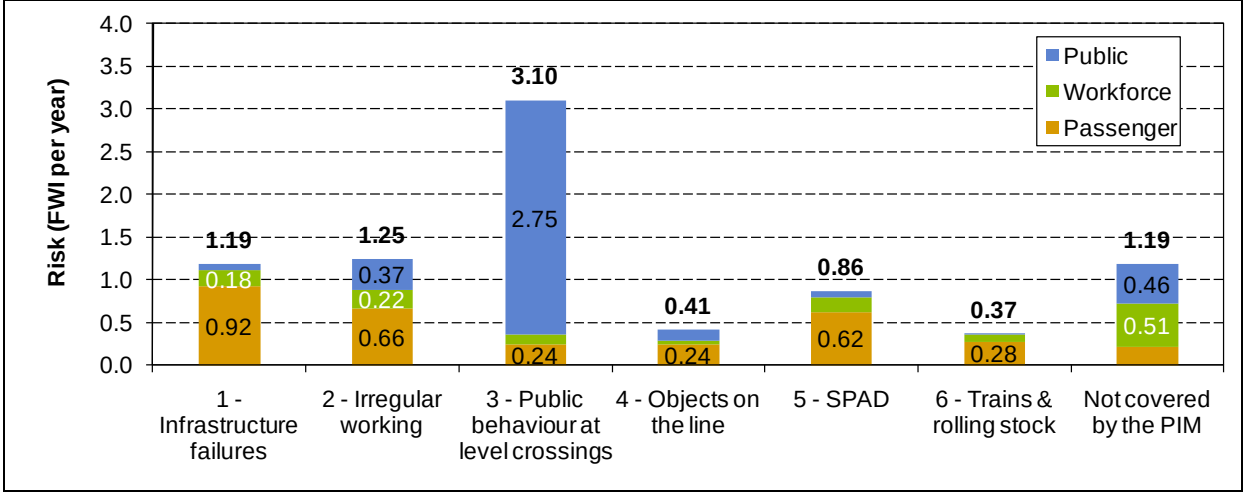
risk = frequency x consequence

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 consequence 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.[65] 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 170 shows the contribution to train accident risk from each PIM group (based on SRMv7).

Chart 170. Train accident risk by PIM group and person type (SRMv7)



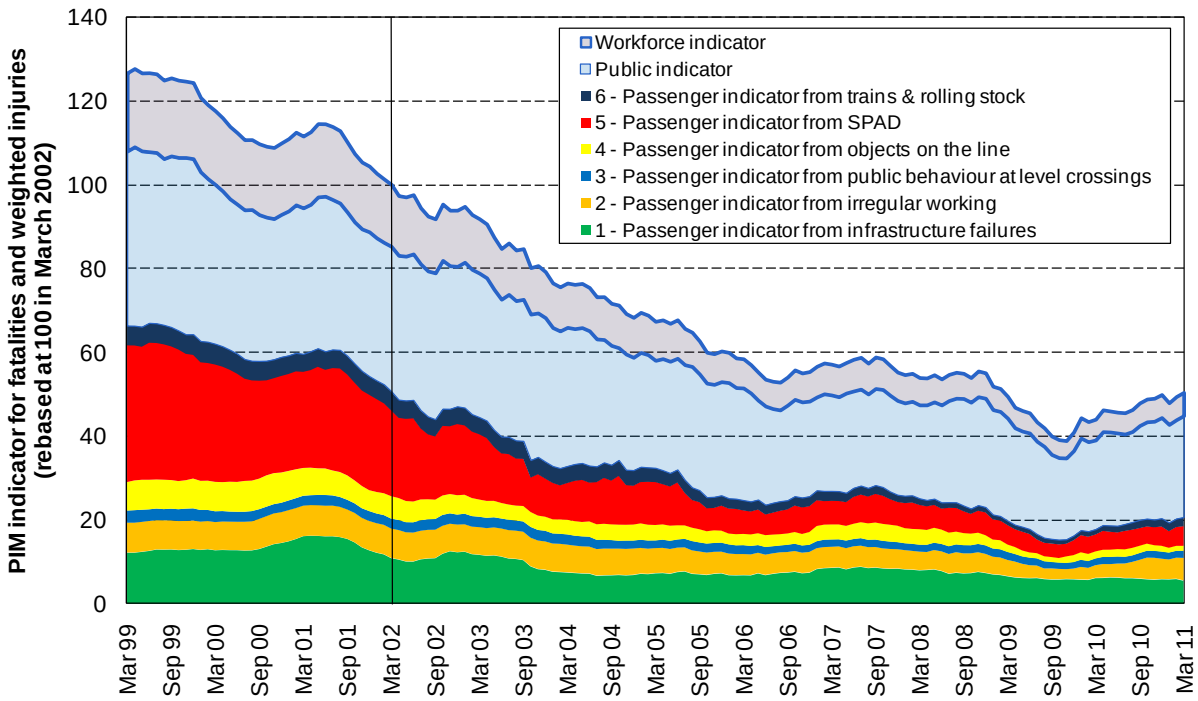
- While public behaviour at level crossings contributes most to overall risk, it has a relatively low impact on passenger and workforce safety.
- The largest contribution to passenger risk comes from infrastructure failures.

[65] A slightly different approach is taken for SPADs and irregular working. The PIM indices for these groups are based on the risk ranking scores assigned to relevant events over the previous 12 months. See pages in this section on *Irregular working* and *SPADs* for more information on how these events are risk ranked.

8.7.2 Trends in the PIM indicator

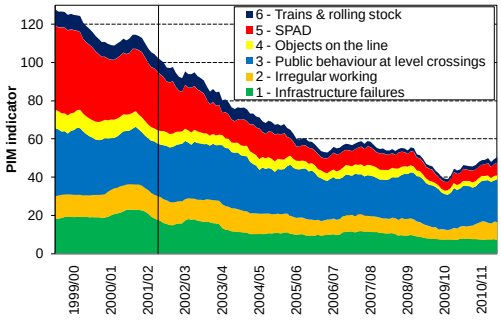
In previous years, the main PIM chart has been based on the combined level of risk to all parties (passengers, workforce and members of the public). Chart 171 shows the same overall PIM indicator (the topmost line) but highlights the risk to passengers.

Chart 171. Trends in overall train accident risk and risk to passengers from train accidents



- There has been an increase in train accident risk as measured by the PIM over the past year, although it remains low by historical standards. This applies both to the overall indicator, and the indicator of passenger risk.
- The chart shows that the largest reduction in passenger risk has occurred in the SPAD group over the past decade. This is largely due to the introduction of TPWS. Other sources of risk, such as infrastructure failures and irregular working, have also reduced.
- The mini chart shows the risk to all person types, as measured by the PIM. Public behaviour at level crossings accounts for a much greater share of the risk when harm to members of the public is taken into account.
- There has been relatively little change in the risk from public behaviour at level crossings, which – being outside the *direct* control of the railway – has proved relatively difficult to reduce.

Chart 172. PIM indicator – all risk



Trends in the subgroups of the PIM

The following table shows how individual PIM subgroups have changed over time.

Table 24. Changes in the PIM indicator by precursor group

	March 2007	March 2008	March 2009	March 2010	March 2011
PIM indicator value	**57.2**	**54.0**	**49.5**	**44.0**	**50.4**
1 - Infrastructure failures	**11.5**	**10.6**	**8.5**	**7.8**	**7.1**
Environmental	2.6	3.3	2.3	2.5	1.2
Level crossing failures	0.5	0.4	0.4	0.3	0.3
Structural failures	3.1	2.5	1.0	0.7	1.4
Track	4.6	3.4	3.2	2.9	3.2
Wrongside signal failures	0.8	0.9	1.5	1.3	1.0
2 - Irregular working	**8.7**	**7.8**	**7.0**	**6.4**	**9.5**
Irregular loading of freight trains	0.0	0.1	0.1	0.2	0.0
IW - affecting level crossing	2.8	2.9	2.9	1.8	3.1
IW - objects foul of the line	0.2	0.2	0.3	0.1	0.3
IW - other	1.6	1.4	1.0	0.4	0.7
IW - other signaller errors	0.3	0.2	0.2	0.1	0.4
IW - routing	0.6	0.4	0.3	0.3	0.1
IW - track issues	1.1	1.2	1.2	0.4	2.3
Runaway trains	1.9	1.2	1.0	2.5	2.2
Train speeding	0.1	0.2	0.2	0.7	0.3
3 - Public behaviour at level crossings	**21.0**	**20.1**	**23.4**	**19.9**	**22.2**
Public behaviour	20.7	19.0	22.7	19.4	19.9
Weather-related incidents	0.3	1.1	0.6	0.5	2.2
4 - Objects on the line	**5.0**	**5.2**	**2.6**	**2.5**	**2.3**
Animals	0.4	0.3	0.2	0.1	0.2
Non-rail vehicles	1.7	1.7	0.8	0.7	1.4
Objects blown onto the line	1.7	1.7	1.3	1.5	0.7
Objects on the line due to vandalism	1.2	1.5	0.3	0.1	0.1
5 - SPAD	**7.9**	**8.1**	**6.5**	**5.6**	**6.5**
Category A SPAD	7.9	8.1	6.5	5.6	6.5
6 - Trains & rolling stock	**3.1**	**2.2**	**1.5**	**1.8**	**2.8**
Brakes	0.3	0.1	0.0	0.0	0.3
Fires due to rolling stock failures	0.7	0.5	0.4	0.4	0.4
Fires due to vandalism	0.5	0.3	0.2	0.1	0.1
Hot axle box	0.1	0.1	0.1	0.1	0.0
Other rolling stock failures	1.4	1.2	0.6	1.0	1.9
Other train fires	0.2	0.1	0.2	0.2	0.1

- The overall PIM indicator increased from 44.0 at the end of 2009/10 to 50.4 at the end of 2010/11.
- There were reductions in two of the six PIM groups:
  - *Infrastructure failures*: due to a reduction in flooding and landslips.
  - *Objects on the line*: due to a reduction in the risk from objects blown onto the line.
- The indicator for the other four groups increased.

Reasons for the increase in the PIM measure

- The largest increase was in *irregular working*, which reached its highest level since 2005. This was due to a higher proportion of events being ranked potentially significant or potentially severe than in previous years,[66] an increase in the number of reports of irregular working by signallers, and irregular working affecting level crossings returning to its former level (after a relatively low number of reports in 2009/10).
- The increase in risk from *public behaviour at level crossings* came mostly from weather related issues: there was a relatively high incidence of these events in the winter of 2010/11 and the SRM-modelled risk also increased.
- The increased risk attributable to *trains and rolling stock* has arisen largely as a result of a greater number of reports of train defects from one operator. Because this precursor is relatively rare, a small number of events can have a substantial effect on modelled risk. Work is ongoing to determine whether the increase represents a genuine increase in risk, or a change in reporting practice.
- Smaller increases were seen in a number of other areas including Category A SPADs (see the *SPAD risk* section for more information) and non-rail vehicles on the line (largely due to an increase in the SRM-modelled risk).

Comparing the PIM index with other measures of train accident risk

While the PIM rose in 2010/11, the number of PHRTAs reduced significantly. The total number of RIDDOR-reportable train accidents also reduced.

- As the number of PHRTAs declines, the statistical variation from one year to the next becomes greater (in relative terms). Nevertheless, the reduction from 42 in 2009/10 to 18 in 2010/11 is statistically significant, and RSSB does not believe the reduction is an artefact of changes in reporting or interpretation.
- Changes in the total number of RIDDOR-reportable accidents are unlikely to accurately reflect changes in train accident risk, because many of them are relatively low risk events. Although PHRTAs form a subset of accidents with a high average consequence, it is also unlikely that changes in their overall frequency will be proportional to changes in risk.
- The PIM aims to provide a robust assessment of changes in train accident risk by tracking frequently occurring precursors, and mapping frequencies to risk using information on average consequences. Nevertheless, some components of the PIM are sensitive to a relatively small number of incidents, and the available precursors may not always correlate directly with the risk they are used to track. RSSB continues to examine the PIM precursors to ensure they remain a good and consistent indicator of train accident risk.
- The SRM provides the most thorough assessment of train accident risk, but is only updated every two-to-three years. The overall SRM estimate of train accident risk remained largely unchanged between SRMv6.5 and SRMv7.
- Overall, the PIM provides the best measure of ongoing changes in train accident risk. It may not always be consistent with changes in number of PHRTAs because – in a given year – there is a degree of fortune in which precursors materialise into train accidents.[67]

[66] See the *Irregular working* section for more information on risk ranking. There is not thought to have been any systematic change in the process of assigning risk ranking scores that would explain the increase in average ranking in 2010/11.

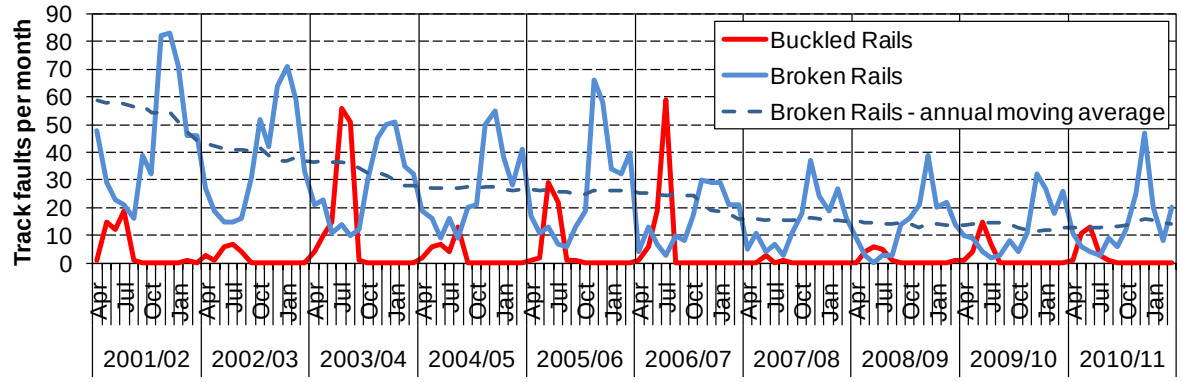
[67] Similarly, in 2010/11, the overall number of reported derailments did not change substantially from the previous year. However, a greater proportion fell outside the definition of what is reportable under RIDDOR (and thus constitutes a PHRTA) – primarily because the derailed portion of the train was not fouling a running line.

8.7.3 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 173) and level 2 exceedences (a measure of track faults per mile, shown on the *Precursors* key safety facts table at the end of this chapter).

Chart 173. Trends in track failures



- 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.
  - December 2010, which was exceptionally cold, recorded the highest number of broken rails (47) in any month since 2005.
- There has been a significant long-term reduction in the number of broken rails, which – notwithstanding the exceptional weather in December – has remained at a fairly static annual level for the past four years. Substantial improvements 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.

Infrastructure failure or design was a factor in three PHRTAs in 2010/11:

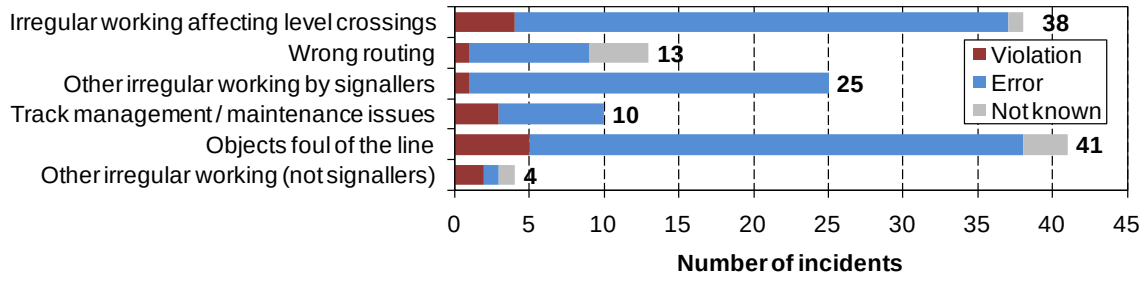
- The boulder that derailed a train near the Falls of Cruachan on 6 June 2010 fell from within Network Rail's boundary. A system installed to warn drivers of fallen boulders did not help because it is only operated by rocks falling from outside the railway boundary.
- The large block of ice that derailed a train in Summit Tunnel on 28 December 2010 fell from a ventilation shaft. The severe weather of January, February and December 2010 (and subsequent thaws) caused a number of incidents involving ice in tunnels.
- The derailment near Bankhouse Tunnel on 5 February 2011 was caused by the collapse of a retaining wall.

Another noteworthy (non-PHRTA) accident took place on 11 July 2010 near Slough. A train ran into an insulator hanging down from the overhead line equipment, which punched a hole in the cab beneath the windscreen. The driver was not physically injured, but suffered shock.

8.7.4 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. In 2010/11, there were 131 of these incidents that had the potential to result in a train accident and were ranked as being potentially significant or potentially severe.[68] Chart 174 shows the number of events in each of the PIM sub-groups, broken down by whether the act of irregular working was primarily an error or a violation.

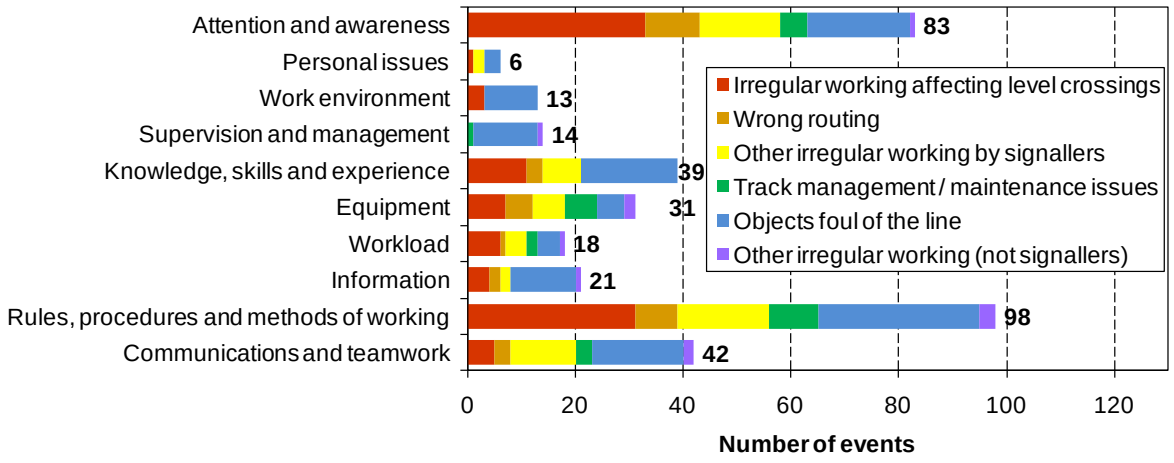
Chart 174. Potentially significant or severe irregular working incidents in 2010/11



- Irregular working on level crossings and objects foul of the line accounted for most of the potentially severe and significant events in 2010/11 (as in 2009/10).
- Errors are much more common than violations.

Chart 175 shows, for each of ten different factors, the number of events in which they were relevant. Several factors may be relevant to a single event.

Chart 175. Causal factors in irregular working incidents in 2010/11



- Weaknesses in or non-compliance with rules, procedures or methods of working was a factor in around three-quarters of the potentially significant or severe events.
- The majority of incidents also involved some deficiency in attention and awareness.

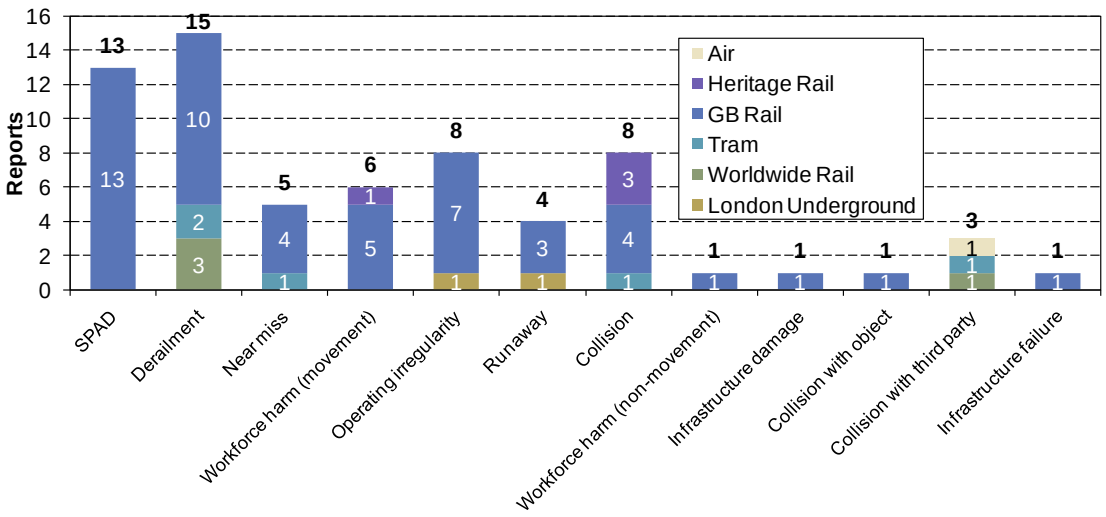
[68] Risk ranking of irregular working events is carried out by Network Rail. After an initial filter to remove those that carry no risk, the remaining events are risk ranked into one of four categories: negligible risk, low risk, potentially significant and potentially severe, based on the potential for the event to lead to an accident and the potential consequences of the accident if it had occurred. Only those irregular working events that are judged to have had the potential to cause a train accident contribute to the PIM.

Exploring contributory and underlying accident causes

Accident investigations often identify underlying human, organisational or procedural weaknesses, even if the immediate cause is a technical fault. For example, the primary cause of the derailment at Ashburys in 4 May 2010 (off NRMI) was brake failure, but the RAIB investigation also identified maintenance plans, testing processes and procedures for detaching wagons as possible contributory/underlying factors. It also identified as a contributing factor the '*lack of a system for the rail industry to be made aware of safety information concerning equipment arising from its use in other industries'*.

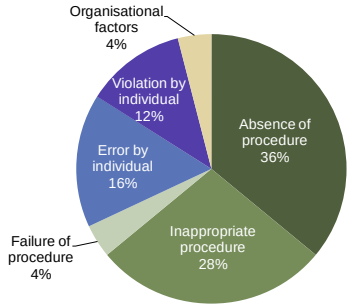
As part of its Learning from Operational Experience programme, RSSB has developed an Incident Causal Classification System, based on the classification scheme used by RAIB, to analyse incident reports. This covers RAIB reports, formal inquiries and local investigations,[69] as well as reports from other countries and industries. Chart 176 shows – based on the 370 reports in the Incident Causal Classification Scheme at 31 December 2010 – the types of accident for which weakness in procedures and/or the way in which procedures were implemented were identified as primary, contributory or underlying causes.

Chart 176. Reports identifying weaknesses in procedures and/or their implementation



- Weaknesses in procedures or in the way in which procedures are implemented contribute to a wide range of accidents from different industries.
- Chart 177 shows that, when investigations cite causal factors that relate to procedures, it is most frequently because procedures are lacking (36%) or not appropriate for the task (28%).
- For more information about the Incident Causal Classification System, see the Learning from Operational Experience Annual Report 2010: http://www.rssb.co.uk/LEARNING/OPFeedbackSumm/Pages/AnnualReports.aspx.

Chart 177. Breakdown of causes related to procedures and their application

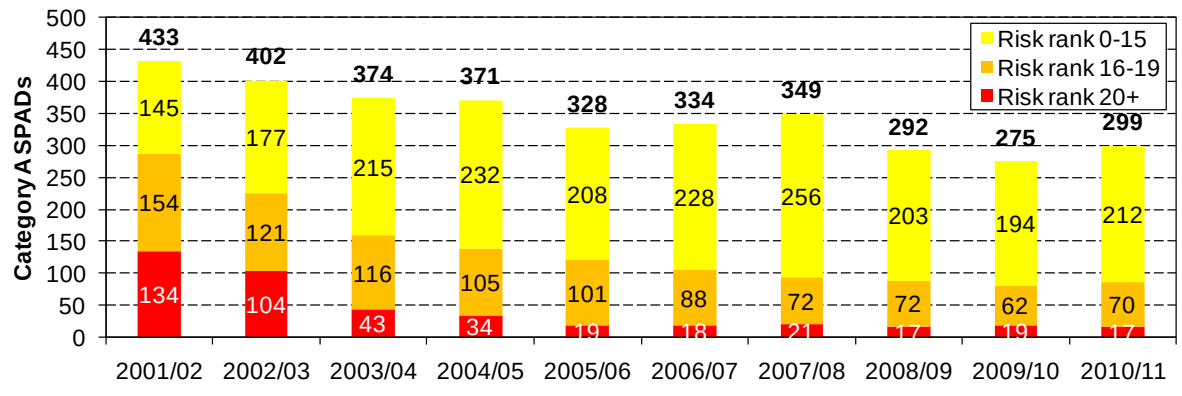


[69] RSSB receives investigation reports from all railway organisations, which is mandatory under Railway Group Standard GO/RT3119.

8.7.5 SPADs

On 30 January 2011, a freight train passed a signal at danger and collided with a passenger train near Magdeburg, Germany. Eleven people were killed, making this Europe's worst train accident of 2010/11. Historically, train accidents resulting from category A SPADs have also resulted in high numbers of fatalities and injuries in Britain. The last fatal accident from this cause occurred at Ladbroke Grove in 1999; 31 people lost their lives. The industry subsequently focused much effort on reducing the risk from SPADs. An important strand of work was the TPWS fitment programme, 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 178. Trend in the number of SPADs by risk ranking score[70]



- There were 299 SPADs in the year to the end of March 2011, compared to 275 for the corresponding period one year ago.
- There was a significant reduction in the number of SPADs with a high risk ranking after the introduction of TPWS in 2003/04. The numbers ranked 16+ (potentially significant) and 20+ (potentially severe) have remained fairly static for the past four years.

The SPAD with the highest risk ranking (26) in 2010/11 occurred at Uphill Junction on 20 December. A passenger train, formed by an HST set, passed the signal at danger by 380 yards, running through a crossover fitted with High Performance Switch System points, but not derailing. An Urgent Operating Advice notice (issued under GO/RT 3350) was subsequently raised, which advised that the build up of ice and snow underneath the train had impeded its braking performance, 'despite the undertaking of the laid down brake gear de-icing tasks prior to the train entering service that morning'.

Two trains derailed after passing signals at danger in 2010/11:

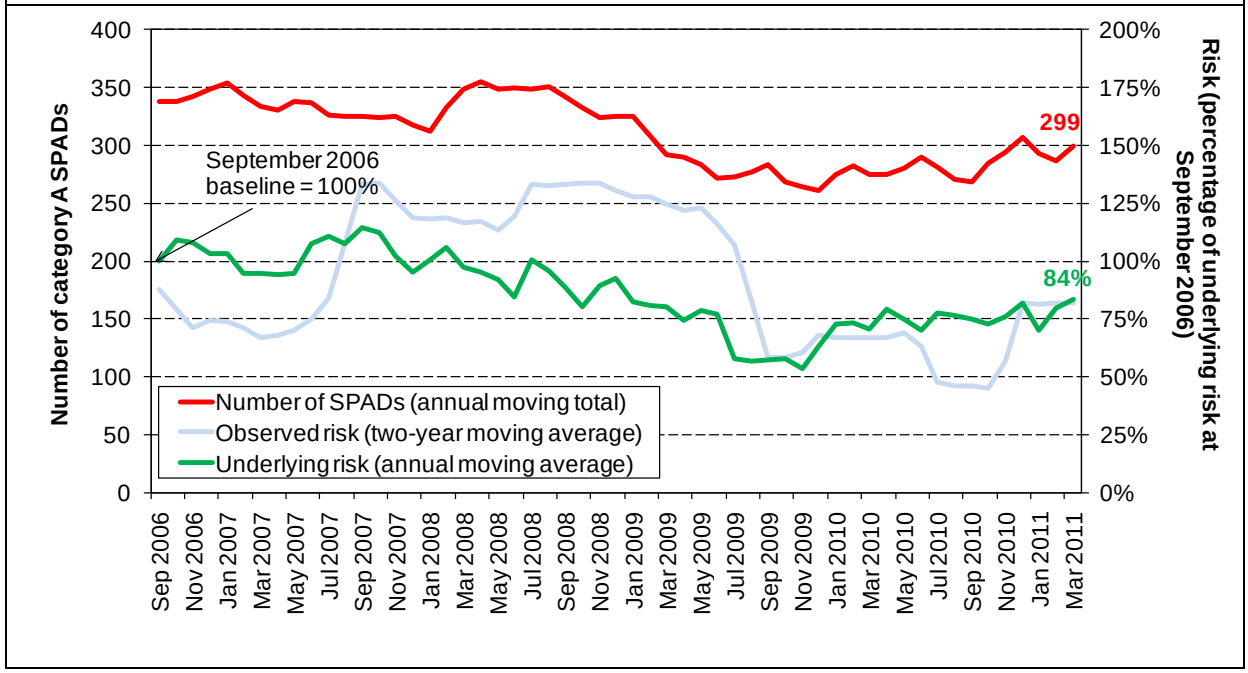
- On 28 August 2010, a passenger train departed from Guildford against a signal at danger. TPWS intervened to apply the brake but the train derailed on points.
- On 11 September 2010, the leading bogie of a freight train derailed after it passed a signal at danger near Great Chesterford. Distraction (caused by spilling coffee) and fatigue were cited as potential contributory factors.

[70] 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).

SPAD risk

RSSB uses results from the SPAD risk ranking process to assess trends in SPAD risk. In July 2010, the industry adopted a new method for estimating SPAD risk. This method (used to produce the line labelled *underlying risk* in Chart 179) provides a more stable estimate of the true risk than the old method (labelled *observed risk*), which is an aggregation of the risk associated with each of the individual SPADs that occurred over the previous two years.[71] At the same time, the baseline date was reset to September 2006, after the introduction of TPWS and the removal of Mark I rolling stock.

Chart 179. Trend in SPADs and SPAD risk

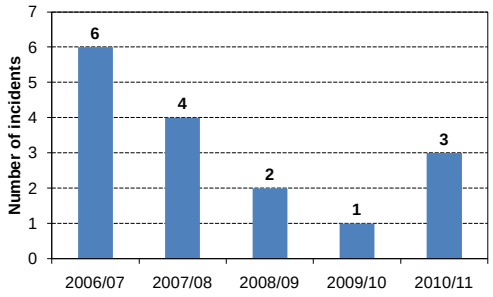


- At the end of the year, the estimated level of SPAD risk was 16% lower than it was in September 2006.
- The estimated level of risk rose slightly during the year, but by a small amount that is well within the expected statistical variation of the estimation method.

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 had fallen.
- However, there were three TPWS reset & continue incidents in 2010/11, which represents an increase on the previous two years.

Chart 180. TPWS reset and continue



[71] The old method (observed risk) is no longer used in routine SPAD performance reporting.

8.7.6 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.

Three derailments resulted from trains striking objects that had fallen onto the line in 2010/11 (a boulder, a block of ice and a retaining wall), and the accident near Oxshott on 5 November 2010 was caused by a cement lorry crashing through a road-over-rail bridge and landing on a train.

The accident at Lavington on 10 July 2010, in which the train driver suffered a broken wrist, was caused by a tree that had fallen onto the line from farm land adjacent to the railway. Another accident in which a train struck a tree near Knaresborough on 10 March 2011 resulted in two passengers receiving minor injuries.

The PIM measure of risk associated with objects on the line fell slightly in 2010/11.

8.7.7 Public behaviour at level crossings

Most of the risk from train accidents at level crossings affects road users whose vehicles are involved in collisions with trains. SRMv7 indicates that around 90% of the train accident risk at level crossings derives from the behaviour of road users (rather than workforce errors or equipment failures).

The PIM measure of risk from public behaviour at level crossings increased during 2010/11, largely as a result of a rise in weather-related incidents. See Chapter 9 for more information on risk at the road-rail interface.

8.7.8 Trains and rolling stock

According to SRMv7, trains and rolling stock defects contribute the smallest amount of train accident risk out of the six PIM groups. Nevertheless, they have the potential to cause serious accidents. One derailment on NRMI in 2010/11 resulted from rolling stock failure:

- On 23 February 2011, the brake assembly came loose below a wagon on a freight train, causing damage to 10 miles of track and derailing the wagon (which subsequently rerailed itself) when the projecting components struck a cattle grid at a level crossing.

Defective hand brakes also caused five freight wagons to run away from sidings at Ashburys on 4 May 2010; they derailed close to (but not fouling) the running line.

The last fatality from a rolling stock defect in Great Britain occurred at Rickerscote in 1996. A freight train derailed when an axle fitted to one of its wagons completely fractured. It was struck by a Post Office train running in the opposite direction, killing a Royal Mail employee.

The PIM measure of risk associated with trains and rolling stock increased in 2010/11. Much of the change is attributable to one operator reporting an increased number of defects. Work is ongoing to determine whether this represents a change in reporting practice, or a real change in risk.

8.8 Train accident key safety facts[72]

Train accidents	2006/07	2007/08	2008/09	2009/10	2010/11
Fatalities (excluding suicides)	**5**	**0**	**2**	**7**	**0**
Passengers	1	0	0	0	0
Workforce	0	0	0	0	0
Members of the public	4	0	2	7	0
Weighted injuries (excluding suicides)	**4.21**	**0.97**	**0.57**	**1.18**	**1.32**
Passengers	3.28	0.12	0.03	0.39	0.72
Workforce	0.82	0.63	0.33	0.57	0.50
Members of the public	0.10	0.21	0.21	0.21	0.10
Total train accidents	**825**	**783**	**697**	**581**	**523**
PHRTAs	**45**	**44**	**49**	**42**	**18**
Involving passenger trains	24	20	31	26	14
Collisions between trains	1	4	6	4	1
Derailments	11	3	3	8	5
Collisions with road vehicles (not at LC)	2	5	0	2	0
Collisions with road vehicles (at LC)	9	7	18	12	5
Striking buffer stops	1	1	4	0	2
Struck by large falling object	0	0	0	0	1
Not involving passenger trains	21	24	18	16	4
Collisions between trains	1	1	0	0	1
Derailments	15	18	13	12	3
Collisions with road vehicles (not at LC)	1	3	2	2	0
Collisions with road vehicles (at LC)	4	1	3	2	0
Striking buffer stops	0	1	0	0	0
Struck by large falling object	0	0	0	0	0
Non-PHRTA train accidents	**780**	**739**	**648**	**539**	**505**
Involving passenger trains	665	621	552	471	443
Open door collisions	2	3	3	1	0
Roll back collisions	4	3	2	4	4
Striking animals	126	112	116	144	169
Struck by missiles	221	225	198	141	90
Train fires	136	87	73	69	57
Striking level crossing gates/barriers	3	4	6	2	7
Striking other objects	173	187	154	110	116
Not involving passenger trains	115	118	96	68	62
Open door collisions	0	0	0	1	0
Roll back collisions	0	0	0	0	2
Striking animals	13	14	12	16	21
Struck by missiles	63	60	46	22	8
Train fires	11	9	11	6	9
Striking level crossing gates/barriers	1	4	2	5	1
Striking other objects	27	31	25	18	21
PIM index (at year end)	**57.2**	**54.0**	**49.5**	**44.0**	**50.4**
Infrastructure failures	11.5	10.6	8.5	7.8	7.1
Irregular working	8.7	7.8	7.0	6.4	9.5
Public behaviour at level crossings	21.0	20.1	23.4	19.9	22.2
Objects on the line	5.0	5.2	2.6	2.5	2.3
Signals passed at danger	7.9	8.1	6.5	5.6	6.5
Trains and rolling stock	3.1	2.2	1.5	1.8	2.8

[72]The category *collisions with road vehicles (not at LC)* excludes accidents that result in a derailment; these incidents are included in the *derailments* category. Similarly the *derailments* category excludes derailments resulting from *collisions between trains*, *collisions with road vehicles at level crossings* and trains *struck by large falling objects*.

Train accident precursors	2006/07	2007/08	2008/09	2009/10	2010/11
Infrastructure failures					
Environment: adhesion	93	80	137	104	184
Environment: flooding	62	138	108	105	39
Environment: landslips	27	37	31	34	11
Level crossing failures	2636	2376	2238	2017	1579
Other structural failures	80	74	66	51	92
Track: broken rails	192	182	164	154	171
Track: buckled rails	85	4	17	27	29
Track: level 2 exceedences per mile	0.80	0.81	0.68	0.72	0.71
Wrongside signalling failures	589	595	827	772	786
Irregular working					
Runaway trains	13	7	4	9	6
Train speeding	73	113	73	213	145
Objects foul of the line	-	-	184	152	198
Track management/maintenance issues	-	-	156	112	103
Irregular working affecting level crossings	-	-	92	81	90
Misrouting	-	-	2345	2207	2087
Other signaller errors	-	-	86	62	91
Level crossing incidents					
Near misses with road vehicles	191	170	197	159	149
Objects on the line					
Trains striking objects blown onto the line	278	237	207	215	122
Trains striking objects due to vandalism	71	46	36	26	31
Animals on the line (including train strikes)	2390	1923	1857	1300	1527
Road vehicle incursions	77	87	66	50	60
Category A SPADs					
Total number of cat A SPADs	334	349	292	275	299
Risk ranked 20+	18	21	17	19	17
Risk ranked 16+	106	93	89	81	87
Trains and rolling stock					
Brakes	49	13	8	5	23
Hot axle boxes	888	636	730	664	396
Fires due to rolling stock failures	74	58	49	47	52
Fires due to vandalism	65	35	29	21	8
Other rolling stock failures	88	67	30	34	56
Other train fires	9	3	8	7	5
Dangerous goods incidents					
All incidents involving dangerous goods trains	128	163	164	169	97
Confirmed dangerous goods incidents	96	142	125	150	79

Only those irregular working events judged to have had the potential to cause a train accident are featured in the table. Risk ranking of irregular working events was not carried out prior to 2008/09.
SPADs risk ranked 20+ are also included in the totals of SPADs risk ranked 16+.

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9 Risk at the road-rail interface

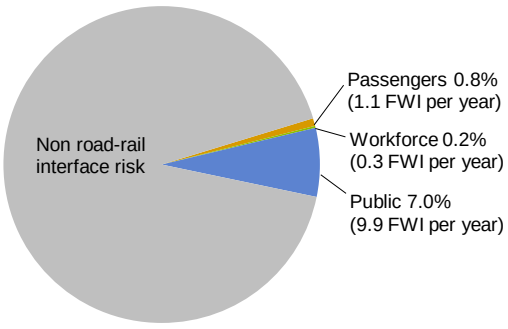
This chapter covers the risk related to level crossings, vehicle incursions onto the railway and bridge strikes. Much of the risk at the road-rail interface is caused by public behaviour, and most casualties are road vehicle occupants and pedestrians. Network Rail's *Don't run the risk* campaign, which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

2010/11 Headlines

- Excluding suicides, four pedestrians died in accidents at level crossings in 2010/11. There were 10 major injuries and 48 reported minor injuries or cases of shock/trauma. This equated to a total FWI of 5.2, which is the lowest total in the past ten years.
- There were five collisions between trains and road vehicles at level crossings during the year, which is also a ten-year low. There has been an average of 15 accidents per year since 2001/02. There is some evidence that the underlying rate of collisions at level crossings has reduced over the past ten years.
- One of these accidents, a collision between a train and a sewage tanker on a user-worked crossing, caused the train to derail and resulted in five major injuries.
- Most accidents at level crossings are caused by user behaviour – misjudgements, errors and wilful misuse.
- There was a fall in the number of near misses with road vehicles at level crossings.[73] Conversely, there was an increase in the number of reported near misses with pedestrians and cyclists.
- Overall, there were more road vehicle incursions onto the railway than last year. One incursion, when a cement lorry fell from a bridge onto a passing train, resulted in two major injuries to passengers. Most incursions result from road traffic accidents, and there is no discernable trend in these incidents. There is a downward trend in vehicles placed on the line by vandals.
- There was a an increase in bridge strikes in 2010/11, but fewer of these were classified as *serious* or *potentially serious* than in the previous year.

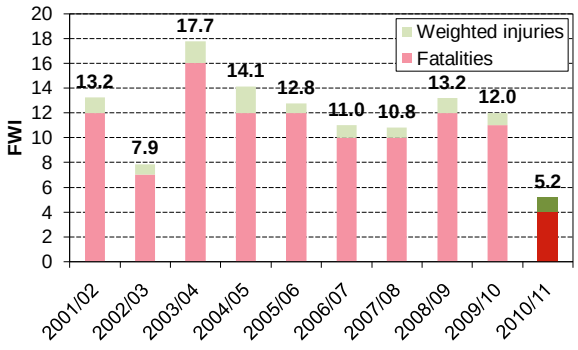
Road-rail interface safety at a glance

Road-rail interface risk in context (SRMv7)



Road-rail interface risk = 11.3 FWI per year (8.0% of total risk)

Trends in level crossing safety



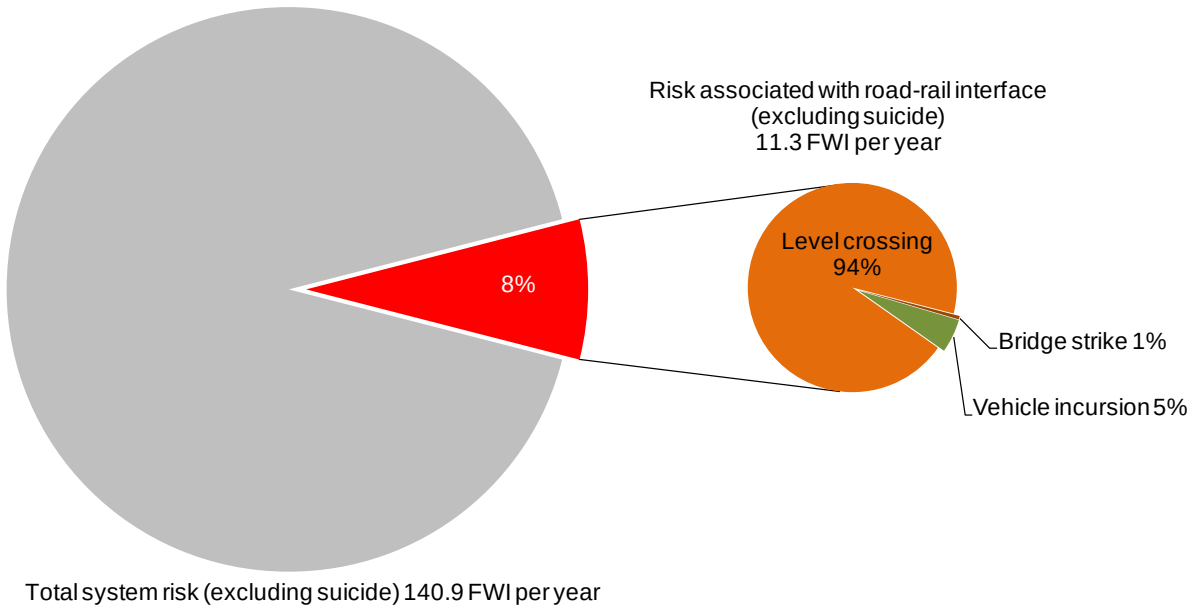
[73] The term *road vehicle* is used in this report to describe a range of vehicles, including farm machinery and off-road vehicles such as quad bikes (but not pedal cyclists, who are grouped with *pedestrians*).

9.1 Risk at the road-rail interface

SRMv7 estimates the overall risk at the road-rail interface to be 11.3 FWI per year,[74] which is 8.0% of the total risk (excluding suicide).

Most of this (9.9 FWI per year) affects members of the public, predominantly level crossing users. The risk to passengers is 1.1 FWI per year, but 0.7 FWI per year of this is to pedestrians on station foot crossings.[75] The risk to train occupants from collisions with vehicles and from bridge strikes amounts to around 0.6 FWI per year.

Chart 181. Risk at road-rail interface by site type (SRMv7)



- Most road-rail interface risk (around 94%) occurs at level crossings. Level crossings are an open interface between the road and the railway, so there is a greater opportunity for road user behaviour to affect train operations.
- Most of the remaining risk (5%) arises from road vehicle incursions, for example as a result of crashing through fences following a road traffic accident.
- Bridge strikes account for approximately 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 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*. The latest version was released in April 2011 and is available from the RSSB website.

[74] This estimate excludes the risk from collisions with maintenance vehicles, and from collisions with vehicles deliberately placed on the line by vandals. In the case of road vehicle incursions, it 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.
[75] People on station level crossings are classified as passengers if they are in the station in connection with a rail journey they are making.

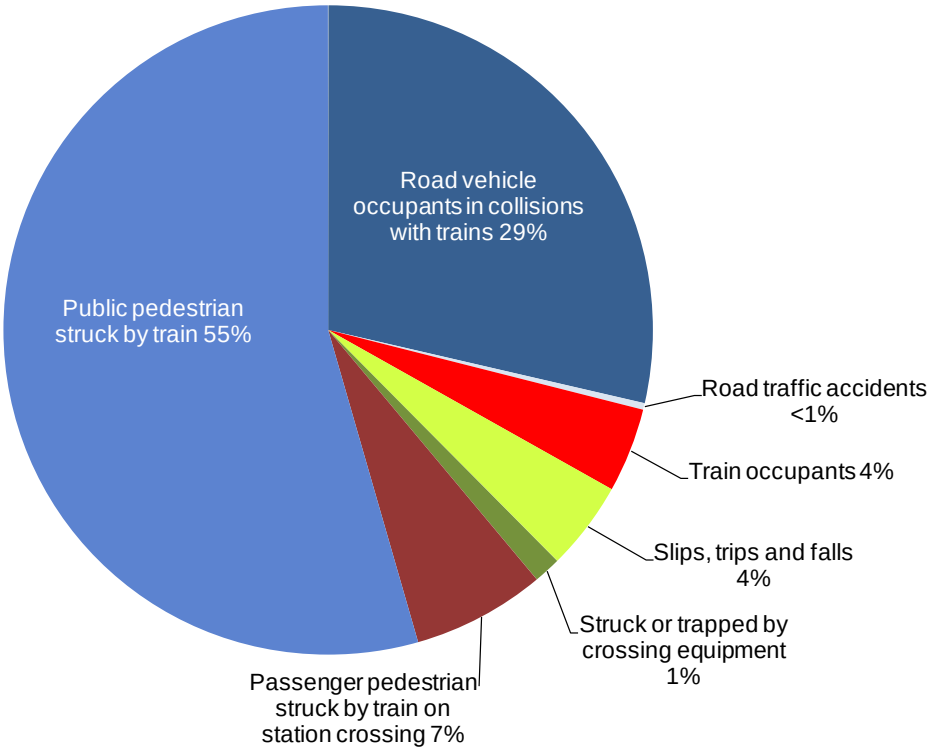
9.2 Risk at level crossings

9.2.1 Level crossing risk by cause and user type

SRMv7 estimates the risk at level crossings to be 10.6 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 is based on six years' performance data. See section 3.3 – *Common Safety Targets* for more information about NRVs.

Chart 182. Level crossing risk by event and user type, from SRMv7 (10.6 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 (55%) followed by passengers being struck on station crossings (7%).
- 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 respectively account for around 4% and 1% 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 25. Level crossing categories by class and type

Crossing type				Number
Passive		UWC-T	User-worked crossing with telephone	1614
		UWC	User-worked crossing	805
		OC	Open crossing	53
		FP	Footpath crossing	2456
Active	Manual	MCG	Manually controlled gate	189
		MCB	Manually controlled barrier	230
		MCB-CCTV	MCB monitored by closed-circuit television	390
	Automatic	AHB	Automatic half-barrier	452
		ABCL	Automatic barrier locally monitored	52
		AOCL/R	Automatic open crossing locally or remotely monitored	115
		UWC-MWL	User-worked crossing with miniature warning lights	96
Total				**6452**

- 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, compared with manually controlled gate and barrier crossings, have a relatively high average risk per crossing. Automatic open crossings, which have lights but no barriers, have a higher average risk from collisions with road vehicles (see section 9.2.7).
- 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 5.

Data source: Network Rail level crossing census (as at 31 December 2010). 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 2010/11

Fatalities

Excluding suicides and suspected suicides, four pedestrians died as a result of accidents at level crossings during the year. Two of the deceased were walking dogs, one was being pursued by the police and one was jogging with headphones. Details of the incidents are shown in Table 26.

Table 26. Pedestrian fatalities at level crossings in 2010/11

Date	Location	Territory	Type	Description
16/05/2010	Old Gashouse LC (Morley)	London North Eastern	footpath	The train driver had blown the horn at the whistle board before seeing a dog run across, closely followed by a 16-year-old female. As she crossed, she was clipped by the train. She later died from her injuries.
14/07/2010	Sherrington LC (Warminster)	South East	footpath	An elderly male pedestrian was struck after following his dog onto the line in an apparent attempt to retrieve it.
09/08/2010	Enfield Lock LC (Ordnance Road)	South East	MCB-CCTV	A pedestrian was struck after climbing over the barriers. The Metropolitan Police had been in pursuit of three suspects when the incident occurred.
14/02/2011	Sharpenhurst No.3 LC (Christ's Hospital)	South East	footpath	An 18-year-old male jogger was struck and killed. He had been listening to music through headphones at the time of the incident.

Injuries

Five train occupants (four passengers and the driver) sustained major injuries as a result of the collision and subsequent derailment at Sewage Works Lane level crossing on 17 August 2010. The remaining 16 occupants of the train sustained minor injuries. This was the first derailment following a collision at a level crossing since the fatal accident at Pumphouse crossing in December 2004.

There was one other minor injury to a train occupant as a result of a level crossing accident in 2010/11: a passenger on board the train involved in the fatality at Enfield Lock sustained whiplash injuries.

There were five major injuries to level crossing users. Two people were struck by trains and received serious leg injuries, one was in a road vehicle that was hit by a train (see Table 27), and two people received major injuries as a result of falls while attempting to rush across CCTV level crossings after the barrier sequence had commenced.

There were 22 reported minor injuries to level crossing users. These arose as a result of slips, trips and falls (13) and striking or being struck by crossing equipment (nine).

There were nine reported cases of shock or trauma, predominantly to train drivers involved in accidents.

9.2.4 Collisions between trains and road vehicles in 2010/11

There were five collisions between trains and road vehicles at level crossings during the year. Unusually, there were no fatalities to road vehicle occupants. One collision, shown in red, is subject to a RAIB investigation. Unless otherwise stated, the crossing was working correctly at the time of the accident.

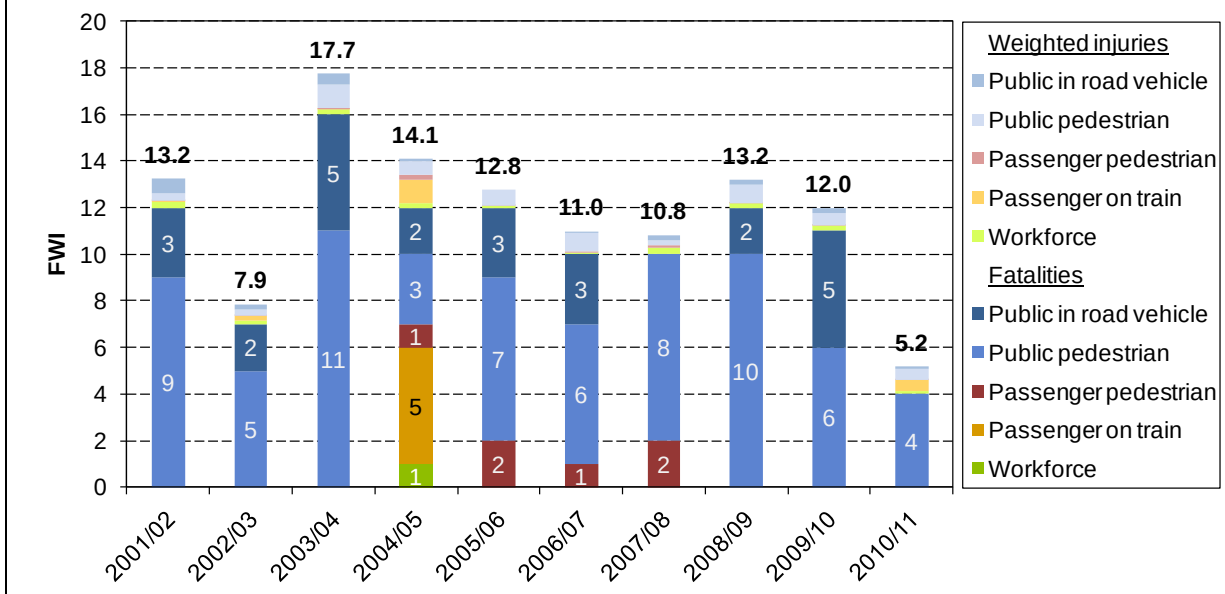
Table 27. Collisions between trains and road vehicles at level crossings in 2010/11

Date	Location	Territory	Type	Description
03/07/2010	Wrights No. 19 LC (Beccles)	South East	UWC	A passenger train struck a road vehicle. It did not derail and there were no passenger injuries (although the train driver suffered shock). The child occupant of the road vehicle received a major head injury. He is thought to have climbed into the driver's seat when his grandfather got out to open the crossing gates. Possibly distracted through moving the child off the seat, the grandfather did not then see the approaching train.
17/08/2010	Sewage Works Lane LC (Sudbury)	South East	UWC-T	A passenger train collided with a sewage tanker and became derailed. Twenty one people were injured on the train (two workforce and 19 passengers), five of them with major injuries. The sewage tanker driver had not sought the signaller's permission to cross. This incident is subject to a RAIB investigation.
13/12/2010	Lime Kiln Quay LC (Woodbridge)	South East	AOCL	A passenger train struck a road vehicle at around 15mph. The train was not derailed and there were no reported injuries. The car driver had passed the red traffic signals and attempted to cross immediately in front of the train.
31/01/2011	Morfa Main LC (Kidwelly)	Western	UWC-T	A passenger train struck a tractor and trailer. The train did not derail and there were no reported injuries. The tractor driver had not sought the signaller's permission to cross.
10/02/2011	Halloon LC (St. Columb Road)	Western	AOCL	A van passed red traffic signals and collided with a passenger train. The train did not derail and there were no reported injuries. The van driver clamied to have slipped in wet conditions while braking for the crossing. Previous collisions at this crossing occurred on 08/04/2003 and 06/04/2004.

9.2.5 Trends in harm at level crossings

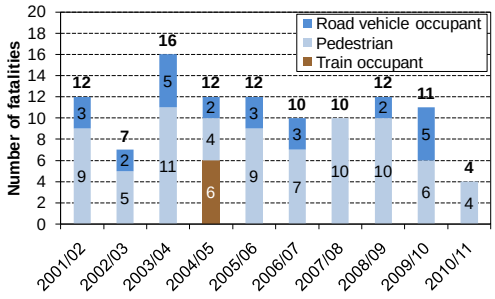
Most of the harm at level crossings arises from pedestrians, cyclists and road vehicles being struck by trains. Some people are also injured each year as a result of being hit by or colliding with crossing barriers, and from slips, trips and falls.

Chart 183. Harm at level crossings (excluding suicides)[76]



- The total level of harm at level crossings in 2010/11 was lower than for any other year in the past decade. Level crossing harm tends to be dominated by a relatively small number of fatalities, so figures from a single year should be interpreted with caution.
- The ten years to March 2011 have seen 106 fatalities on level crossings, excluding suicides. This figure comprises 75 pedestrians (including six passengers on station crossings), 25 road vehicle occupants and the six train occupants who died in the collision at Ufton in 2004.
- There is no clear overall trend in the harm at level crossings, although, overall, 2010/11 was a relatively good year. 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.

Chart 184. Fatalities at level crossings

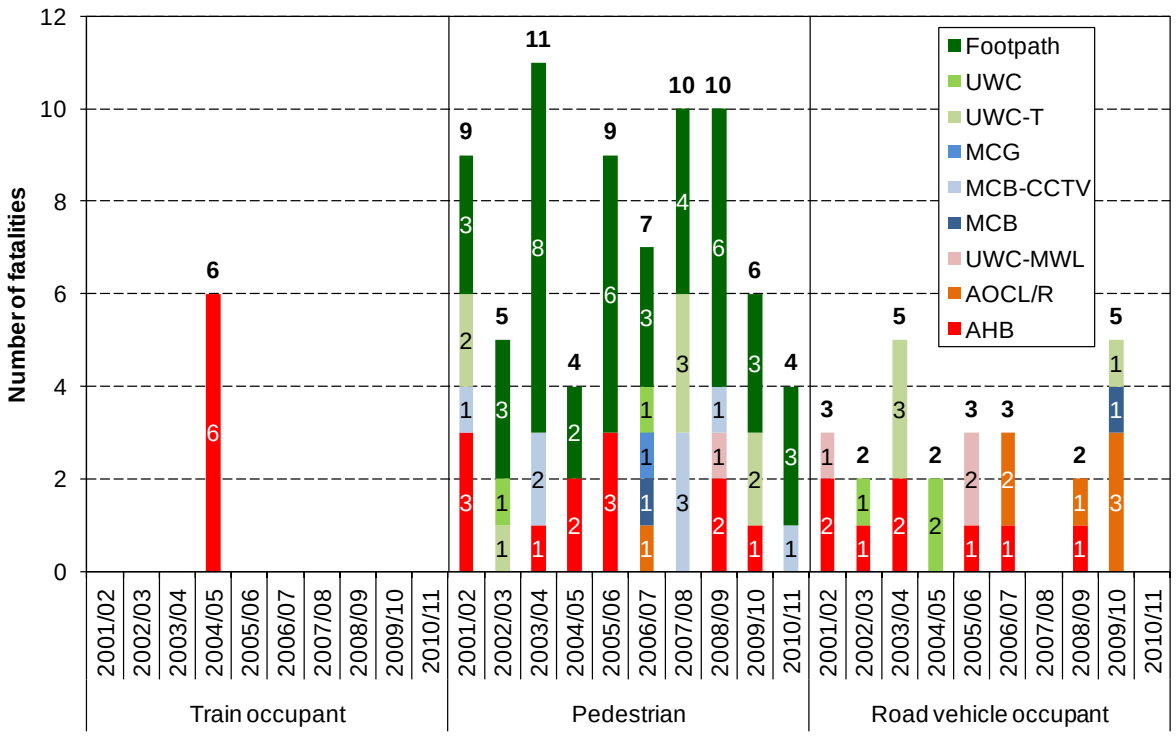


[76] All of the pedestrian fatalities shown in Chart 183 resulted from a person being struck by a train, with the exception of one case in July 2003, when a man died after falling and striking his head on a concrete post.

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



- Three of the four fatalities in 2010/11 occurred on footpath crossings. Since 2001/02, more than half of pedestrian fatalities have occurred on this type of crossing.
- The other fatality in 2010/11 occurred on a manually controlled barrier crossing with CCTV. In this case, the person who was struck by a train was being pursued by police, so it is unlikely that the level of protection at the crossing would have had any influence on his actions.

Since April 2001, around 11% of railway suicides have taken place at level crossings.

Table 28. Number of suicides and suspected suicides at level crossings

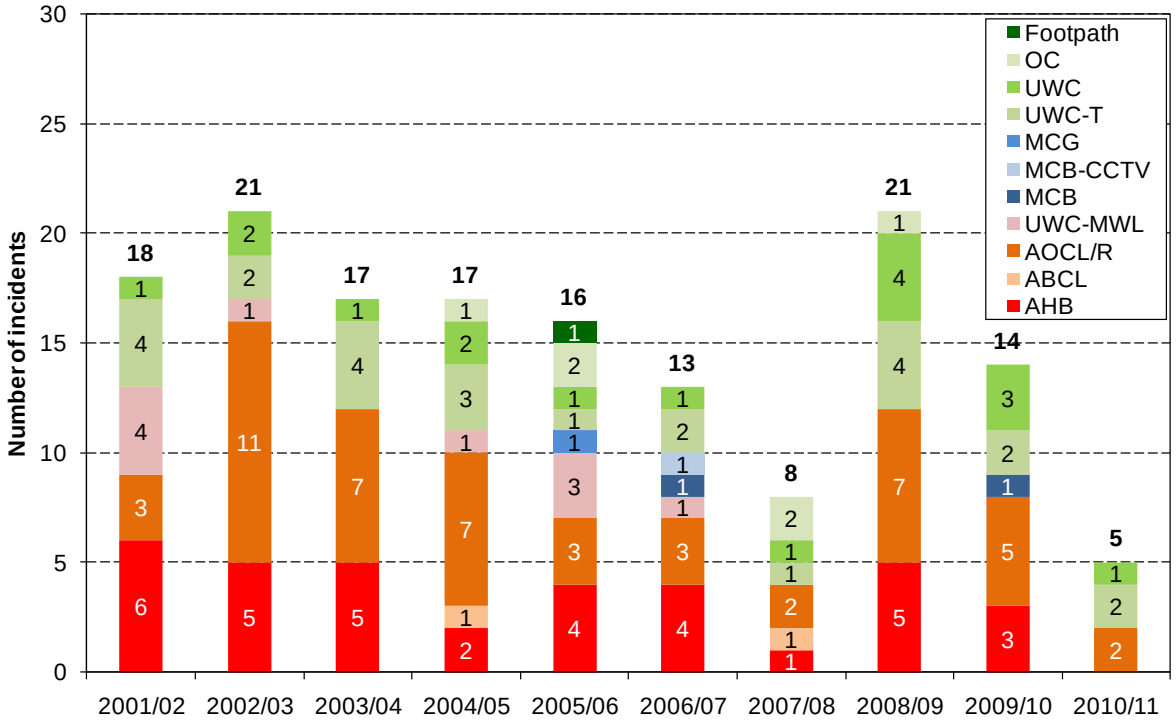
	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Pedestrian	13	17	17	19	24	21	20	22	34	28
Road vehicle occupant	0	0	1	1	2	1	0	1	1	0
Total	13	17	18	20	26	22	20	23	35	28

- The number of suicides recorded at level crossings reduced in 2010/11, although it remains higher than in 2008/09 and earlier years. There was a general reduction in the number of railway suicides compared with 2009/10 (see section 7.6).

9.2.7 Collisions between trains and road vehicles

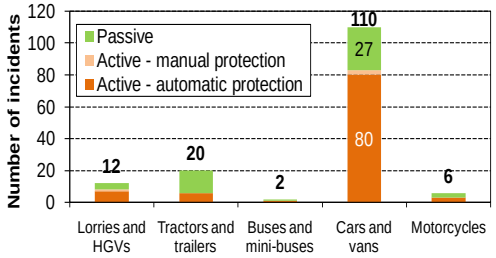
Historically, most collisions have occurred on AHBs, AOCLs and UWCs. The proportion of collisions that result in a fatality varies by crossing type, reflecting factors such as differences in train speed. For example, many AHBs are situated on faster lines and, as a result, collisions with road vehicles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

Chart 186. Collisions between trains and road vehicles by crossing type



- There is some evidence that the underlying rate of collisions at level crossings has reduced over the past ten years. Because the number of accidents that occurs each year is relatively small it is difficult to distinguish trends from 'statistical fluctuations'. However, grouping the decade into two five-year periods shows a significant reduction in the number of collisions from the period 2001/02 to 2005/6 (89) to the period 2006/07 to 2010/11 (61).
- Unusually, there were no collisions at automatic half-barrier crossings in 2010/11. Otherwise, the crossing types at which the accidents occurred were reasonably typical of previous years. Of the 150 collisions in the ten years from April 2001, 50 occurred at AOCL crossings, 35 at AHB crossings and 25 at user-worked crossings with telephones.
- 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. There has been no significant trend in the types of vehicles involved in collisions at level crossings.

Chart 187. Road vehicles in collisions at level crossings (2001/02–2010/11)



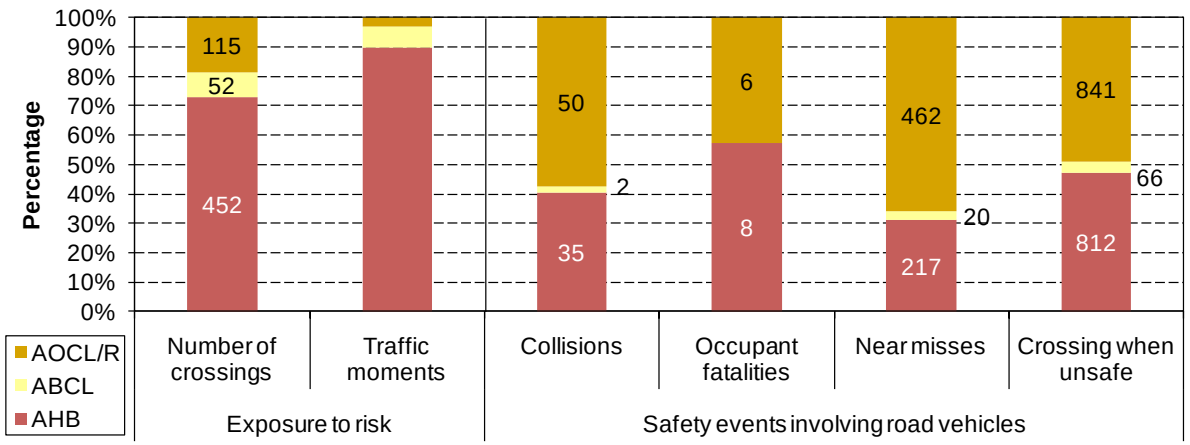
Risk at AOCL crossings

Since 2001/02, one-third of collisions have taken place at automatic open crossings. Because this is disproportionate to the number of AOCLs in the crossing population, RAIB's investigation into the fatal collision at Halkirk in September 2009 reviewed the more general risk from this type of crossing as well as the specifics of that accident. The findings are due to be published in mid 2011.

Chart 188 compares AOCL crossings with AHB and ABCL crossings. These are all types of unmanned crossing that are located predominantly on the public highway. The main difference is the absence of physical barriers at AOCL crossings.

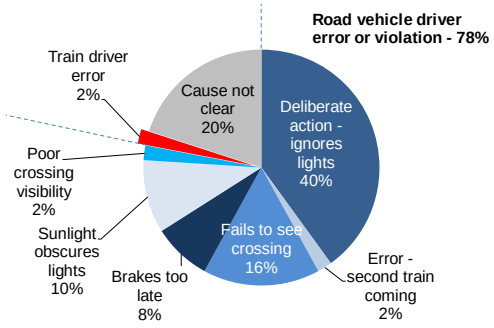
Physical barriers act as deterrents to those who violate the rules, and also reduce error rates by reinforcing the 'stop' message more strongly than lights alone. However, barrier crossings are clearly more expensive to install and maintain.

Chart 188. A comparison of AOCL, AHB and ABCL level crossings (2001/02-2010/11)



- There are around four times as many AHB crossings as AOCL crossings. AHB crossings also tend to be relatively heavily used. Accounting for levels of road and rail traffic, the potential exposure at AHB crossings is far greater than at AOCL crossings.[77]
- Over the past ten years, there have been more collisions at AOCL crossings than at AHB crossings. There have also been more reports of near misses and of road vehicles using the crossing when unsafe to do so.
- On all measures, AOCL crossings appear to be significantly higher risk than AHB crossings when crossing numbers and usage are taken into account.
- Chart 189 shows that most collisions at AOCL crossings are caused by road vehicle driver behaviour. There is a fairly even split between deliberate violations and errors (that can occur for various reasons).

Chart 189. Causes of collisions at AOCL crossings (2001/02-2010/11)



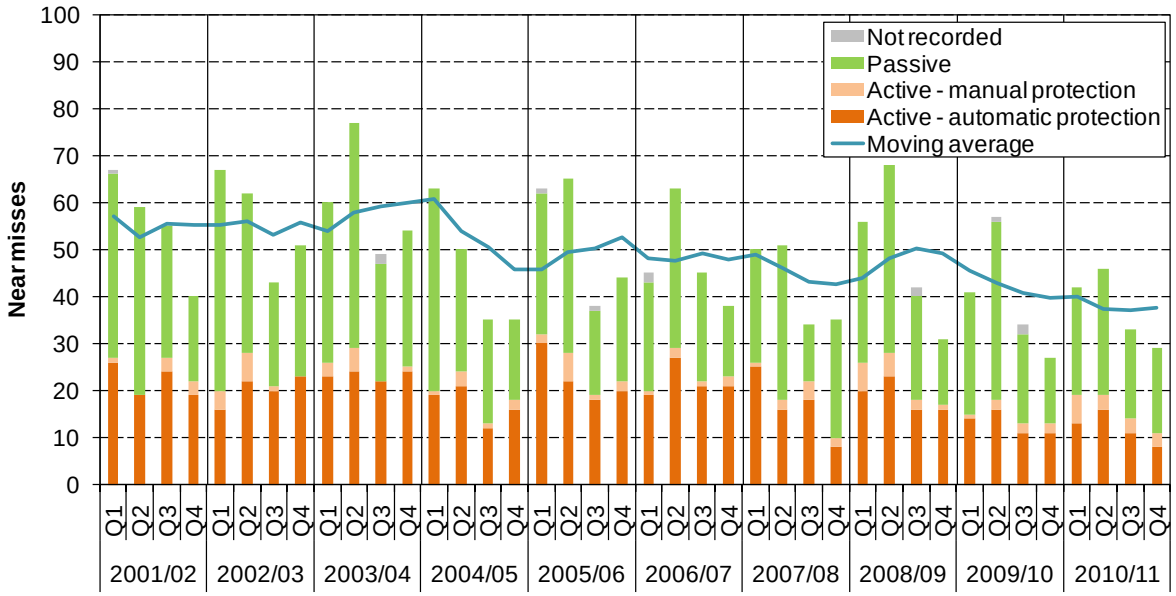
[77] *Traffic moments* is a measure of the number of road vehicles using the crossing per day multiplied by the number of trains passing over it. These figures have been obtained from Network Rail's All Level Crossing Risk Model.

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 also likely that many near misses go unobserved due to prevailing light and visibility conditions.

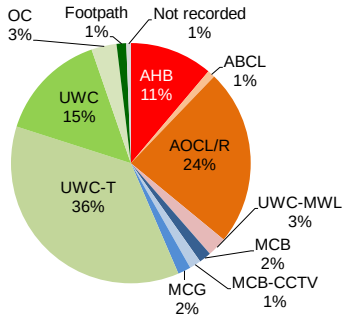
Near misses with road vehicles by crossing type

Chart 190. Trends in reported near misses with road vehicles



- There appears to be a long-term downward trend in near misses with road vehicles. The number of near miss reports dropped for the second successive year.
- The majority of near misses occur on user-worked crossings (with and without telephones). It is estimated that around one in six 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.
- Other seasonal factors that affect level crossing risk include ice and snow and sunlight, which can make it harder for the motorist to see warning lights.

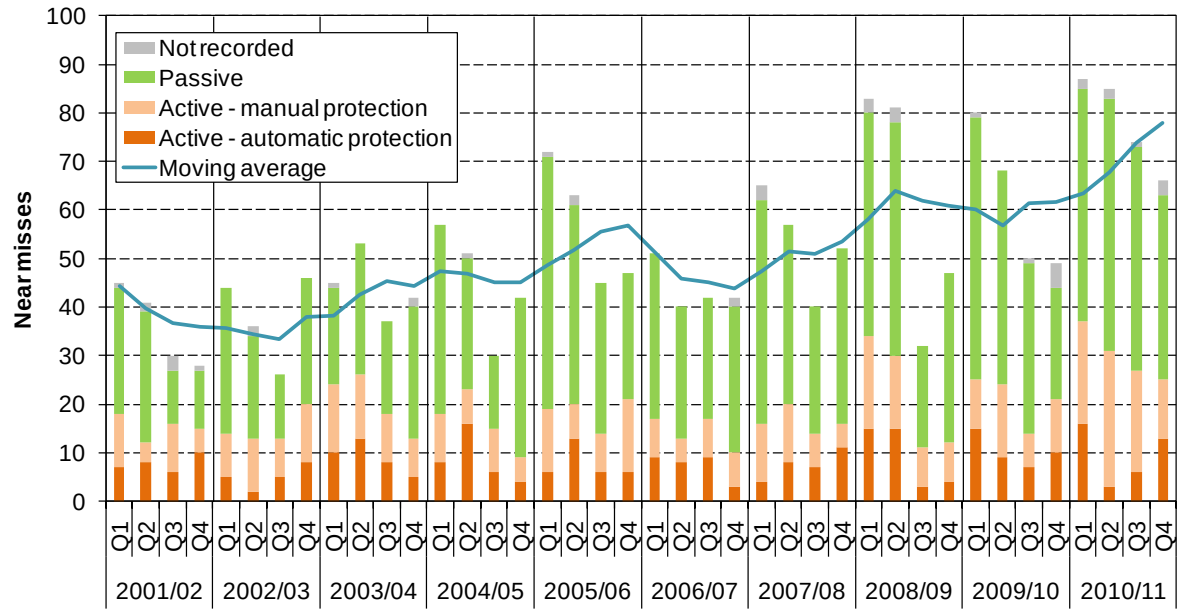
Chart 191. Near misses with road vehicles (2001/02-2010/11)[78]



[78] The incidents at footpath crossings include near misses with mopeds and other motorcycles.

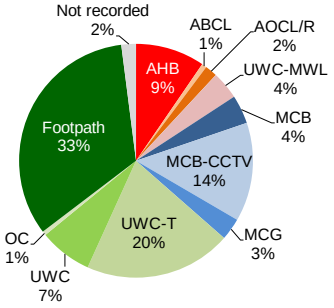
Near misses with pedestrians and cyclists by crossing type

Chart 192. Trends in reported near misses with pedestrians and cyclists



- There was a further increase in the number of reported near misses with cyclists and pedestrians in 2010/11. This continues the general upward trend that has been evident for most of the past decade.
- 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, as – as with road vehicle near misses – train drivers are more likely to see crossing users during daylight hours.
- Around 11% of the near misses shown in the chart involve cyclists.
- Anecdotal evidence, and a qualitative review of accident data, suggests that dog walkers may be particularly vulnerable to accidents at level crossings. Around 11% of reported near misses mention that the person was walking a dog.
- Auditory distractions, such as personal stereos, can also increase the risk to level crossing users. Headphones may have been a factor in the fatal accident at Sharpenhurst No. 3 level crossing on 14 February 2011.
- 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.

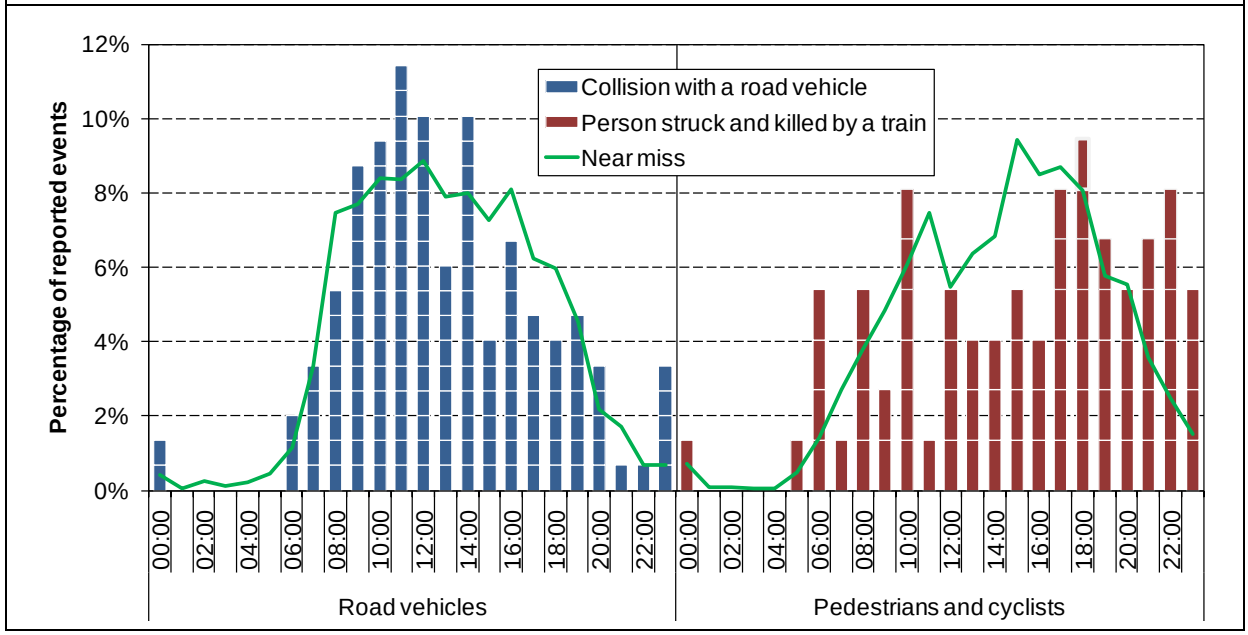
Chart 193. Near misses with pedestrians and cyclists (2001/02-2010/11)



Near misses by time of day

Chart 194 shows the proportion of accidents and near misses at level crossings reported in each hour of the day over the period 2001/02 to 2010/11.

Chart 194. Accidents and near misses by time of day (2001/02 to 2010/11)

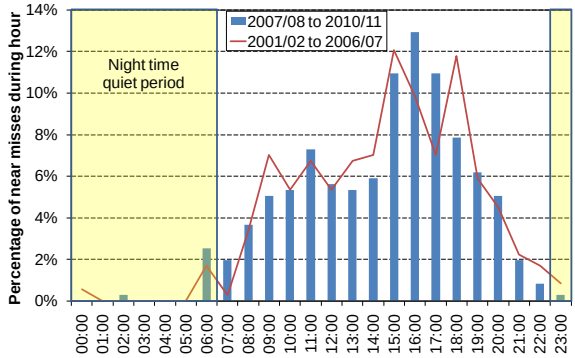


- Accidents and reported near misses tend to occur at similar times of the day.
- The main exception to this is that a higher proportion of pedestrian/cyclist fatalities occur in the late evening (9pm to 1am) than would be anticipated from near miss reporting. One explanation for this is that many near misses go unseen (and therefore unreported) during hours of darkness. There may also be an effect from alcohol affecting people's ability to observe and get clear of approaching trains.[79]
- 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. Chart 195 shows near misses at footpath crossings by time of day both before and after April 2007.

- There is little evidence that a higher proportion of near misses are occurring during the quiet period.
- Since its introduction, one fatality (in May 2009) has occurred at a crossing with a whistle board during the quiet period.

Chart 195.Near misses on footpath crossings

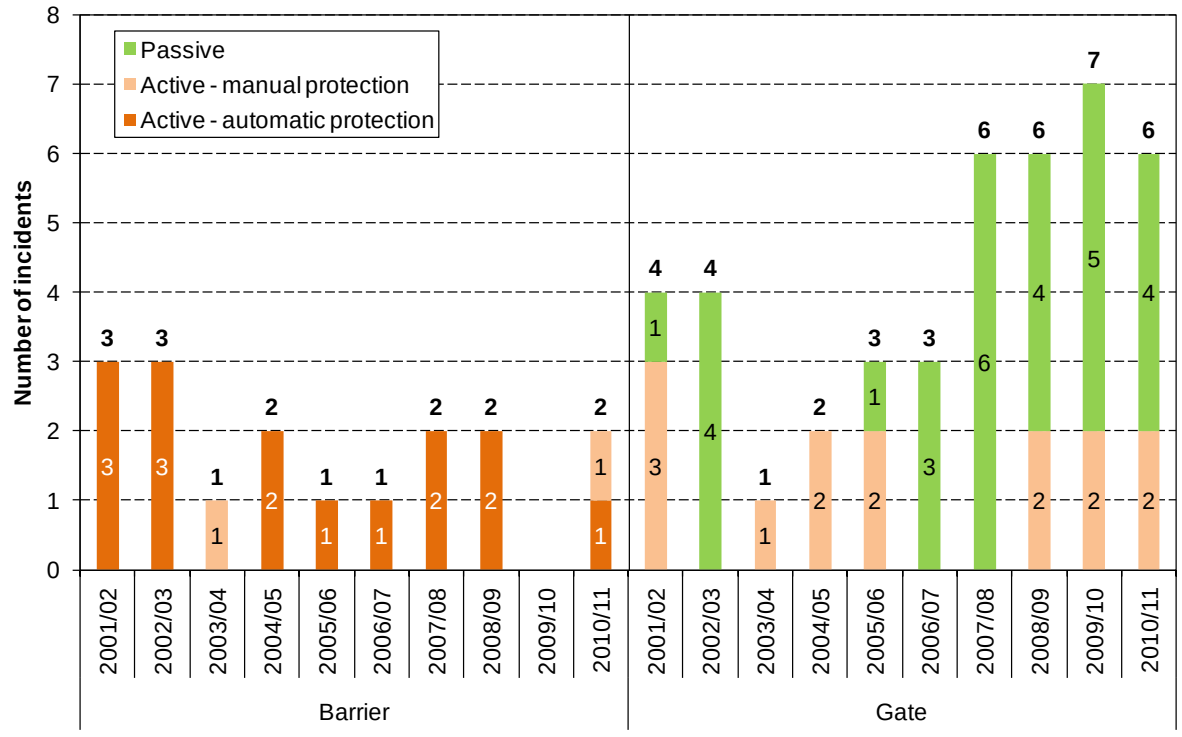


[79] Intoxication is known to have been a factor in only one of the 16 fatalities that occurred between 9pm and 1am. However, it may have been a factor in other cases but not recorded as such.

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 196. Trains striking gates or barriers at level crossings



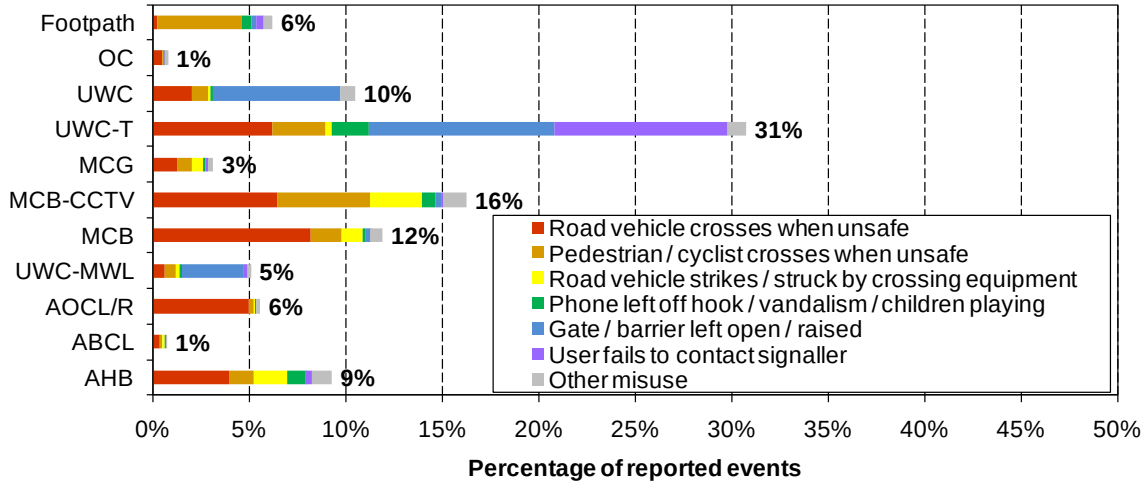
- There were six instances of trains striking level crossing gates in 2010/11, and two instances of trains striking barriers.
- One accident – at Harling Road manually controlled gated crossing on 9 April 2010 – was the result of workforce error. The signaller opened a gate to road traffic in front of an approaching train. The local investigation found that it had become standard practice to return the home signal to danger when a train had passed it and immediately operate the level crossing gate release lever. On this occasion the signaller was distracted and failed to ensure that the train had traversed the crossing before opening the gate.

9.2.10 Factors affecting the risk at level crossings

User behaviour

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. There was a significant increase in reported misuse by pedestrians in 2010/11 (and a fall in misuse involving road vehicles) by 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 197. Reported level crossing misuse by misuse category (2001/02 – 2010/11)



- 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 29. 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	2010/11
153	126	185	139	68	99	38	40	44	14

- The number of incidents of reported interference with crossing equipment further reduced in 2010/11 to less than 10% of the total from 2001/02. There has been a general downward trend in railway vandalism (see section 7.5) but data quality issues mean that the scale of the reduction should be interpreted with some caution.

Irregular working at level crossings

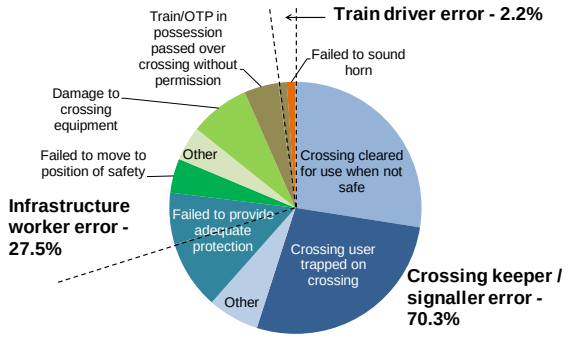
SRMv7 estimates that workforce error contributes around 7% of the risk from collisions between trains and road vehicles at level crossings. A fatal collision between a train and road vehicle at Moreton-on-Lugg in January 2010 was caused by the signaller raising the barriers to road traffic when a train was approaching (the RAIB report was released in February 2011). Two events within three days in 2010/11 had echoes of this accident:

- On 21 March 2011, the crossing keeper at Four Lane Ends MCB crossing raised the barriers in error as a train approached. The train driver observed a car edging forwards onto the crossing and applied the emergency brake, passing the car (which had not encroached onto the crossing) at around 30mph.
- On 23 March 2011, a train passed over Lydney MCB crossing with the barriers in the raised position (but with the warning lights operating). The crossing keeper had been lowering and raising the barriers manually due to a fault with the crossing equipment. The level crossing equipment was not interlocked with the signalling system, so that raising the barriers would not return the protecting signals to danger. RAIB is investigating.

Chart 198 shows the breakdown of workforce errors affecting level crossings that were reported under the *irregular working* component in SMIS in 2010/11.

- 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.

Chart 198. Workforce errors affecting 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).

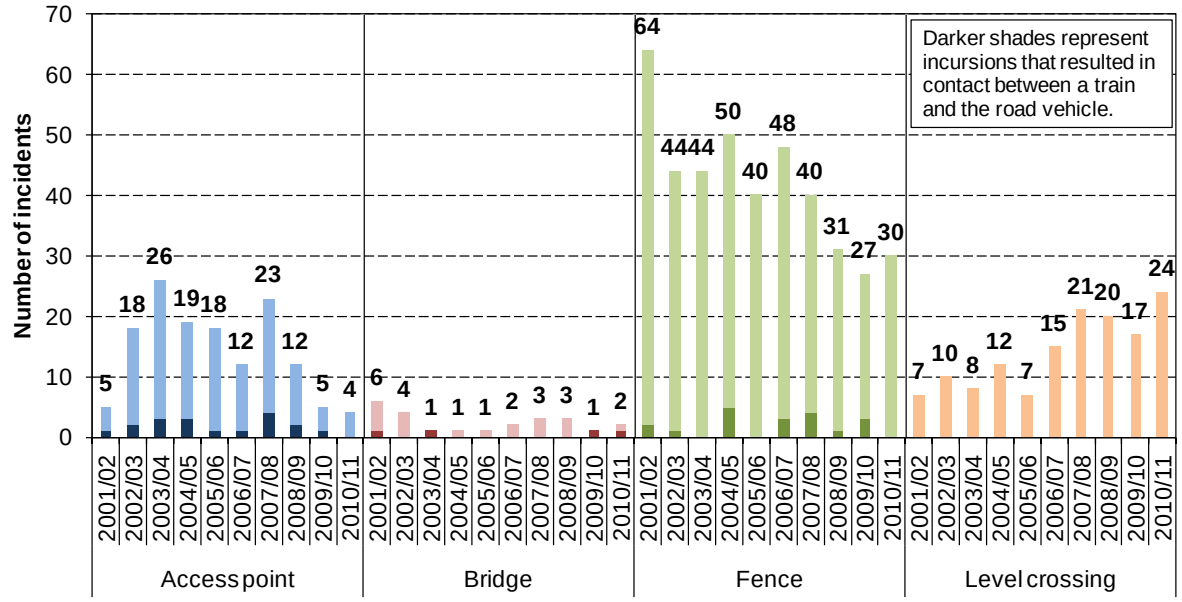
Equipment failure accounts for a small proportion of the risk at level crossings, the risk being mitigated by the fact that equipment is designed to 'fail safe'. For example, if the equipment fails at an automatic level crossing, the warning lights operate and the barriers lower.

- The number of RIDDOR-reportable level crossing equipment failures recorded in SMIS has increased dramatically over the past few years (from 42 in 2004/05 to 1,211 in 2010/11). It is believed that this is due to improved reporting and does not reflect a genuine increase in equipment failure rates. The trend in all reported level crossing equipment failures, which includes those that are not reportable under RIDDOR, shows a different trend: (see the *Train accident precursors* key safety fact sheet in section 8.8).
- In 2010, around 60% of RIDDOR-reportable equipment failures related to telephones, and 17% to level crossing barriers.

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 199. Vehicle incursions by entry point



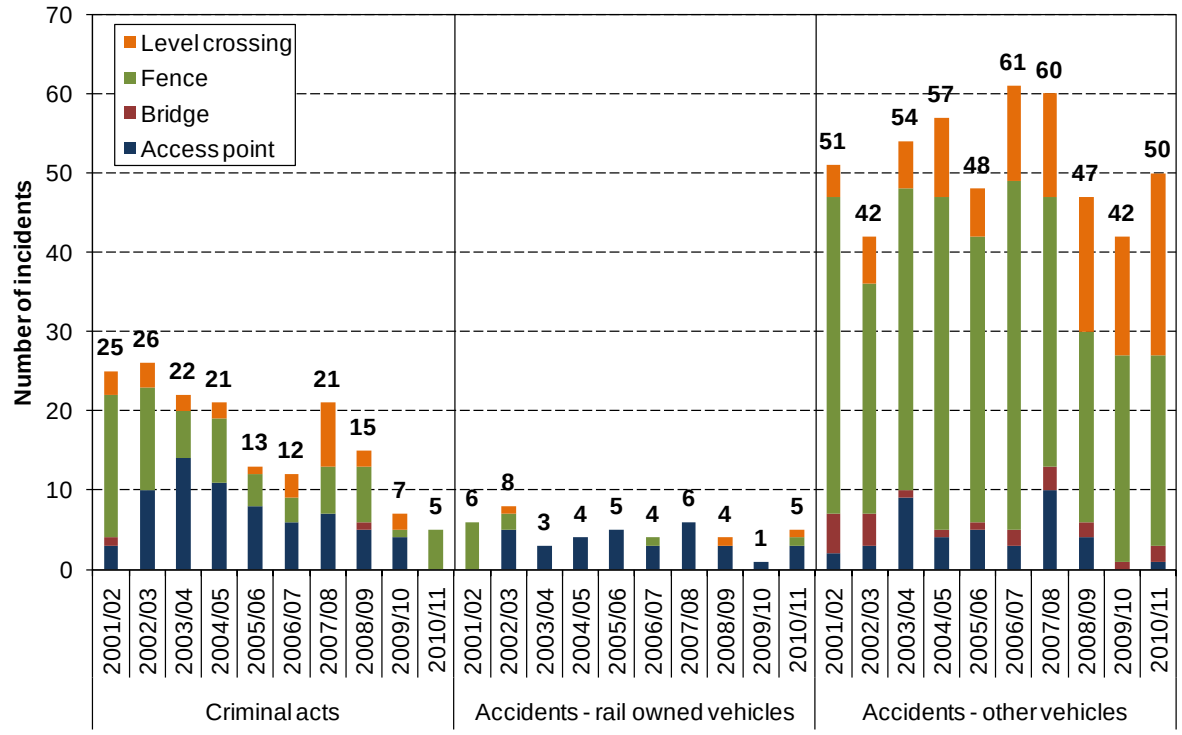
- There were 60 road vehicle incursions in 2010/11. Most of these accessed railway property via fences or level crossings.[80]
- One incursion in 2010/11 resulted in a train accident:
  - On 5 November 2010, a cement mixer lorry breached the parapet and fell from a road-over-rail bridge near Oxshott onto a passing passenger train. This caused extensive damage to, and the derailment of, part of the rear unit of the eight-car train and two passengers received major injuries.
- Network Rail has a process in place to identify high risk sites that are adjacent to the railway. The site of the Oxshott incident was not classified as high risk because the bridge is on a straight stretch of road: an accident of the type that occurred can be regarded as a very unusual occurrence.

[80] The *level crossings* category in Chart 199 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) or has become stuck on the crossing. It does not include collisions between trains and road vehicles on level crossings.

Trends in incursions by cause

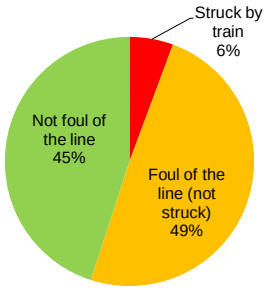
Vehicles can intrude onto the railway as a result of road traffic accidents, deliberate acts of vandalism or trespass and, occasionally, navigational errors. Railway personnel sometimes leave vehicles too close to the line, or not properly secured. There has also been a small number of cases of aircraft crashing onto the railway.[81]

Chart 200. Vehicle incursions by cause



- Most incursions are the result of road traffic accidents.
- Although there were more incursions in 2010/11 than the previous year, there has been a long-term reduction in the number of incidents.
- This reduction is most evident in road vehicle incursions resulting from criminal acts (primarily vehicles placed on the infrastructure by vandals). This reflects a general reduction in railway vandalism (see section 7.5).
- The mini chart shows that around half of all vehicle incursions end up foul of the running line, and around 6% are struck by (or otherwise make contact with) trains.

Chart 201. Consequence of vehicle incursions (2001/02 to 2010/11)



[81] Aircraft incursions are included in Chart 199 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

Responsibility for controlling the risk from bridge strikes is shared by the railway industry and highways authorities. Road-over-rail bridge strikes can result in debris or even vehicles on the line, and rail-over-road bridge strikes have the potential to cause track distortion or weaken the bridge structure.

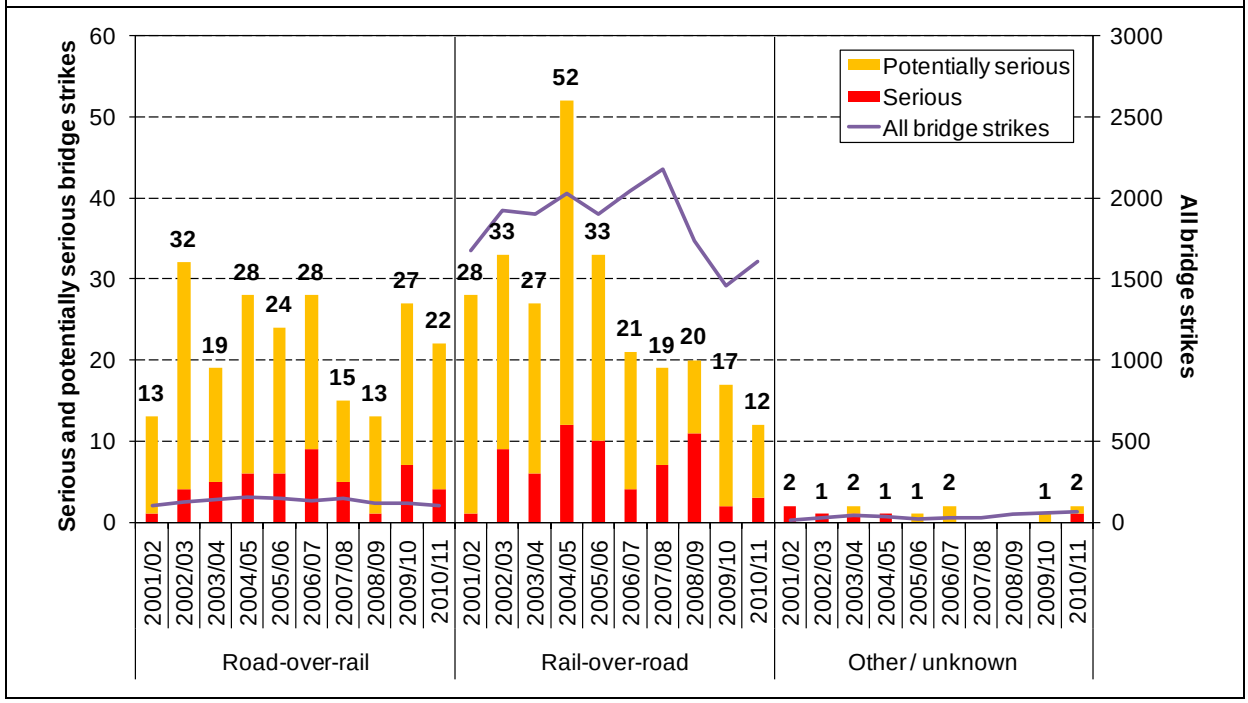
On 5 November 2010, a cement lorry crashed through a road-over-rail bridge at Oxshott and fell onto the sixth and seventh carriages of a passenger train, resulting in two major injuries.

The last recorded case of a rail-over-road bridge strike leading to track displacement and the 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.

SRMv7 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 bridge strikes are a major source of service disruption.

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 202. Total number of bridge strikes – all types of bridges[82]



- Most bridge strikes are reported at rail-over-road bridges. Heavy goods vehicles are frequently involved. Although there are more rail-over-road than road-over-rail bridges, the number of accidents per bridge is also much higher.
- 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 four such incidents in 2010/11, including the accident at Oxshott.

[82] The *other/unknown* category includes rail-over-water bridges, footbridges, viaducts and some cases where the bridge type was not entered into SMIS.

9.5 Road-rail interface key safety facts

Road-rail interface	2006/07	2007/08	2008/09	2009/10	2010/11
Fatalities at LC (level crossings)	**10**	**10**	**12**	**11**	**4**
Pedestrians	**7**	**10**	**10**	**6**	**4**
Passenger on station crossing	1	2	0	0	0
Member of public	6	8	10	6	4
Road vehicle occupants	**3**	**0**	**2**	**5**	**0**
Train occupants	**0**	**0**	**0**	**0**	**0**
Passenger on train	0	0	0	0	0
Workforce on train	0	0	0	0	0
Weighted injuries at LC	**0.99**	**0.82**	**1.18**	**0.99**	**1.18**
Pedestrians	**0.85**	**0.50**	**0.92**	**0.72**	**0.50**
Road vehicle occupants	**0.10**	**0.21**	**0.21**	**0.21**	**0.10**
Train occupants	**0.05**	**0.12**	**0.05**	**0.06**	**0.59**
Suicide and attempted suicide					
Suicide	**22**	**20**	**23**	**35**	**28**
Attempted suicide	**0.00**	**0.10**	**0.11**	**0.13**	**0.21**
Collisions with road vehicles at LC	**13**	**8**	**21**	**14**	**5**
Resulting in derailment	0	0	0	0	1
Collisions with gates or barriers at LC	**4**	**8**	**8**	**7**	**8**
Gates	3	6	6	7	6
Barriers	1	2	2	0	2
Reported near misses	**361**	**382**	**437**	**403**	**460**
With pedestrians	174	212	242	247	312
With road vehicles	187	170	195	156	148
Reported incidents of crossing misuse	**2545**	**2290**	**3023**	**2549**	**2967**
With pedestrians	1008	860	866	921	1393
With road vehicles	1537	1430	2157	1628	1574
Vehicle incursions	**77**	**87**	**66**	**50**	**60**
Via fences	48	40	31	27	30
Via bridges	2	3	3	1	2
Via level crossings	15	21	20	17	24
Via access points	12	23	12	5	4
Number foul of the track	36	59	34	31	33
Number struck by trains	4	8	3	5	0
Train struck by falling vehicle	0	0	0	0	1
Bridge strikes	**2200**	**2351**	**1908**	**1631**	**1782**
Underline (rail over road)	2042	2176	1736	1456	1609
Serious	4	7	11	2	3
Overline (road over rail)	132	149	119	117	105
Serious	9	5	1	7	4
Other	26	26	53	58	68
Serious	0	0	0	0	1

10 Data quality

10.1 SMIS

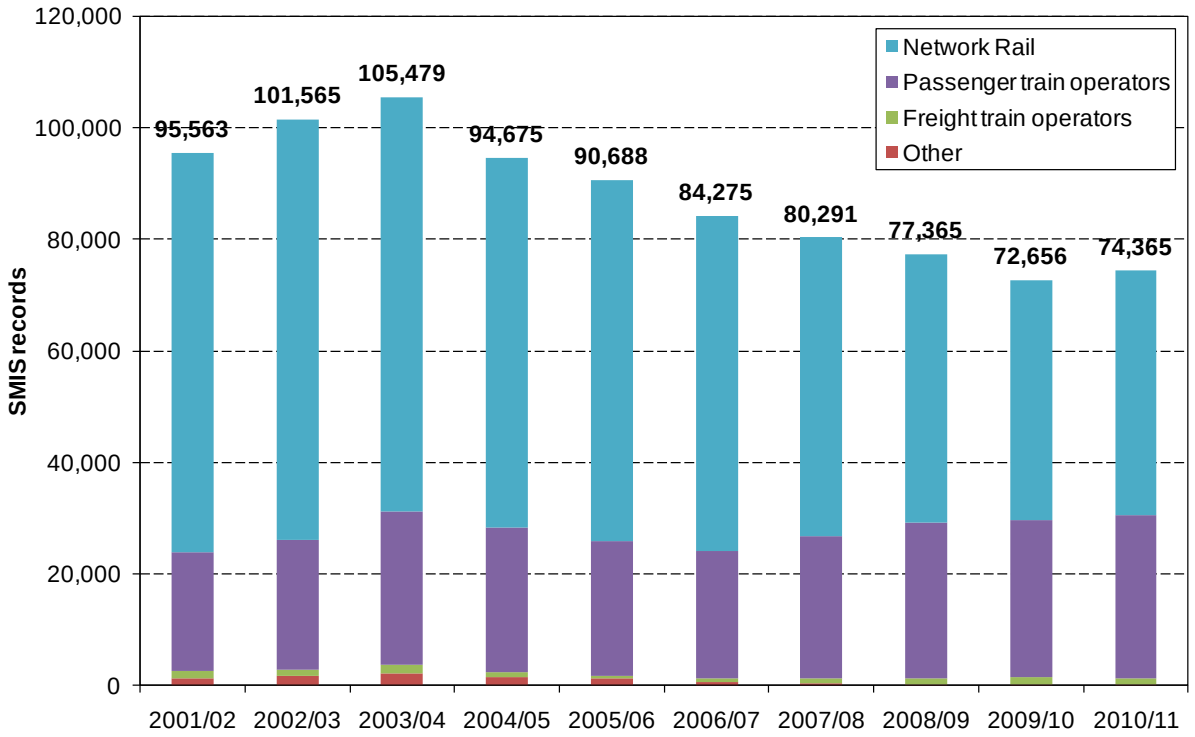
The analysis in this report relies on the quality of the data it uses. The majority of the analysis is based on data from the industry's safety management system (SMIS). To ensure that the conclusions are meaningful, effort is put into ensuring that the data is of the highest possible quality. The data quality work carried out by RSSB relating to SMIS is governed by the SMIS Programme Board, which includes representatives of Network Rail, train operators and infrastructure contractors.

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. However, 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 fifth edition went live in March 2011 and may be found at: http://www.rgsonline.co.uk.

In 2010/11 about 75,000 incidents were reported into the SMIS system, mostly by Network Rail, as shown in Chart 203.

Chart 203. Number of SMIS records per year



10.1.1 Data quality issues

The following sub-headings describe data quality issues that are general to all data systems. The following section, 10.1.2, describes how RSSB's data quality project works to minimise the effects.

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 be affected. Substantial under-reporting will lead to an underestimate of risk. It can occur because of a lack of understanding, training, guidance, a lack of resources or safety culture. Under-reporting is normally more of a concern for minor events, and the weighting that is attached to non-reportable minor injuries in part takes account of this. If the level of under-reporting changes over time, without the reasons being understood, estimates of trends may be misleading.

Timeliness

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. The group standard requires that events are entered into SMIS within five working days of their occurrence.

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 – ie 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 overleaf), so the significance of this issue is reducing.

10.1.2 Data quality improvement measures

Summary of how improvement measures address quality issues

To minimise the number of data quality errors and their effects, RSSB employs a number of data quality control measures. Table 30 shows the issue that each measure is tackling. Each issue and measure is then discussed in detail.

Table 30. 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					✓

Daily checks

In SMIS, the event types that have regular checks are limited to fatalities, injuries, category A signals passed at danger, 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 SRM. 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 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 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 2010, each organisation's SMIS data quality was ranked for the second time. This score was based on four factors: timeliness, under-reporting, response to actions and quality of input. The ranking allows each organisation to see clearly where their weaknesses lie and provides the capability to compare each organisation, to measure the total quality and to see how companies have changed from the previous year. Companies will be re-measured again at the end of 2011 against the same criteria. Each company is advised of its performance and the national benchmark, and the SMIS programme board review the overall results.

At the end of 2009, the average data quality ranking score was 74%, and by the end of 2010 this had improved to 81%. Of the 30 stakeholders, 19 improved their data quality scores in 2010 compared with the previous year. Five companies maintained the same level as 2009, and four organisations had a deterioration in the data quality score over the year. Two companies had their first health checks in 2010.

Definitions

RSSB has produced a document defining the most commonly used terms within SMIS, safety performance analysis and reporting and risk profiling, which can be found here: http://www.rssb.co.uk/publications/guidance.asp.

In addition, RSSB is currently defining every hazardous event and precursor used in the SRM. Following the completion of SRMv7, these definitions are being finalised and will be made available to the industry in late 2011.

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.

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 for a years worth of data. From this RSSB can monitor changes in data quality. It shows continued improvement in each category:

Table 31. Improvements in SMIS error rates[83]

Category	15/10/2009	31/03/2010	31/03/2011
Active records	10.9%	9.0%	6.4%
Classification questions not answered	0.4%	0.3%	0.2%
Failure to call and stop shorts with no train	8.0%	5.7%	2.7%
Injury degree discrepancies	1.3%	0.7%	0.3%
Injury duplicates	0.3%	0.0%	0.1%
Injury person type discrepancies	0.4%	0.2%	0.1%
Irregular working with no activity	15.1%	12.0%	2.7%
Line type discrepancies	0.5%	0.3%	0.1%
Missing narratives, locations or descriptions	1.2%	0.8%	0.3%
Missing train details	1.2%	0.8%	0.3%
Train type discrepancies	0.9%	0.8%	0.1%

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 sources 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[84] (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 the ASPR uses SMIS data to analyse workforce assaults, trespass and vandalism and CRIME for all other crimes, including assaults on passengers.

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 eight 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 generated from Network Rail's Track Access Billing System. The figures refer to mileage actually run, not timetabled journeys.

[83] 15th October 2009 was the first time the daily check of errors was conducted.
[84] 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.[85] Each year this is reconciled with the TOCs and passenger transport executives 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

The HLOS safety metric uses 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, hours worked are also used for individual risk estimates.

National Travel Survey

The Department for Transport conducts a continuous National Travel Survey (NTS). The NTS is a household survey which provides information about personal travel within Great Britain and monitors trends in travel behaviour. In this report, information from the survey is used in the *benchmarking* chapter, and in the chapter on *risk to passengers* (information on passenger characteristics and when journeys are made).

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 ORR website states that "*there are limitations to the dataset and these estimates should be treated with caution*". These are a consequence of problems with the data quality of the ORR origin-destination matrix that is used in its derivation (and which, in turn, is affected by data quality problems in the source LENNON data). Manual checking is carried out for stations with growth that deviates by more than 20% from the national average.

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. From 2010/11, the safety information contained in the NRT chapter 10 will be supplied by RSSB and will be consistent with the information reported in the ASPR.

National Passenger Survey

Twice a year Passenger Focus collects passenger opinions on 30 specific aspects of service, as well as irregular/one-off question form the National Passenger Survey (NPS). Personal security data from the NPS is reproduced in the ASPR report.

[85] 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.

European data

GB 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.

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 32. Differing definitions of terms (person types)

Term	ERA definition	RSSB definition	RIDDOR definition
Workforce	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 or who was boarding or alighting the train.	A person on railway infrastructure, who either intends to travel, is travelling or has travelled.	Same as RSSB definition except that those people who are fare evaders are classified as trespassers.
Public	ERA has categories: - LC users - unauthorised persons - others	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. This excludes people on level crossings. The ERA call this group 'unauthorised persons'.		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 33. 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 (an injury that requires a stay in hospital of at least 24 hours), and is caused by rolling stock in motion.	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	2006/07	2007/08	2008/09	2009/10	2010/11
Fatalities					
Passenger	9	7	5	5	8
Workforce	2	2	3	3	1
Public	57	59	59	62	31
Total	**68**	**68**	**67**	**70**	**40**
Major injuries					
Passenger	246	225	234	235	240
Workforce	128	138	130	122	122
Public	57	45	55	39	33
Total	**431**	**408**	**419**	**396**	**395**
Minor injuries					
Passenger	4888	5028	5237	5280	5555
Workforce	6202	5663	5455	5305	5335
Public	159	140	126	186	185
Total	**11249**	**10831**	**10818**	**10771**	**11075**
Shock/trauma					
Passenger	322	330	260	205	227
Workforce	1450	1422	1335	1140	1101
Public	3	7	7	3	3
Total	**1775**	**1759**	**1602**	**1348**	**1331**
Fatalities and weighted injuries					
Passenger	43.4	39.3	38.4	38.7	42.6
Workforce	26.4	26.0	26.0	25.0	22.9
Public	63.1	63.9	64.9	66.3	34.8
Total	**132.9**	**129.2**	**129.3**	**130.0**	**100.4**
Suicide and attempted suicide					
Suicides	225	208	218	233	208
FWI	228.4	210.8	221.5	235.6	211.9

Passengers

Passengers	2006/07	2007/08	2008/09	2009/10	2010/11
Fatalities	**9**	**7**	**5**	**5**	**8**
Train accidents	1	0	0	0	0
Slips, trips, and falls	2	1	2	1	2
Platform-train interface	4	3	3	4	5
Assault and abuse	1	1	0	0	1
On-board injuries	0	0	0	0	0
Contact with object or person	0	0	0	0	0
Struck by train on station crossing	1	2	0	0	0
Other type of passenger injury	0	0	0	0	0
Major injuries	**246**	**225**	**234**	**235**	**240**
Train accidents	29	0	0	3	6
Slips, trips, and falls	134	142	158	144	146
Platform-train interface	39	41	40	42	43
Assault and abuse	7	10	6	9	10
On-board injuries	30	22	24	29	29
Contact with object or person	7	9	4	7	4
Struck by train on station crossing	0	1	0	0	0
Other type of passenger injury	0	0	2	1	2
Minor injuries	**4888**	**5028**	**5237**	**5280**	**5555**
RIDDOR reportable	1140	1103	1118	1168	1201
Non-RIDDOR reportable	3748	3925	4119	4112	4354
Incidents of shock	**322**	**330**	**260**	**205**	**227**
Class 1	10	13	5	3	7
Class 2	312	317	255	202	220
Fatalities and weighted injuries	**43.41**	**39.32**	**38.39**	**38.67**	**42.61**
Train accidents	4.28	0.12	0.03	0.39	0.72
Slips, trips, and falls	20.77	20.90	23.55	21.11	22.47
Platform-train interface	9.64	8.98	8.98	10.37	11.60
Assault and abuse	2.08	2.29	0.84	1.19	2.29
On-board injuries	4.38	3.37	3.68	4.13	4.12
Contact with object or person	1.22	1.51	1.05	1.35	1.14
Struck by train on station crossing	1.00	2.10	0.00	0.00	0.01
Other type of passenger injury	0.04	0.05	0.26	0.13	0.27
Passenger kms (billions)	**46.2**	**48.9**	**50.8**	**51.4**	**54.5**
Passenger journeys (millions)	**1145**	**1218**	**1267**	**1259**	**1355**

BTP Passenger & Public Assaults	2006/07	2007/08	2008/09	2009/10	2010/11
Total	**4079**	**3530**	**3574**	**3170**	**3277**
Actual bodily harm	**1623**	**1485**	**1413**	**1145**	**1096**
Common assaults	**1793**	**1500**	**1594**	**1451**	**1506**
GBH and more serious cases of violence	**152**	**109**	**175**	**173**	**224**
Other violence	**73**	**50**	**47**	**60**	**55**
Racially aggravated harassment	**438**	**386**	**345**	**341**	**396**

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	2006/07	2007/08	2008/09	2009/10	2010/11
Fatalities	**2**	**2**	**3**	**3**	**1**
Infrastructure worker	0	2	2	3	1
Train driver	1	0	0	0	0
Other on-board train crew	0	0	0	0	0
Station staff	0	0	0	0	0
Revenue protection	0	0	0	0	0
Other workforce	1	0	1	0	0
Major injuries	**128**	**138**	**130**	**122**	**122**
Infrastructure worker	76	73	78	73	73
Train driver	7	19	6	10	12
Other on-board train crew	20	17	19	18	11
Station staff	13	14	9	8	8
Revenue protection	4	2	2	4	5
Other workforce	8	13	16	9	13
Minor injuries	**6202**	**5663**	**5455**	**5305**	**5335**
RIDDOR-reportable	711	566	589	555	571
Non RIDDOR-reportable	5491	5097	4866	4750	4764
Incidents of shock	**1450**	**1422**	**1335**	**1140**	**1101**
Class 1	264	219	223	273	255
Class 2	1186	1203	1112	867	846
Total FWI	**26.35**	**26.03**	**26.04**	**24.96**	**22.94**
Infrastructure worker	9.65	11.02	11.44	11.95	10.14
Train driver	3.79	3.94	2.62	2.99	3.19
Other on-board train crew	6.38	5.33	5.52	5.39	4.64
Station staff	3.00	3.02	2.42	2.18	2.12
Revenue protection	1.12	0.96	0.94	1.06	1.12
Other workforce	2.42	1.77	3.10	1.39	1.72

Members of the public

Public	2006/07	2007/08	2008/09	2009/10	2010/11
Trespass					
Fatalities	45	50	46	50	27
Major injuries	38	30	33	20	16
Minor injuries	33	25	20	34	29
Shock/trauma	1	0	1	0	0
Total trespass FWI	**48.91**	**53.09**	**49.38**	**52.13**	**28.71**
Level crossings					
Fatalities	9	8	12	11	4
Major injuries	8	4	9	7	5
Minor injuries	34	18	19	24	19
Shock/trauma	0	1	3	2	1
Total level crossings FWI	**9.89**	**8.44**	**12.97**	**11.75**	**4.56**
Non-trespass non-LX					
Fatalities	3	1	1	1	0
Major injuries	11	11	13	13	12
Minor injuries	92	97	87	128	137
Shock/trauma	2	6	3	1	2
Total non-trespass non-LX FWI	**4.29**	**2.33**	**2.51**	**2.55**	**1.54**
Total public accidental FWI					
Fatalities	57	59	59	62	31
Major injuries	5.70	4.50	5.50	3.90	3.30
Minor injuries	0.39	0.34	0.34	0.41	0.49
Shock/trauma	0.00	0.01	0.02	0.01	0.01
Total accidental FWI	**63.09**	**63.86**	**64.86**	**66.33**	**34.80**
Suicide					
Fatalities	225	208	218	233	208
Major injuries	33	27	34	25	36
Minor injuries	9	9	18	13	15
Shock/trauma	1	0	0	1	0
Total suicide FWI	**228.34**	**210.74**	**220.48**	**235.57**	**210.67**

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

Train accidents

Train accidents	2006/07	2007/08	2008/09	2009/10	2010/11
Fatalities (excluding suicides)	**5**	**0**	**2**	**7**	**0**
Passengers	1	0	0	0	0
Workforce	0	0	0	0	0
Members of the public	4	0	2	7	0
Weighted injuries (excluding suicides)	**4.21**	**0.97**	**0.57**	**1.18**	**1.32**
Passengers	3.28	0.12	0.03	0.39	0.72
Workforce	0.82	0.63	0.33	0.57	0.50
Members of the public	0.10	0.21	0.21	0.21	0.10
Total train accidents	**825**	**783**	**697**	**581**	**523**
PHRTAs	**45**	**44**	**49**	**42**	**18**
Involving passenger trains	24	20	31	26	14
Collisions between trains	1	4	6	4	1
Derailments	11	3	3	8	5
Collisions with road vehicles (not at LC)	2	5	0	2	0
Collisions with road vehicles (at LC)	9	7	18	12	5
Striking buffer stops	1	1	4	0	2
Struck by large falling object	0	0	0	0	1
Not involving passenger trains	21	24	18	16	4
Collisions between trains	1	1	0	0	1
Derailments	15	18	13	12	3
Collisions with road vehicles (not at LC)	1	3	2	2	0
Collisions with road vehicles (at LC)	4	1	3	2	0
Striking buffer stops	0	1	0	0	0
Struck by large falling object	0	0	0	0	0
Non-PHRTA train accidents	**780**	**739**	**648**	**539**	**505**
Involving passenger trains	665	621	552	471	443
Open door collisions	2	3	3	1	0
Roll back collisions	4	3	2	4	4
Striking animals	126	112	116	144	169
Struck by missiles	221	225	198	141	90
Train fires	136	87	73	69	57
Striking level crossing gates/barriers	3	4	6	2	7
Striking other objects	173	187	154	110	116
Not involving passenger trains	115	118	96	68	62
Open door collisions	0	0	0	1	0
Roll back collisions	0	0	0	0	2
Striking animals	13	14	12	16	21
Struck by missiles	63	60	46	22	8
Train fires	11	9	11	6	9
Striking level crossing gates/barriers	1	4	2	5	1
Striking other objects	27	31	25	18	21
PIM index (at year end)	**57.2**	**54.0**	**49.5**	**44.0**	**50.4**
Infrastructure failures	11.5	10.6	8.5	7.8	7.1
Irregular working	8.7	7.8	7.0	6.4	9.5
Public behaviour at level crossings	21.0	20.1	23.4	19.9	22.2
Objects on the line	5.0	5.2	2.6	2.5	2.3
Signals passed at danger	7.9	8.1	6.5	5.6	6.5
Trains and rolling stock	3.1	2.2	1.5	1.8	2.8

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

Train accident precursors	2006/07	2007/08	2008/09	2009/10	2010/11
Infrastructure failures					
Environment: adhesion	93	80	137	104	184
Environment: flooding	62	138	108	105	39
Environment: landslips	27	37	31	34	11
Level crossing failures	2636	2376	2238	2017	1579
Other structural failures	80	74	66	51	92
Track: broken rails	192	182	164	154	171
Track: buckled rails	85	4	17	27	29
Track: level 2 exceedences per mile	0.80	0.81	0.68	0.72	0.71
Wrongside signalling failures	589	595	827	772	786
Irregular working					
Runaway trains	13	7	4	9	6
Train speeding	73	113	73	213	145
Objects foul of the line	-	-	184	152	198
Track management/maintenance issues	-	-	156	112	103
Irregular working affecting level crossings	-	-	92	81	90
Misrouting	-	-	2345	2207	2087
Other signaller errors	-	-	86	62	91
Level crossing incidents					
Near misses with road vehicles	191	170	197	159	149
Objects on the line					
Trains striking objects blown onto the line	278	237	207	215	122
Trains striking objects due to vandalism	71	46	36	26	31
Animals on the line (including train strikes)	2390	1923	1857	1300	1527
Road vehicle incursions	77	87	66	50	60
Category A SPADs					
Total number of cat A SPADs	334	349	292	275	299
Risk ranked 20+	18	21	17	19	17
Risk ranked 16+	106	93	89	81	87
Trains and rolling stock					
Brakes	49	13	8	5	23
Hot axle boxes	888	636	730	664	396
Fires due to rolling stock failures	74	58	49	47	52
Fires due to vandalism	65	35	29	21	8
Other rolling stock failures	88	67	30	34	56
Other train fires	9	3	8	7	5
Dangerous goods incidents					
All incidents involving dangerous goods trains	128	163	164	169	97
Confirmed dangerous goods incidents	96	142	125	150	79

Only those irregular working events judged to have had the potential to cause a train accident are featured in the table. Risk ranking of irregular working events was not carried out prior to 2008/09.
SPADs risk ranked 20+ are also included in the totals of SPADs risk ranked 16+.

Road-rail interface

Road rail interface	2006/07	2007/08	2008/09	2009/10	2010/11
Fatalities at LC (level crossings)	**10**	**10**	**12**	**11**	**4**
Pedestrians	**7**	**10**	**10**	**6**	**4**
Passenger on station crossing	1	2	0	0	0
Member of public	6	8	10	6	4
Road vehicle occupants	**3**	**0**	**2**	**5**	**0**
Train occupants	**0**	**0**	**0**	**0**	**0**
Passenger on train	0	0	0	0	0
Workforce on train	0	0	0	0	0
Weighted injuries at LC	**0.99**	**0.82**	**1.18**	**0.99**	**1.18**
Pedestrians	**0.85**	**0.50**	**0.92**	**0.72**	**0.50**
Road vehicle occupants	**0.10**	**0.21**	**0.21**	**0.21**	**0.10**
Train occupants	**0.05**	**0.12**	**0.05**	**0.06**	**0.59**
Suicide and attempted suicide					
Suicide	**22**	**20**	**23**	**35**	**28**
Attempted suicide	**0.00**	**0.10**	**0.11**	**0.13**	**0.21**
Collisions with road vehicles at LC	**13**	**8**	**21**	**14**	**5**
Resulting in derailment	0	0	0	0	1
Collisions with gates or barriers at LC	**4**	**8**	**8**	**7**	**8**
Gates	3	6	6	7	6
Barriers	1	2	2	0	2
Reported near misses	**361**	**382**	**437**	**403**	**460**
With pedestrians	174	212	242	247	312
With road vehicles	187	170	195	156	148
Reported incidents of crossing misuse	**2545**	**2290**	**3023**	**2549**	**2967**
With pedestrians	1008	860	866	921	1393
With road vehicles	1537	1430	2157	1628	1574
Vehicle incursions	**77**	**87**	**66**	**50**	**60**
Via fences	48	40	31	27	30
Via bridges	2	3	3	1	2
Via level crossings	15	21	20	17	24
Via access points	12	23	12	5	4
Number foul of the track	36	59	34	31	33
Number struck by trains	4	8	3	5	0
Train struck by falling vehicle	0	0	0	0	1
Bridge strikes	**2200**	**2351**	**1908**	**1631**	**1782**
Rail-over-road	2042	2176	1736	1456	1609
Serious	4	7	11	2	3
Road-over-rail	132	149	119	117	105
Serious	9	5	1	7	4
Other / unknown	26	26	53	58	68
Serious	0	0	0	0	1

Appendix 2. Fatalities in 2010/11

Passenger				8
Date	**Location**	**Territory**	**Event type**	**Event description**
15/05/2010	Park Lane, Tyne & Wear	London North Eastern	Slip, trip or fall	An elderly woman fell on the escalator, causing her husband to fall and sustain a large cut to his forehead. The man was taken to hospital, where he later died.
05/06/2010	Earlsfield	South East	Platform-train interface	A male was injured after falling from the platform and coming into contact with the electrified third rail. The man was reportedly under the influence of alcohol. He died from his injuries en route to hospital.
01/07/2010	Stansted Mountfichet	South East	Platform-train interface	A passenger who was standing close to the platform edge was struck and killed by a passing train. The passenger, was reported to be under the influence of alcohol and drugs at the time of the incident.
08/07/2010	Langley Green	London North Western	Platform-train interface	A passenger train struck and killed a person who had fallen from the platform whilst reportedly under the influence of alcohol.
20/07/2010	Leytonstone High Road	South East	Physical assault	A passenger was fatally injured after falling down the stairs after being assaulted by another passenger. The police treated the incident as murder. A man was later arrested and charged.
23/07/2010	Twickenham	South East	Platform-train interface	A passenger alighted from a train, staggered across the platform and fell from the edge to the track. He was electrocuted on the third rail.
22/09/2010	Sudbury & Harrow Road	London North Western	Platform-train interface	A passenger fell from the platform whilst reportedly under the influence of alcohol. He was struck by a train and sustained fatal injuries.
24/03/2011	Canterbury West	South East	Slip, trip or fall	A man had been helped from a train whilst reportedly under the influence of alcohol the previous night and remained on the platform. He later fell on his face whilst walking along the platform and died from his injuries.

Workforce				1
Date	**Location**	**Territory**	**Employer:**	**Description**
13/04/2010	Stewarton Viaduct	Scotland	SW Global Resourcing	A contractor working for Network Rail was fatally injured after the cherry picker, which he was using while engaged on viaduct strengthening work, toppled over, causing him to fall around 70ft.

Public (not including suicide or trespass)				4
Level crossing users (pedestrians)				4
Date	**Location**	**Territory**	**LC type**	**Description**
16/05/2010	Gas House	London North Eastern	UWC	A 16-year old female was struck by a train, after reportedly chasing after her dog, which had run onto the crossing.
14/07/2010	Sherrington	South East	UWC	A man was fatally injured after running onto the crossing, reportedly in an attempt to retrieve his dog.
09/08/2010	Enfield Lock	South East	CCTV	One of a group of three suspects being pursued by the police was fatally injured after trying to cross the crossing when the barriers were lowered.
14/02/2011	Sharpenhurst	South East	footpath	A young man was struck by a train after jogging across the crossing while it was unsafe to cross. He was reportedly wearing earphones and listening to a personal music device at the time of the incident.

Trespass	27
At station	10
On or about the track	17

Suicide	208
Coroner's confirmed verdict	41
Application of Ovenstone criteria	167

Appendix 3. Interim methodology for assessment of trajectories and targets

The SRM is being used as the primary means of measuring the performance of the industry against the SSP trajectories and HLOS targets over CP4.

Full updates of the SRM occur at specific points during CP4. SRMv6 applied at the beginning of CP4, SRMv7 is being used to assess the change in risk occurring at the end of 2010/11, and at the end of CP4 (March 2014), SRMv8 will be used.

In producing SRMv7, some improvements to the modelling of a number of hazardous events and precursors took place. To ensure that comparisons of risk at the end of 2010/11 with risk at the start of CP4 are based only on changes in performance data, and not on changes in modelling approaches, SRMv6 risk estimates were updated to reflect the modelling changes used in SRMv7. The updated SRMv6 has been termed SRMv6.5. Both SRMv7 and SRMv6.5 take into account the additional risk estimated to be due to The under-reporting of RIDDOR-reportable injuries by Network Rail and its contractors, which particularly affects the area of infrastructure worker risk.

It has been agreed that between updates, an indication of the performance against the targets and trajectories 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 methodology was reviewed and endorsed by Safety Policy Group (SPG)[86] in October 2009.

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.

The measures produced by the interim methodology are normalised to account for changes to the use of the network. The normalisers used are those most appropriate for the target or trajectory under consideration. The main normalisers are the number of train miles, passenger journeys, and workforce hours.

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

Table 34. Event types and interim assessment methodology for SSP trajectories

	March 2009 baseline risk	March 2011 update risk	Hazardous events (HEs) covered	Interim assessment methodology	Normaliser
	SRMv6/6.5	SRMv7			
Passenger slips, trips and falls in stations	22.44	23.42	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	10.13	10.44	Accidents during boarding/alighting, and falls from the platform, with or without a train present.	As (i)	Passenger journeys
Passenger on-board injuries	3.88	4.06	All injuries on-board trains, excluding assaults or resulting from train accidents.	As (i)	Passenger kms
Passenger assault	8.08	8.07	Assaults occurring anywhere on NRMI.	As (i) - number of events is taken from BTP data	Passenger journeys
Infrasctructure worker injuries	#N/A	#N/A	All injuries occurring to infrastructure workers, wherever the location, and whatever the cause.	As (I)	Workforce hours
Train crew on-board injuries	3.72	3.20	All injuries on-board trains, excluding assaults or resulting from train accidents. Includes injuries to revenue protection staff on trains.	As (i)	Workforce hours
Station staff slips, trips and falls	1.30	1.24	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	1.73	1.20	Train crew assaults occurring anywhere on NRMI. Injuries to revenue protection staff on trains.	As (i)	Workforce hours
Station staff assault	1.37	1.07	Station staff assaults occurring anywhere on NRMI. Injuries to revenue protection staff in stations.	As (i)	Workforce hours
Public behaviour at LX	11.87	9.95	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	43.26	48.46	All injuries to people arising from trespass. Includes incidents of passenger trespass.	As (i)	No normaliser
Vandalism	0.42	0.46	Collisions, derailments or train fires due to vandalism.	As (ii)	Train kms
SPADs	0.88	0.86	Train accidents resulting from SPADs, where the cause of the SPAD is due to human error.	As (ii)	Train kms
Infrastructure failure	1.60	1.45	Train accidents resulting from infrastructure failure, including track defects, signalling failure, structural collapse.	As (ii)	Train kms
Rolling stock failure	0.46	0.49	Train accidents resulting from the failure of any rolling stock component.	As (ii)	Train kms
Not covered by an SSP trajectory	16.21	15.02			
Total system risk	140.6	140.9			

Appendix 4. Ovenstone criteria adapted for the railways

Every railway fatality in Great Britain (including Scotland) is classified as:

- Accidental
- A suicide (that is, in accordance with the coroner's verdict – or Scottish equivalent),
- A suspected suicide (using the criteria provided),

A suspected/attempted suicide requires objective evidence of suicidal intent (other than a coroner's verdict). It is a managerial assessment, based on applying the Ovenstone criteria adapted for the railways.

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:

- For the purpose of 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.

- 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)

In the absence of evidence fulfilling the above criteria, 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).

Appendix 5. Level crossing types

Level crossing population on NRMI (as at 31 December 2010)

	London North East	London North West	Scotland	South East	Western	TOTAL
MCG	112	13	3	43	18	189
MCB	93	25	16	45	51	230
MCB-CCTV	148	49	18	139	36	390
Total active manual	***353***	***87***	***37***	***227***	***105***	***809***
AHB	187	19	28	172	46	452
ABCL	11	3	3	19	16	52
AOCL/R	25	9	24	21	36	115
UWC-MWL	38	8	6	32	12	96
Total active automatic	***261***	***39***	***61***	***244***	***110***	***715***
UWC	283	71	55	184	212	805
UWC-T	380	150	310	286	488	1614
OC	15	4	2	13	19	53
footpath	586	338	77	673	782	2456
Total passive	***1264***	***563***	***444***	***1156***	***1501***	***4928***
TOTAL	**1878**	**689**	**542**	**1627**	**1716**	**6452**

Source: Network Rail. The table shows only open active level crossings. Level crossings that have been temporarily closed, are no longer used, or are on 'mothballed' lines have been omitted. 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 6. 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.
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-board injuries	All injuries on trains, excluding train accidents, assaults, and those occurring during boarding or alighting, or whilst leaning from trains.
Platform-train interface (boarding/alighting)	Accidents occurring whilst getting on or off trains. Includes falls between train and platform where it is not known if the person is boarding or alighting.
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, suspected suidice and attempted 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 or platforms, or are climbing on the outside of overbridges etc. People misusing them, whether by error of violation, are not included in this category.
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 7. Definitions

Term	Definition
Accidental	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 19) 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)	The aggregate amount of safety harm. One FWI is equivalent to: • one fatality, or • 10 major injuries, or • 200 RIDDOR-reportable minor injuries, or • 200 Class 1 shock/trauma events, or • 1,000 non-RIDDOR-reportable minor injuries, or • 1,000 Class 2 shock/trauma events.
Fatality	Death within one year of the causal accident.
Hazardous event	An incident that has the potential to be the direct cause of safety harm.
Infrastructure worker	A member of workforce whose responsibilities include engineering or technical activities associated with railway infrastructure. This includes track maintenance, civil structure inspection and maintenance, S&T renewal/upgrade, engineering supervision, acting as a controller of site safety (COSS), hand signaller or lookout and machine operation.
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 nine KRAs, covering causes of risk from engineering and workforce, passenger & public behaviour. Individually, the KRAs make a significant contribution to the overall safety risk profile of the railway; collectively they represent around 98% of the residual risk on the railway.
Level crossing	A junction between the road and the railway, where both are at ground-level. The different types of crossing are defined in Appendix 5.

Term	Definition
Major injury	An injury as defined in Schedule 1 of RIDDOR. This includes most fractures, amputations and losses of consciousness, or where the injury resulted in hospital attendance for more than 24 hours.
Minor injury	Physical injuries that are not major injuries. For the workforce, minor injuries are **RIDDOR-reportable** if they result in the staff member being unable to return to their normal duties for more than three days. For passengers and members of the public, minor injuries are **RIDDOR-reportable** if the injured person was taken directly to the hospital from the accident site. Other minor injuries are not reportable under RIDDOR, but must still be reported for compliance with *GE/RT8047*
National Reference Values (NRVs)	NRVs are reference measures indicating, for each Member State, the maximum tolerable level for particular aspects of railway risk. NRVs are calculated and published by the European Railway Agency, using Eurostat and CSI data.
Network Rail managed infrastructure (NRMI)	All structures within the boundaries of Network Rail's operational railway, including the permanent way, land within the lineside fence, and plant used for signalling or exclusively for supplying electricity for railway operations. It does not include stations, depots, yards or sidings that are owned by, or leased to, other parties. It does, however, include the permanent way at stations and plant within these locations.
Ovenstone criteria	An explicit set of criteria, adapted for the railway, which provides an objective assessment of suicide if 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 4
Passenger	A person on railway infrastructure, who either intends to travel on a train, is travelling on a train, or has travelled on a train. 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. Note that a train of empty coaching stock brought into a terminal station, for example, becomes a passenger train in service as soon as it is available for passengers to board.
Pedestrian	This refers to a person travelling on foot, on a pedal cycle, on a horse or using a mobility scooter.
Possession	The complete stoppage of all normal train movements on a running line or siding for engineering purposes. This includes protection as defined by the Rule Book (GE/RT8000).
Potentially higher-risk train accidents (PHRTA)	Accidents that are RIDDOR-reportable and have the most 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, trains running into road vehicles not at level crossings (with no derailment), train explosions, and trains being struck by large falling objects.
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.

Term	Definition
Public (members of)	Persons other than passengers or workforce members. This includes passengers who are trespassing (eg when crossing tracks between platforms), and anyone who commits, or attempts to commit suicide.
RIDDOR	*The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995* (RIDDOR) 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 runs between two distinct locations, as shown in Table A of the appropriate Sectional Appendix.
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.
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 120 individual models, each representing a type of **hazardous event**.
Shock/trauma	Shock or traumatic stress affecting an employee, passenger or member of the public who has been involved in, or a witness to, a **hazardous event**. **Class 1** Shock or trauma resulting from being involved in or witnessing events that have serious potential of a fatal outcome eg train accidents such as collisions and derailments, or personal accidents involving being struck by train. **Class 2** refers to all other causes of Shock or trauma resulting from other causes, such as verbal abuse and near misses, or personal accidents of a typically non-fatal outcome.
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** 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 stop safely.
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 2009-2014 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.

Term	Definition
Suicide and suspected suicide	A fatality is classified as a suicide where a coroner's verdict has returned a verdict of 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 the **Ovenstone criteria**.
Trackside	A collective term referring to the running line, Network Rail managed sidings and depots.
Train	Any vehicle (with flanged wheels on guided rails), whether self powered or not, on rails within the uk rail network. This includes locomotives, tramcars, trolley vehicles and other guided transport vehicles. This also includes the train carriages themselves.
Train accident	Reportable train accidents are defined in **RIDDOR**. The main criterion is that the accident must be on or affect the running line. There are additional criteria for different types of accident, and these may depend on whether the accident involves 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.*

Term	Definition
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.*
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.

Term	Definition
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 8. 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
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
ERA	European Railway Agency
ERTMS	European Rail Traffic Management System
EU	European Union
FWI	fatalities and weighted injuries
FWSI	fatalities and weighted serious injuries
GB	Great Britain
GSM-R	Global System for Mobile communications – Railway
HEM	hazardous event movement
HEN	hazardous event non-movement
HET	hazardous event train
HGV	heavy goods vehicle
HLOS	High Level Output Specification
HSE	Health and Safety Executive
HST	High Speed Train
KRA	Key Risk Area
LC	level crossing
LX	level crossing
MCB	manually controlled barrier crossing
MCG	manually controlled gate crossing
MOM	mobile operations manager
MOP	member of the public
MWL	miniature warning light
NHS	National Health Service
NPS	National Passenger Survey
NR	Network Rail
NRMI	Network Rail managed infrastructure
NRT	National Rail Trends
NRV	national reference values
NTS	National Travel Survey

Acronym	Expansion
OC	open crossing
OFG	Operations Focus Group
ORR	Office of Rail Regulation
OTP	on-track plant
PICOP	person in charge of possession
PHRTA	potentially higher-risk train accident
PIM	Precursor Indicator Model
PTI	Platform-train interface
RAIB	Rail Accident Investigation Branch
RGS	Railway Group Standard
RIDDOR	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995
ROGS	Railway and Other Guided Transport Systems (Safety) Regulations 2006
RSSB	Rail Safety and Standards Board
S&T	signal and telecommunications
SMIS	Safety Management Information System
SOCA	Serious Organised Crime Agency
SPAD	signal passed at danger
SPG	safety Policy Group
SPI	safety performance indicator
SRM	Safety Risk Model
SRP	Sustainable Rail Programme
SSP	Strategic Safety Plan
TOC	train operating company
TPWS	train protection and warning system
TSAG	Technical Strategy Advisory Group
UWC	user-worked crossing
UWC-T	user-worked crossing with telephone