Annual Safety Performance Report 2013/14

A reference guide to safety trends on GB railways

Annual Safety Performance Report 2013/14

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Executive summary

Introduction

This report reviews the rail industry's safety performance over the financial year 2013/14. 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 covered the period April 2009 to March 2014.

The Railway Safety Directive (2004/49/EC) states the requirement for Member States to ensure that safety is generally maintained and, where reasonably practicable, continuously improved. The trajectories of the SSP are in keeping with this aim as are the passenger and workforce safety targets laid out by the Department for Transport (DfT) in the HLOS. At the end of CP4, safety performance satisfies all of the SSP trajectories and both the HLOS safety targets. In addition, performance satisfies each of the National Reference Value (NRV) limits set for the UK by the European Railway Agency, and our railways compare very favourably with Europe as a whole. Rail continues to be one of the safest forms of GB land transport. Nevertheless, the industry is far from complacent about current levels of safety, and continues to seek opportunities to reduce risk, particularly in key areas such as signals passed at danger (SPADs) and workforce safety.

2013/14 Headlines

- In 2013/14, there were 1.59 billion passenger journeys (6% increase on 2012/13), 60.1 billion passenger kilometres (3% increase); the length of the average journey has decreased from 38.9km to 37.8km. In addition, 48.5 million freight train kilometres (1% increase) were recorded.
- There were no passenger or workforce fatalities in train accidents in 2013/14. This is the seventh year in succession with no such fatalities. At 0.2 events per year, the ten-year moving average for these train accidents is at its lowest ever level.
- Four passengers died in separate incidents, all at stations. When non-fatal injuries are also taken into account, the total level of passenger harm was 43.1 fatalities and weighted injuries (FWI); this is 9% lower than the 47.4 FWI (four fatalities) recorded for 2012/13; the decrease is due mainly to a fall in the number of major injuries. When normalised by passenger journeys, the rate of harm shows a 14% decrease compared with 2012/13. When CP4 is compared with CP3, there has been an observed improvement in normalised safety performance of 17%.
- There were three workforce fatalities; all were infrastructure workers. Including non-fatal injuries, the total level of workforce harm was 25.2 FWI, which is an increase of 10% compared with 22.8 FWI (two fatalities) occurring in 2012/13. The rate of harm normalised by workforce hours increased by 8%. When CP4 is compared with CP3, there has been an observed improvement in normalised safety performance of 20%.
- There were 32 potentially higher-risk train accidents (PHRTAs). This is a decrease of three on the previous year's total of 35. For the past four years, the number of PHRTAs has remained lower than levels seen prior to this period. When CP4 is compared with CP3, there has been an observed reduction of 39% in the normalised number of PHRTAs.
- There were no passenger train derailments. This is the first year with no such derailments since recording began more than 20 years ago. There were 11 non-passenger train derailments. There were no reported injuries resulting from derailment.
- The Precursor Indicator Model (PIM) provides a measure of trends in the underlying risk from PHRTAs. At March 2014, the overall indicator stood at 7.52 FWI, compared with 7.90 FWI at the end of 2012/13. The reduction was due mainly to reductions in the

number of events at level crossings. The passenger proportion of the PIM remained essentially level: at March 2014, it stood at 3.32 FWI, compared with 3.28 FWI at the end of the previous year.

- At 293, the number of SPADs occurring during 2013/14 was a 17% increase on the 250 occurring during 2012/13. At the end of 2013/14, the estimated level of risk from SPADs was 73% of the September 2006 baseline, compared with 60% at the end of 2012/13.
- At 308, the number of fatalities to members of the public was the highest recorded. Eight of the fatalities were members of the public at level crossings: two were occupants of the same road vehicle, who died when their car was involved in a collision with a train, and six (including one cyclist) were pedestrian users of footpath crossings. When CP4 is compared with CP3, there has been an observed reduction of 33% in the normalised level of harm at level crossings.
- The remaining three hundred fatalities to the public resulted from trespass or suicide. This is an increase of 22 on the 278 trespass and suicide fatalities occurring in 2012/13, and the highest figure recorded. When CP4 is compared with CP3, there has been no observed improvement in trespass and suicide as a whole.
- In total, and excluding suicides, there were 36 fatalities, 440 major injuries, 11,382 minor injuries and 1,238 cases of shock/trauma. The total level of harm was 102.1 FWI, compared with 116.9 FWI recorded in 2012/13. The main cause of the decrease was a fall in the number of fatalities to members of the public.

Risk from train accidents

The past seven consecutive 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 one passenger. Over time, there has been a falling trend in the rate of train accidents involving train occupant fatalities. The current level, based on a ten-year moving average, is the lowest recorded, at 0.2 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 6% of the total number of events that are classed under RIDDOR[1] as train accidents, but contribute around 93% of the train accident risk. In 2013/14, there were 32 PHRTAs, a decrease of three on the previous year. One resulted in a major injury to a passenger, when a collision occurred between two passenger trains during permissive working at a station.

As serious train accidents are rare, RSSB also analyses trends in accident precursors, using the PIM. The PIM indicates that the overall risk from PHRTAs has reduced significantly over the past decade. The most rapid improvement occurred in the period up 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). At the end of 2013/14, the PIM stood at 7.52 FWI, compared with 7.90 FWI at the end of 2012/13. The main reasons behind the overall reduction was a decrease in the number of events at level crossings.

The portion of the PIM related to the risk to passengers stayed essentially level; at the end of 2013/14 it stood at 3.32 FWI compared with 3.28 FWI at the end of 2012/13.

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

SPAD risk currently stands at 73% of the September 2006 baseline level. Although the general long-term trend has been decreasing, more recent performance has shown an upwards trend.

Risk to passengers

Four fatalities occurred during 2013/14, all at the platform-train interface. Based on RSSB's Safety Risk Model (SRM), the platform edge and the interface between train and platform form the greatest source of passenger fatality risk. Most of the fatality risk does not arise from boarding or alighting, but is due to people falling from the platform, or coming into contact with trains while standing too close to the platform edge.

The total number of major injuries to passengers in 2013/14 was 270, compared with 312 recorded for 2012/13, which is a fall of 13%. The reduction is due mainly to a decrease in the numbers of major injuries in stations.

The number of crimes against the person (passengers and public) recorded by British Transport Police for 2013/14 was 3,536, which is higher than the 3,452 recorded for the previous year. When normalised by passenger journeys, the rate of incidents fell by 3%, reaching its lowest recorded level. The likelihood of being the victim of crime during the average rail journey is around one in 450,000.

Risk to the workforce

Three members of the workforce, all infrastructure workers, were killed in 2013/14. Two men died in the same accident, which was a road traffic collision while on duty. The third worker was acting as lookout for a small group working south of a station, when he was struck by a passenger train approaching the station.

Most workforce fatalities have been infrastructure workers. Since 2004/05, there have been 25 workforce fatalities, 20 of whom were infrastructure workers. Infrastructure workers also dominate the major injury figure; since 2004/05, around 60% of major injuries have occurred to this group.

The total number of workforce major injuries was 126, which is 11% higher than the 114 recorded for 2012/13. However, since 2006/07, workforce major injuries have been at a generally lower level than before that date.

In 2013/14, the level of harm from workforce assault was 1.6 FWI, remaining at its lowest recorded level.

Risk to members of the public

Where available, coroners' verdicts are used as the basis for categorising relevant public fatalities as suicide or accidental trespass. Where a coroner's verdict is returned as open or narrative, or where it is not yet returned, the industry applies the Ovenstone criteria to determine the most probable circumstances, ie either trespass or suicide. Throughout 2013/14, a greater amount of information about fatalities related to trespass and suicide was made available by BTP to the industry, through the enhanced co-operation taking place under the National Suicide Prevention Working Group. A specific team was established within BTP, and has worked with Network Rail and RSSB to look at classification of fatalities. As part of this partnership, BTP have been able to share more information on railway fatalities as far back as 2009/10. This has enabled the industry to review a number of cases where the Coroners' verdict is not yet returned, or was recorded as open or narrative, and re-assess them against the Ovenstone criteria. An outcome of this increased data sharing is

that while trespass and suicide data should be more accurate over the past five years, the analysis of separate trends in suicide and trespass across the decade as a whole cannot be done on a consistent basis.

The number of accidental public fatalities due to trespass was 21 in 2013/14, compared with 32 in 2012/13. Over the past five years, the average number of trespass fatalities has been 33. The number of public fatalities due to suicide or suspected suicide was 279, compared with 246 in 2012/13. Over the past five years, the average number of suicide and suspected suicide fatalities has been 244.

Risk at the road-rail interface

The total level of harm at level crossings was 8.7 FWI, of which eight were fatalities. Of these, two were occupants of the same road vehicle, who died when their car was involved in a collision with a train, and the remaining six were public pedestrian users (including one cyclist). There were no passenger or workforce fatalities at level crossings. Since 2004/05, there has been an average of 12 collisions per year between trains and road vehicles at level crossings. There were ten such incidents during 2013/14, and there is some evidence that the underlying rate of train collisions with road vehicles at level crossings has reduced over the past ten years.

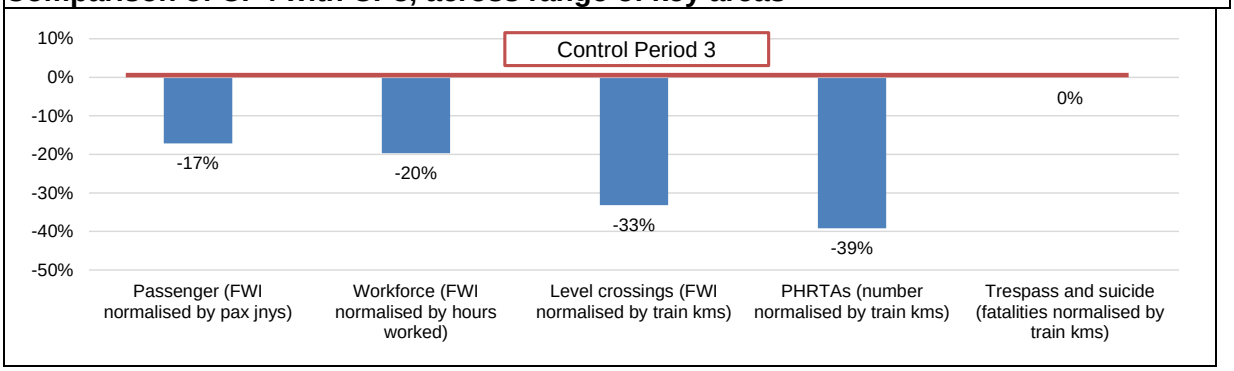
Away from level crossings, the other sources of road-rail interface risk are vehicle incursions and bridge strikes. At 48, the number of vehicle incursions onto the railway was a decrease of nine on the previous year, and below the ten-year average of 66. One incursion involved a collision with a train; there were no reported injuries to occupants of the train or car. At 35, the number of serious or potentially serious bridge strikes was an increase of three compared with 2012/13, but below the ten-year average of 41.

Summary

In comparison with the previous year, 2013/14 has seen some areas of improvement, and some areas where levels of harm have increased. Over the duration of CP4 as a whole, the industry has achieved notably lower rates of train accidents and their precursors, and of injuries to passengers, public and workforce, with the exception of fatalities due to trespass and suicide. When normalised by the increase in system operation, as reflected in train kms, there has been no change in this area.

Against the background of the SSP trajectories and HLOS targets set for CP4, as well as the longer-term context of the European NRV limits, GB performance has met the European requirement to ensure that safety is generally maintained and, where reasonably practicable, continuously improved.

Comparison of CP4 with CP3, across range of key areas



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 analyses of safety performance on the mainline railway. The RSSB Learning from Operational Experience Annual Report (LOEAR) - the 'sister' publication to the ASPR - contributes to this process by providing information on learning points that have arisen across those areas.

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. RSSB is the main source of mainline rail safety statistics in Great Britain, and its figures are reproduced in the Office of Rail Regulation's (ORR) publication *National Rail Trends* and the Department for Transport's (DfT) *Transport Statistics Great Britain*.

This ASPR presents the railway's safety trends across a number of topic areas for the financial year 2013/14, covering the period 1 April 2013 to 31 March 2014. RSSB reports on a financial year basis for consistency with Control Period 4 (CP4), its associated High Level Output Specification (HLOS) and the SSP. This is the last ASPR to report on safety performance relating to CP4; the next ASPR will report on safety performance during the first year of CP5.

1.2 Scope of the report

The analysis in this report relates to the mainline railway in Great Britain. Its scope is generally limited to incidents connected with the operation of the railway, in stations, on trains, or elsewhere on Network Rail managed infrastructure (NRMI), such as the track and the trackside. Fatalities and injuries to the workforce occurring as a result of road traffic accidents while driving between sites to carry out work in association with the maintenance or working of the operational railway are included. Workforce fatalities that occur during working time in yards, depots and sidings are also included; non-fatal injuries in these locations are currently not within scope, but will become so in future years (see Appendix 4 for details). A more complete outline of the scope can be found in Appendix 3.

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. This includes the 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, it is stated in a chart footnote.

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

1.3 How safety is analysed in the report

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 suicide, or attempt to do so. People who are injured in this way are classified and 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). In some charts and tables, the subgroups may not sum exactly to the totals shown on the chart or table due to the effects of rounding 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.

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

Charts and risk estimates based on the SRM are used within the ASPR to set the context for a particular area or topic. The SRM is updated periodically, and the SRM information presented in this report is taken from the latest update – SRM version 8 – which was released in March 2014.

There are around 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 8 provides a list of groupings that are commonly used through the report.

Table 1. Injury degrees and weightings

Injury degree	Definition	Weighting	Ratio
Fatality	Death occurs within one year of the accident.	1	1
Major injury	Injuries to passengers, staff or members of the public as defined in schedule 1 to RIDDOR 1995 amended April 2012. This includes losing consciousness, most fractures, major dislocations, loss of sight (temporary or permanent) and other injuries that resulted in hospital attendance for more than 24 hours.	0.1	10
Class 1 minor injury	Injuries to passengers, staff or members of the public, which are neither fatalities nor major injuries, and: • for passengers or public, result in the injured person being taken to hospital from the scene of the accident (as defined as reportable in RIDDOR 1995[2] amended April 2012) • for workforce, result in the injured person being incapacitated for their normal duties for more than three consecutive calendar days, not including the day of the injury.	0.005	200
Class 2 minor injury	All other physical injuries.	0.001	1000
Class 1 shock/trauma	Shock or trauma resulting from being involved in, or witnessing, events that have serious potential for a fatal outcome, eg train accidents such as collisions and derailments, or a person being struck by train.	0.005	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.	0.001	1000

1.3.3 Methodology

The majority of ASPR analyses are based on data over a ten-year period. When considering trend analysis, it is important to differentiate between real changes in underlying risk 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 risk, 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'.

[2] RIDDOR refers to the *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations,* a set of health and safety regulations that mandate the reporting of, *inter alia*, work-related accidents. These regulations were first published in 1985, and have been amended and updated several times. In 2012, there was an amendment to the RIDDOR 1995 criteria for RIDDOR-reportable workforce minor injuries from three days to seven days. For the purposes of the industry's safety performance analysis, the more-than-three-days criterion has been maintained, and the category termed *Class 1* minor injury. In the latest version of RIDDOR, published in 2013, the term 'major injury' was dropped; the regulation now uses the term 'specified injuries' to refer to a slightly different scope of injuries than those that were classed as major. Again, for consistency in industry safety performance analysis, the term major injury has been maintained, along with the associated definition from RIDDOR 1995.

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 unclear or incomplete 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 many months after the death, and even then may be returned as an 'open' or narrative verdict. In this situation, RSSB makes a judgement (using the Ovenstone criteria – see Appendix 6 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 2013/14 ASPR was 28 April 2014 for SMIS data.

1.5 Report structure

As in previous ASPRs, the *Safety overview* immediately follows this introduction. This sets the overall context by presenting the current industry risk profile, as based on SRMv8, together with an overview of safety performance during 2013/14 and consideration of the long-term changes in railway usage and performance.

The *Progress against industry 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 railway performance* chapter compares the mainline railway 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 at a more local level.

Trends in safety performance related 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 safety at the road-rail interface (ie level crossings, vehicle incursions and bridge strikes) 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 the on-going initiative 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.

1.6 ASPR Dashboard

Even though the ASPR is a document of considerable length, it is not feasible to include all of RSSB's data or analysis. An ASPR dashboard is available to supplement the report.

The dashboard is an interactive tool, which allows users to interrogate the ASPR charts and data based on their particular preferences. The ASPR dashboard is accessible to registered users of RSSB's website www.safetyriskmodel.co.uk; the website also contains other useful information about RSSB's tools and products in the areas of risk analysis and safety decision-making.

If you are unable to find the answers to your safety performance questions here, in our other publications, or via the dashboard, please contact us; we will be happy to be of assistance wherever possible. Contact details are provided on the title page of this report.

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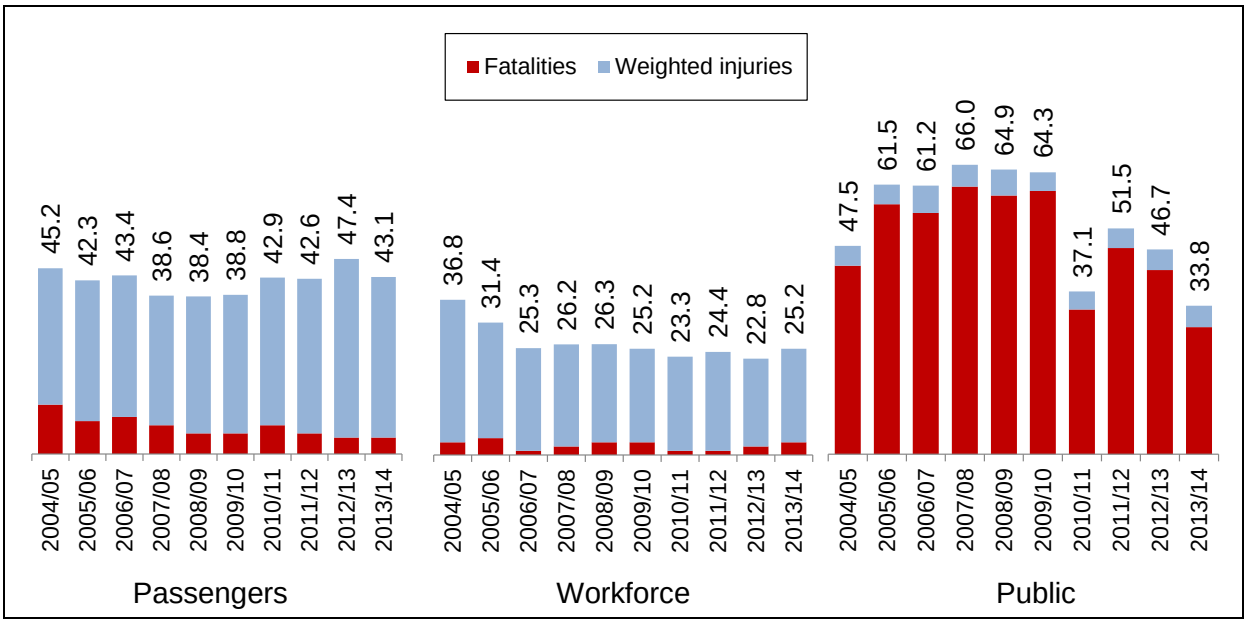
2 Safety overview

The Railway Safety Directive (2004/49/EC) states the requirement for Member States to ensure that safety is generally maintained and, where reasonably practicable, continuously improved. Over the past decade, industry initiatives have brought about improvements in the safety of both passengers and workforce from train accidents and personal accidents, both on absolute and normalised terms. Over the same period of time, passenger journeys and passenger kilometres have risen by 53% and 44% respectively, and train kilometres by 11%.

2013/14 Headlines

- There were no passenger or workforce fatalities in train accidents. This is the seventh year in succession with no such fatalities.
- In total, there were 36 accidental fatalities, 440 major injuries, 11,382 minor injuries and 1,238 cases of shock/trauma. The total level of harm (excluding suicide) was 102.1 FWI, compared with 116.9 FWI recorded in 2012/13. The main cause of the decrease has been a fall in the number of accidental fatalities to members of the public.
- Of the 37 fatalities, four were passengers, three were members of the workforce and the remaining 30 were members of the public, 21 of whom were engaged in acts of trespass. The remaining public fatalities occurred at level crossings.
- Comparing 2013/14 with 2012/13, there has been a decrease in passenger FWI of 9%, an increase in workforce FWI of 10%, and a fall in public FWI of 28%.
- The number of passenger journeys in 2013/14 was 1.59 billion; this is 6% higher than in 2012/13. When normalised by passenger journeys, the rate of passenger harm showed a decrease of 14%, in comparison with 2012/13.
- The number of workforce hours in 2013/14 was 3% higher than in 2012/13. When normalised by workforce hours, the rate of workforce harm showed an increase of 8%.
- In addition to the injuries above, which were accidental in nature, a further 279 people died as a result of suicide or suspected suicide. This is the highest number recorded for the past decade.

System safety at a glance



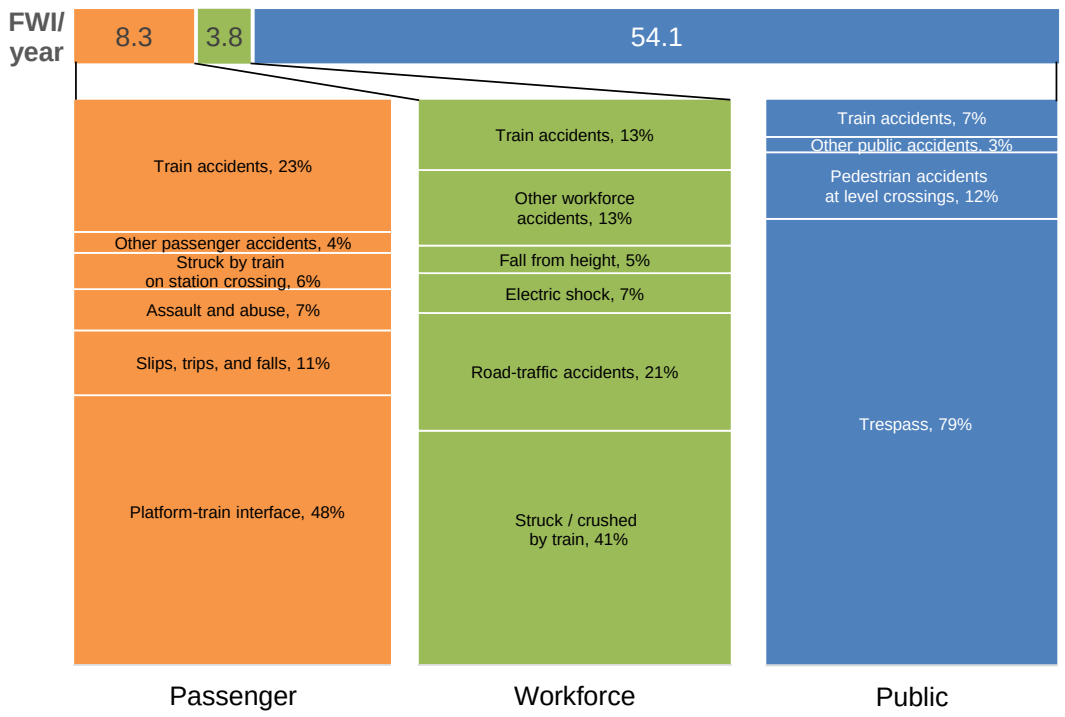
2.1 System risk profile

The SRM estimates the underlying level of risk for the different types of hazardous events and precursors that can occur on the railway. In any given year, the observed levels of harm may differ from SRM modelled risk. One reason for this is statistical variation of frequently occurring events. Another is that the SRM provides an estimate of the risk from low-frequency, high-consequence events that may not have occurred during the year, such as train accidents with on-board injuries.

2.1.1 Fatalities

This section presents the SRMv8 fatality risk profile for passengers, the workforce and members of the public arising from the risk area groups identified in the 2009-2014 SSP. The horizontal bar chart shows the proportion of system risk occurring to each person type and the vertical bars show the different types of events making up each proportion. The chart excludes fatality risk due to suicide and suspected suicide.

Chart 1. Fatality risk profile from SRMv8, excluding suicide (66.2 fatalities/year)



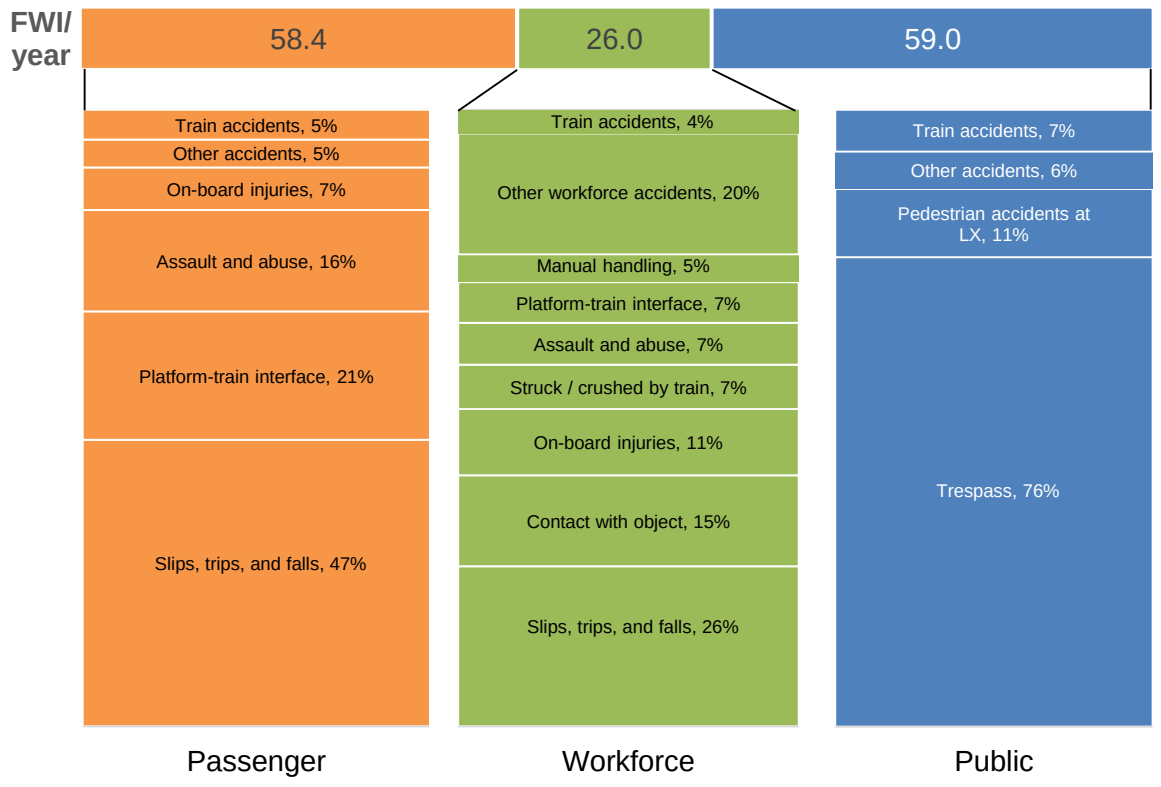
The accidental fatality risk from all sources on the railway is estimated to be 66.2 fatalities per year.

- 12% of the total fatality risk occurs to passengers. The largest contribution to passenger risk arises from accidents at the platform-train interface (PTI); most of this risk is not due to boarding or alighting, but to accidents such as falls from the platform edge. Train accident risk accounts for 23% of the fatality risk to passengers.
- 6% of the total fatality risk occurs to the workforce. The majority of this involves staff (mainly infrastructure workers) being struck by trains. Train accident risk accounts for 13% of the fatality risk to the workforce.
- 82% of the total fatality risk occurs to members of the public. The largest contribution to public risk arises from trespass, with a further 12% occurring to pedestrian level-crossing users. Train accident risk accounts for 7% and, for the most part, affects road vehicle occupants at level crossings.

2.1.2 Fatalities and weighted injuries

This section presents the SRMv8 risk profile for passengers, the workforce and members of the public, this time on a FWI basis. Fatalities and 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 are incorporated. To give a complete picture of risk on the railway, the information includes the estimated FWI risk from assaults.[3]

Chart 2. FWI risk profile from SRMv8, excluding suicide (143.4 FWI/year)



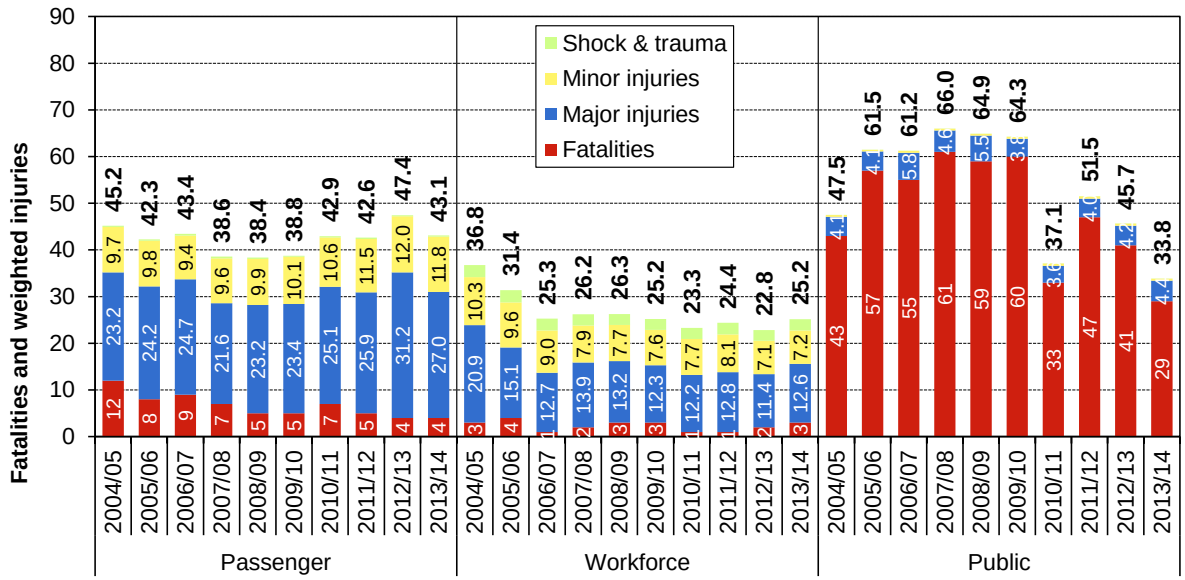
- The accidental FWI risk from all sources on the railway is estimated to be 143.4 FWI per year. FWI risk is split more evenly than fatality risk – 41% occurs to passengers, 18% to the workforce, and 41% to members of the public.
- Nearly half of the FWI risk to passengers arises from slips, trips and falls. The PTI also contributes a notable proportion, with accidents during boarding or alighting accounting for half of this risk. Train accidents account for 5% of the FWI risk to passengers.
- Workforce FWI risk arises from a wide range of sources. Slips, trips and falls account for just over a quarter of the risk, with train accidents accounting for less than 5%.
- The FWI risk profile for members of the public is very similar to the fatality risk profile. The majority of public risk is fatality risk. This is partly due to reporting issues (for example, minor injuries as a result of trespass are less likely to come to the railway's attention) but mostly due to the nature of the events involved, which have a higher likelihood of severe consequences when they occur.

[3]Although some assaults on passengers and members of the public are recorded in SMIS, the BTP CRIME database contains a more complete dataset. The SRM estimates for assaults on passengers and members of the public are therefore based on BTP data.

2.2 Fatalities and injuries in 2013/14

Chart 3 shows the accidental fatalities and weighted injuries that occurred during 2013/14 compared with each year since 2004/05. 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 2013/14.
- Thirty-six people died as a result of other incidents. Four were passengers, three were members of the workforce and the remaining 29 were members of the public, 21 of whom were engaged in acts of trespass. When non-fatal injuries are taken into account, the total harm occurring during the year was 102.1 FWI.
- The level of harm to passengers is lower than 2012/13, due mainly to a decrease in the number of major injuries. At four, the number of passenger fatalities is the joint lowest passenger total on record. The level of harm to members of the workforce is higher than for 2012/13, due to the occurrence of one more fatality and an increase in the number of major injuries.
- The level of accidental harm to members of the public is lower than 2012/13, due to a fall in trespasser fatalities.
- A further 279 people died as a result of suicide or suspected suicide. This is the highest number recorded over the past decade. Improved information relating to public fatalities from 2009/10 onwards was made available during 2013/14, which has enabled a greater number of suspected suicides to be identified (see section 7.2 for details). However, this alone is unlikely to have caused the generally higher number of fatalities in the latter half of the decade.

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

	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Fatality	193	225	224	207	218	238	207	249	246	279
Major injury	21	32	34	28	34	26	36	23	34	54

2.3 Notable safety-related occurrences of 2013/14

This section presents a selection of the safety-related events of 2013/14.

April 2013

Queens Road Peckham, South East London: Elderly passenger falls from the platform and suffers heart attack

On 4 April, an elderly female passenger fell onto the tracks at a station into the path of an approaching train. The passenger suffered a heart attack at the scene as a result of the accident. Although the train passed over the passenger, this was not the cause of the fatal outcome.

Great Coates, Lincolnshire: Car occupants die following collision with train at level crossing

On 9 April, a passenger train struck a car at the AHB crossing at Great Coates station. The car contained two occupants, both of whom were fatally injured. The train did not derail and there were no reported physical injuries, although the train driver reported suffering from shock.

May 2013

Bradford Interchange station, West Yorkshire: Passenger train collides with buffer stops

On 2 May, a passenger train arriving at the station collided with the buffer stops, pushing them back approximately one metre. The TPWS overspeed sensor was not activated due to the low speed of the train; the driver applied the brakes too late to stop before the buffer stops. The conductor and two passengers reported minor injuries.

June 2013

Newark, Nottinghamshire; Two Network Rail contractors are fatally injured in a road traffic accident whilst on duty

On 19 June, two infrastructure workers were fatally injured in a car accident whilst travelling between sites while on duty. The two members of staff had been welding on site at Langley Junction in Lincolnshire, and whilst returning to their depot the car was reported to have collided with the rear of a lorry that was parked in a layby of the A1.

July 2013

[4]Buttington Hall UW: A passenger train struck a trailer on a user-worked crossing

On 16 July, a passenger train struck a trailer being towed across Buttington Hall user-worked crossing by a tractor. The train was not derailed by the impact. The train driver, guard and 13 passengers suffered minor injuries, and one passenger shock/trauma. RAIB investigated the accident and concluded that it occurred because the system of work in use at the crossing was unsafe, leading to ineffective control of road vehicle movements and frequent use of the crossing without the signaller being contacted.

[4] Photo reproduced by kind permission of RAIB.

Norwich station, Norfolk: Passenger train collides with stabled train at platform

On 21 July, a passenger train was routed into a platform at Norwich and collided with a train stabled there during conditions of permissive working. One passenger suffered a major injury and a further 17 received minor injuries. RAIB investigated the incident and concluded that it was the result of either a lapse in concentration or a microsleep by the driver, during the last 20 seconds of his approach to the station.

August 2013

[5]Stoke Lane level crossing, Nottingham: Freight train partially derails due to track dip

On 27 August, two wagons of a freight train conveying diesel derailed after encountering a track dip on a level crossing. The train was travelling at around 50 mph when the driver noted an irregularity in the track as he went over the crossing. Examination of the track revealed that the derailment had been caused by a severe track dip, related to a large void in the ground running across both the up and down lines. Both derailed carriages remained upright and there was no leakage of the diesel fuel, but 1,000 yards of track was damaged by the incident. RAIB launched an investigation into the event.

Southend Central station, Essex: Platform 'roll-off' incident involving a wheechair

On 28 August, a wheelchair being used by an elderly woman rolled off the platform and onto the track at Southend Central station. The wheelchair brake had not been applied, and subsequently began to move towards the platform edge, before falling with the occupant still strapped inside. Passengers and members of staff went to assist the woman. No train was involved in the incident, but the woman suffered a broken hip from the fall. The woman was being accompanied by a carer, and at the time of the incident a member of station staff was also present, but neither noticed the wheelchair begin to roll towards the platform edge. An examination of the platform revealed a gradient towards the track was present in the area where the wheelchair was originally positioned.

This is one of two platform 'roll off' incidents subject to a group investigation by RAIB.

September 2013

Whyteleafe Station, Surrey: Platform 'roll-off' incident involving a pushchair

On 17 September 2013, a woman with a small child and a baby in a pushchair was purchasing a ticket from a machine on the platform, leaving the pushchair parallel with the railway while she did so. She did not apply the hand brake on the pushchair and did not notice that it had started to roll forward. The pushchair then turned through 90 degrees and fell onto the track, narrowly missing the live conductor rail. The woman and other passengers jumped onto the track to recover the baby and pushchair. Examination of the platform identified that a gradient was present around the area where the ticket machine had been installed, both parallel with the track and falling towards it.

This is the second of two platform 'roll off' incidents subject to a group investigation by RAIB.

[5] Photo reproduced by kind permission of RAIB.

October 2013

Gloucester: Freight train derails but continues for several miles, without driver being aware

On 15 October, the rear axle of the rear wagon of a freight train derailed on approach to Gloucester station. The train driver was unaware of the derailment and the train continued with one axle derailed for a distance of around 3.8 miles (6.1 km) until the derailed wagon collided with a set of facing points. As a result, both wheelsets were torn from the rear bogie and the empty container on the rear wagon was thrown off. As the driver still remained unaware, the train then continued towards Gloucester causing further damage to the track and wagon, damaging two bridges and throwing some debris onto a road below. No one was injured as a result of this accident. RAIB launched in investigation into the incident.

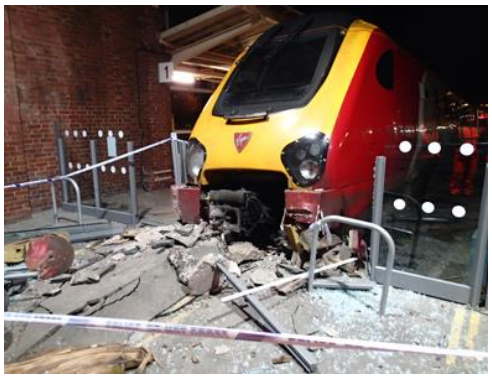
November 2013

East Croydon station, Surrey: Passenger fatality after fall from platform

On 06 November, a male passenger stumbled and fell backwards from the platform onto the tracks at East Croydon station. He was taken to hospital with suspected spinal injuries and later died. Alcohol was reported to be a potential factor in the incident.

[6]Chester station, Cheshire: Passenger train strikes buffer stops

On 20 November, a passenger train arriving at Chester struck the buffer stops after experiencing problems whilst braking. The front bogies of the front coach derailed and significant damage was caused to the platform and the buffer stops. Four passengers and one member of train crew sustained minor injuries. RAIB launched an investigation into the incident.



December 2013

Mansfield Viaduct, Nottinghamshire: Passenger struck by a train

On 21 December, a male passenger on the track at Mansfield Viaduct station was hit by a through train and fatally injured. It is unclear how the person came to be on the line. It was reported that at one point the man was sitting with his legs over the platform edge, and alcohol was reported to be a potential factor in the incident.

Storms and strong winds result in heavy traffic disruption

During much of December and into the New Year, storms and strong winds affected Britain, bringing much travel disruption. With winds of up to 80 mph predicted, speed restrictions were imposed on some routes to reduce the risk from trees, branches and other debris on the line. During the month around the Christmas period, the railway dealt with multiple and sustained extreme weather conditions. Storm-force winds brought down several hundred trees onto the railway while torrential rain caused large numbers of floods and landslips, some blocking major routes.

[6] Photo reproduced by kind permission of RAIB.

January 2014

Shropshire: Passenger train strikes an engineering trolley at high speed

On 17 January, a passenger train travelling between Manchester Piccadilly and Shrewsbury struck an engineering trolley at 70mph. The trolley had been placed in error on an open line adjacent to a work site. There were no injuries on the train, but one site worker suffered shock and another received minor injuries.

Newark Northgate station, Nottinghamshire: Infrastructure worker struck by passenger train and fatally injured

On 22 January, an infrastructure worker who was acting as lookout for a small gang engaged in the inspection of points to the south of Newark North Gate station, was struck by a passenger train approaching the station. The injured person was taken to hospital by air ambulance, but died of his injuries on 31 January. RAIB launched an investigation into the incident.

February 2014

Devon and Cornwall: Storms result in widespread flooding and damage

Early in February, the country was again subjected to severe weather conditions, resulting in widespread flooding and travel disruption. The Dawlish line was heavily affected; necessitating eight weeks of painstaking reconstruction by Network Rail, involving a team of around 300 engineers.

Charlbury station, Oxfordshire: Workforce suspected suicide

On 26 February, an infrastructure worker was struck by a passenger train to the west of Charlbury Station. The man was acting as watchman for a gang engaged in track work. It is currently believed that the event was a deliberate act and it is therefore currently classed as a suspected suicide.

March 2014

Shepherds Bush, West London: Passenger fatality after fall from platform

On 01 March, a train travelling through Shepherds Bush station in the early hours of the morning reported striking a person on the track. CCTV appeared to show the person fall from the platform while under the influence of alcohol, a short while before the train approached.

Cattishall, Suffolk: Cyclist struck by a train on level crossing

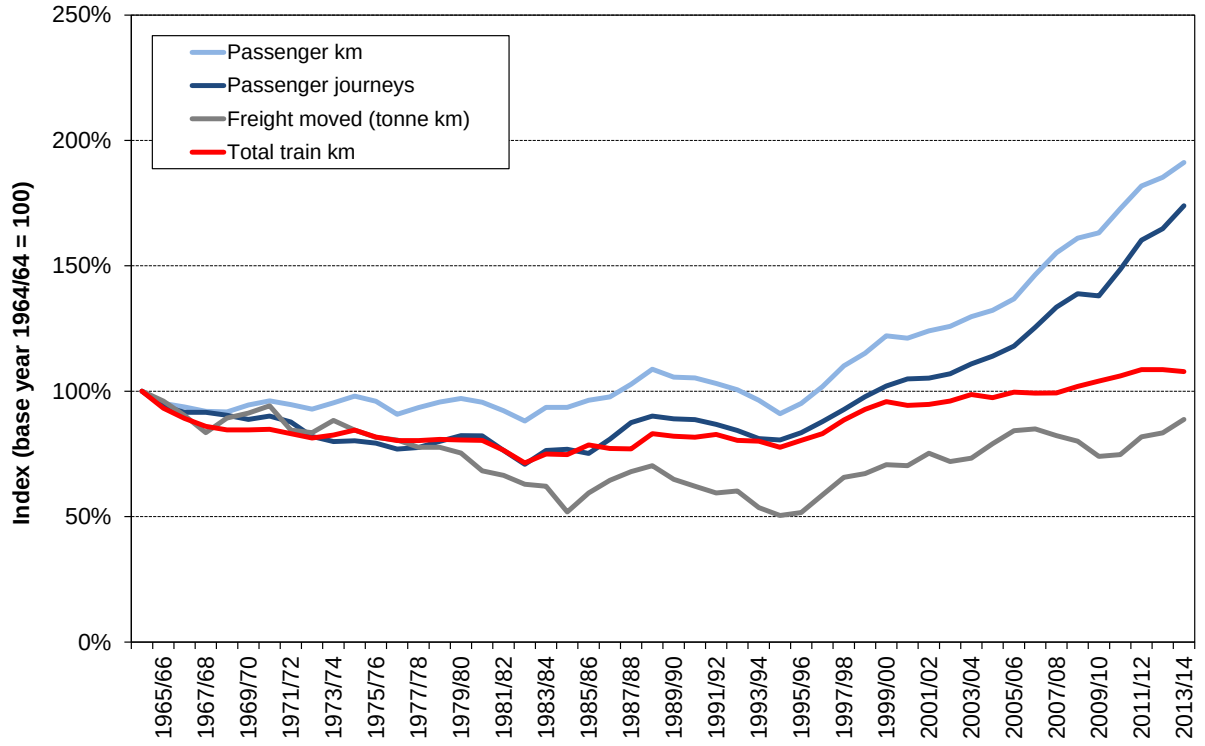
On 24 March, a cyclist was struck by a train on Cattishall level crossing. The train driver reported that the cyclist opened the gate and crossed without appearing to observe the approach of the train.

2.4 Long-term historical trends

2.4.1 Rail usage

In 2013/14, there were 1.59 billion passenger journeys (6% increase on 2012/13), 60.1 billion passenger kilometres (3% increase), and 48.5 million freight train kilometres (1% increase).

Chart 4. Trends in rail usage over the past 50 years

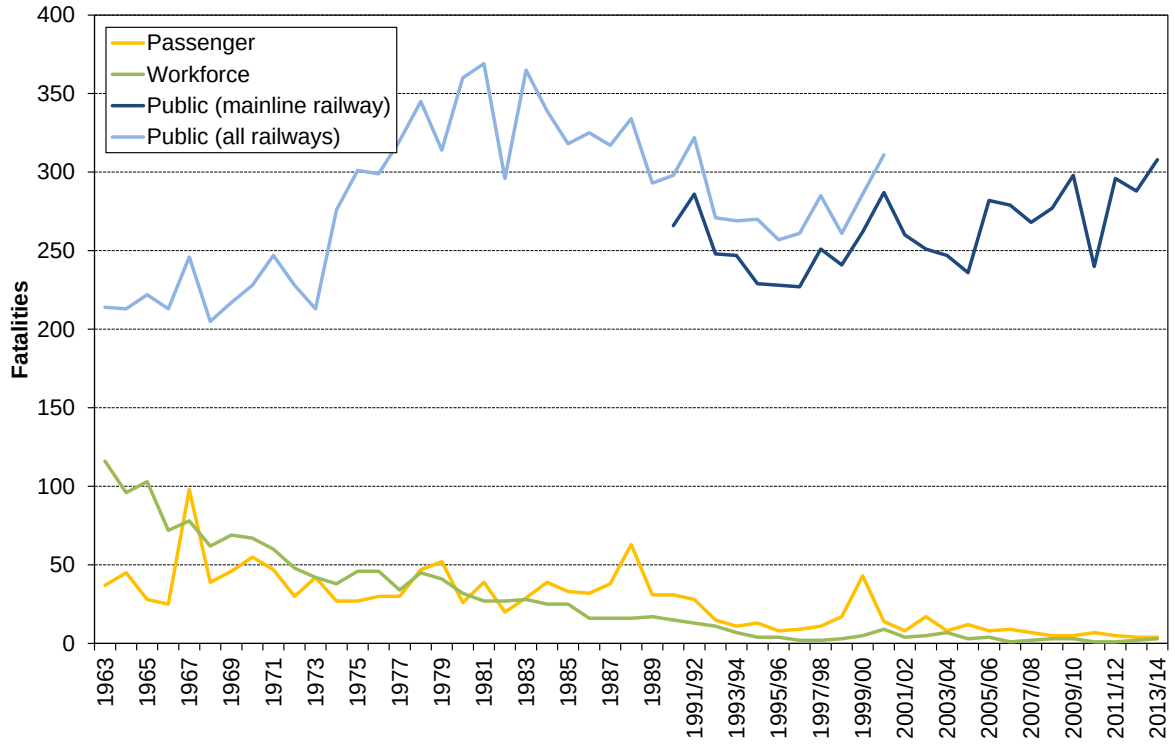


Data source: ORR National Rail Trends and DfT Transport Statistics Great Britain

- Between the mid 1960s and the early 1980s, passenger journeys and passenger kilometres showed decreasing or flat trends, 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 briefly showed a small decrease. However, figures since then indicate that this was a temporary effect, with usage again showing rising trends.
- Up until around 2006/07, freight usage showed a similar trend to passenger usage, although it has never regained the volumes seen in the early 1960s and earlier. Following 2006/07, there was a short period of decreasing usage, which now appears to be reversing.
- Over the past decade (2004/05 to 2013/14):
  - Passenger kilometres have increased by 44%
  - Passenger journeys have increased by 53%
  - Freight tonne kilometres have increased by 12%
  - Train kilometres have increased by 11%

2.4.2 Fatalities

Chart 5. Trends in fatalities over the past 50 years



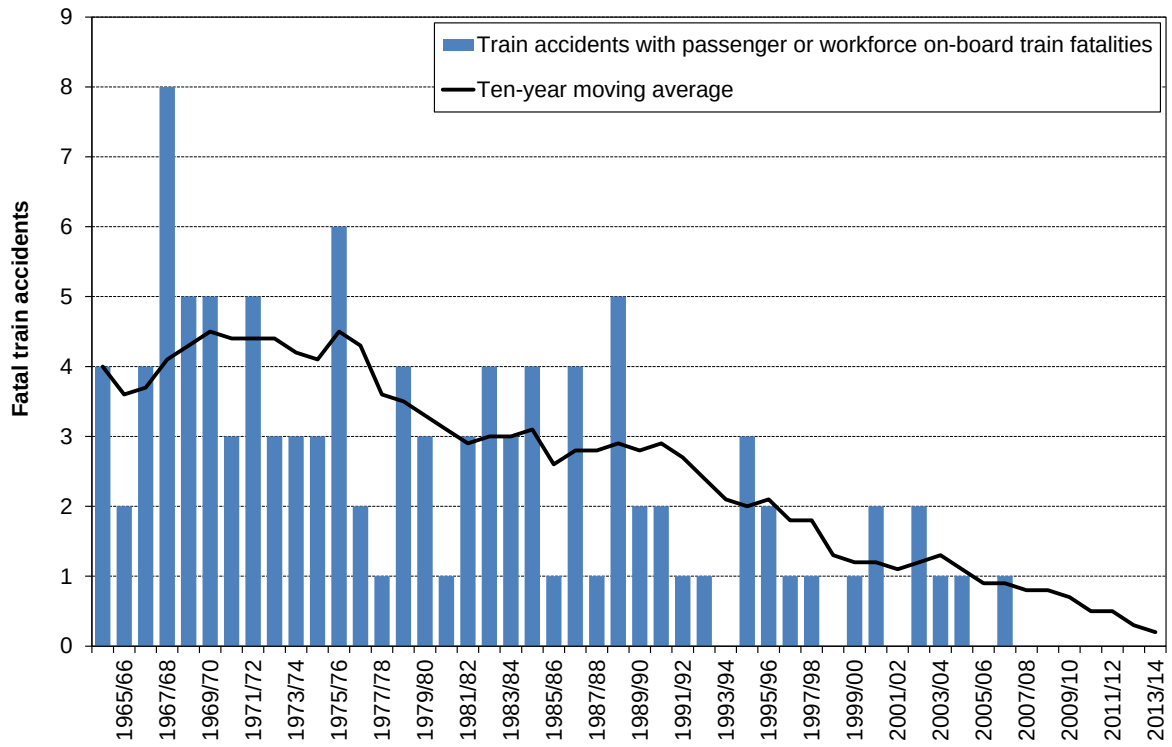
- The trend in fatalities for both passengers and workforce has shown marked long-term improvement.
- The greatest improvement over the past 50 years has been in the number of workforce fatalities, which exceeded 100 per year in the early 1960s, but is now typically lower than five per year.
  - The amount of maintenance work being performed in the early 1960s, 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 (mainly trespass, suicide and suspected suicide) are shown for the whole railway system (ie including London Underground and other non-mainline railways) up to 2001/02 and for the mainline railway only from 1990/91 onwards. The ten-year period of overlap indicates that the shape of the trend is similar, with or without the inclusion of non-mainline data.
- 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. The number of public fatalities recorded for the mainline railway in 2013/14 is at its highest point.

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

2.4.3 Train accidents

Over the past 50 years, there have been many improvements in rail operations and management, such as multi-aspect signalling and increased application of the Automatic Warning System. In more recent years, there have been developments in the areas of SPAD risk, including the implementation of the Train Protection and Warning System, improvements in track quality and increased crashworthiness of rolling stock. These have all led to further reductions in train accident risk.

Chart 6. Fifty-year trend in train accidents with passenger or workforce fatalities



- There were no train accidents resulting in passenger or workforce fatalities during 2013/14. This is the seventh year in succession with no such fatalities.
- Over the last 50 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 on-board fatalities is 0.2 per year. This is the lowest level achieved to date.
- The chart does not show train accidents that result solely in fatalities to members of the public, for example as might result from a train collision with a road vehicle at a level crossing.

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

2.5 The management of system risk

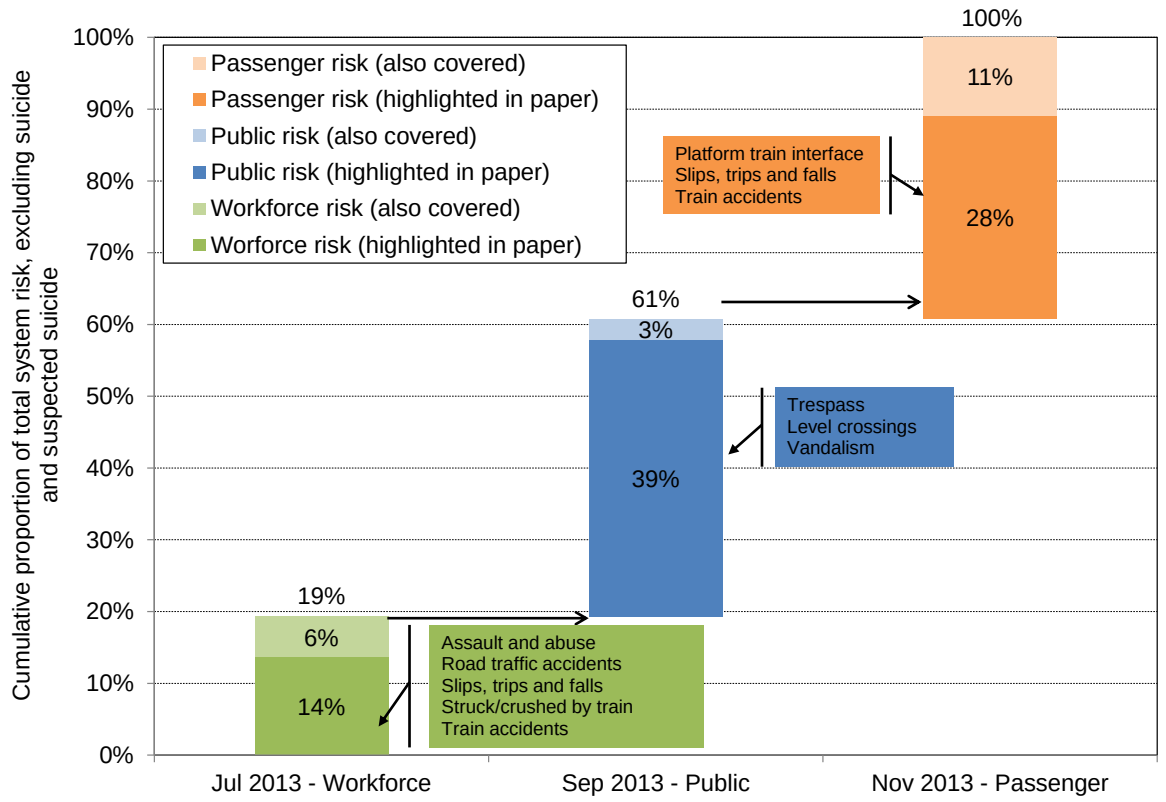
Over the years a wide variety of groups, forums and arrangements have been established both nationally and regionally between train operators, freight operators, Network Rail, infrastructure contractors and RSSB to help understand system safety risk, review performance and sponsor improvement actions. These meetings all play a part in delivering the legal 'duty of co-operation' obligation on rail companies.

Historically, a number of these cross-industry groups have found governance through RSSB's Board (itself a cross-industry group). On an annual basis, the RSSB Board considered a number of strategic board papers. These papers comprise stewardship reports from the cross-industry groups falling within its governance, and papers covering the risk to passengers, workforce and members of the public. At the end of the review year, a separate paper – the annual review of risk – looked at what the Board had considered, to confirm that it has looked at system risk in its entirety. Chart 7 provides an example showing how the strategic risk papers for 2013 covered the risk profile.

In relation to its annual review for 2013, RSSB Board minutes stated:

> *In conclusion the directors confirmed that during the year they had reviewed and considered the significant items of system safety risk that impact on the industry and were satisfied with the risk review arrangements.*

Chart 7. Annual review of total system risk profile (2013 example).



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

Industry developments over recent years, including Network Rail route devolution and the subsequent formation of regional 'alliances', changes in the approach to train operator franchising, the Rail Value for Money study, coupled with the safety regulatory regime now in place (ROGS regulations) have provide an opportunity to modernise and improve the approach to co-operative management of system safety. During 2012/13, work took place within the industry to review and revise the existing framework of industry co-operative groups, and ensure that the future approach is based on a proactive understanding of risk, transparency of information and partnering approach. To help modernise these arrangements a new co-operative framework has been established, headed by the System Safety Risk Group.

Following the establishment of the new co-operative structure, the RSSB Board decided that SSRG was the best place to take control of the three main risk papers, and produce a consolidated report annually to the RSSB board on how all risks are understood and mitigated. This requirement is now part of the remit of SSRG.

2.5.1 System Safety Risk Group (SSRG)

The purpose of SSRG is to understand 100% of system safety risk, identifying areas for improvement, facilitating safety co-operation across the industry, including the sharing of good practice and the identification of potential threats and opportunities through horizon scanning. The group has representation from across the rail industry, including Network Rail, TOCs and FOCs, infrastructure companies and ROSCOs. The group is facilitated by RSSB, and has observer membership from BTP, ORR and trade unions.

The SSRG reports to the RSSB Board and has three subgroups reporting directly to it, described briefly below. In addition it works co-operatively with the wider industry, through other existing groups.

The Train Operations Risk Group (TORG)

The purpose of TORG is to understand and review the proportion of total system risk relevant to its scope. The group is required to: monitor the effectiveness of current control arrangements, identify and sponsor improvement opportunities including research and RSSB-facilitated products and services; learn from and promote good practice; facilitate co-operation; respond to requests from SSRG and other co-operative forums; and consider future developments that may impact its risk.

People on Trains and Stations Risk Group (PTSRG)

The purpose of PTSRG is to consider risks to the workforce, passengers and public in stations and on-board trains on Network Rail controlled infrastructure and interfaces with other rail, resulting from trespass, assault and other crime and anti-social behaviour, train despatch and the PTI, on board injuries, and slips trips and falls.

Data and Risk Strategy Group (DRSG)

The purpose of DRSG is to develop and oversee the delivery of the industry-wide strategy for the collection, analysis and reporting of safety related data, and the development and use of risk tools and models.

2.5.2 SSRG: Industry horizon scanning

Another key role of the SSRG is horizon scanning. To this end an initial horizon scanning review was undertaken by RSSB which produced an initial list of around 35 factors deemed as having the potential to induce future changes in the risk profile of the railway. From this initial list, a small number of the issues are selected for review and discussion in more detail at each SSRG meeting. These more detailed reviews are intended to identify whether sufficient action is already being taken and if further action is required. If further action is required, SSRG will task people with taking the future actions forward. SSRG members will also identify any new horizon scanning issues to be added to the list either at the meeting or via direct communication with RSSB.

The following pages detail some of the various factors that have already been subject to horizon scanning by SSRG, and lists remaining topics that the group will consider in due course.

Topics discussed by SSRG by the end of 2013/14

Increases in the retirement age

The default retirement age (formerly 65 for the UK) has been phased out, so most people can now work for as long as they want to and cannot be discriminated against because of their age. However, some employers can set a compulsory retirement age if they can clearly justify it. People can carry on working beyond State Pension age, which is between 61 and 68 depending on date of birth and gender, and beyond the age at which other pension schemes pay out.

Physical and cognitive skills decline with age, after peaking generally in the mid to late 20s. The rate of decline is influenced by factors such as health and wellbeing, and its effect is often offset by accumulating experience and knowledge.

An increasing number of people working beyond the traditional retirement age might be expected to result in increasing numbers of older commuters using the railway, and potentially increasing numbers of older railway staff.

Presenteeism

An economic recession has the potential to result in increased employee presenteeism, whereby people report for work when they are ill. Unfit individuals may be unable to perform at the required level, which is of particular concern if they are employed in a safety-critical role. They may also spread illness to colleagues (and others) and delay their own recovery. This issue is likely to affect different types of worker differently. There is also a balance to strike between presenteeism (working when unfit) and absenteeism (not working when fit).

Developments in communication and personal media devices

The proportion of the population that owns smart phones, uses social media and communicates via Twitter is already large (especially among the under 30s) and increasing. Changes in the ways and means by which people communicate present both opportunities and threats to the railway.

Improved connectivity, the related phenomenon of remote working and the increasing ease and quality of video and web conferencing have the potential to affect demand for rail travel, with some services and passenger groups more affected than others.

Social media provides a means for transport operators to communicate with passengers and the public. It can provide an effective way of getting messages to a large number of people, for example passing on information during situations of emergency or delay.

Personal media devices have the potential to cause distraction and loss of awareness of surroundings, and increase the potential for accidents. The risk from distraction is potentially even higher with new technology such as *Google Glass*™, a computer contained within spectacle frames that displays information within the user's field of vision, which is due to be released onto the market in 2014.

Increasing electrification

Network Rail's 2009 electrification Route Utilisation Strategy (RUS) identified that the introduction of an electric service will reduce costs for the rail industry, whilst providing a better service to passengers by improving service reliability and journey time. In addition to this, there are significant environmental benefits to the introduction of electric services.

Whilst the economic and environmental advantages of electrification are clear, the introduction of high voltage overhead line equipment (OLE) poses a potential safety risk to workforce (both during construction and whilst working on the electrified lines), members of the public and passengers. Network Rail have a National Electrical Safety Improvement Programme (NESIP) where they are aiming to implement a series of changes which will reduce the frequency of electrical injuries. These changes will be applied across the rail industry, not just within Network Rail. This programme is now in the implementation phase for AC OLE. Network Rail have a target of zero fatalities and major injuries due to electrical accidents to the workforce by the end of CP5.

Topics to discussed by SSRG at future meetings

Political: European legislation and TSIs

The European Fourth Railway Package proposes a number of legislation changes, including changes to the Railway Safety Directive, changes to European legislation and the further introduction of Europe-wide Technical Specifications for Interoperability (TSIs). There is a potential for multiple impacts over the various timeframes as a result, a number of questions have arisen including;

- What are the risks associated with the integrity of products and systems cross-accepted into use in the UK based on a native acceptance process in another member state?
- What are the safety risks associated with the difficulties of making changes to the TSIs where they are not appropriate for UK rail?

This has been seen to be of greater concern for TOCs than for FOCs as the freight operators are already used to dealing with vehicles entering the UK from other member states and with cross border issues. TOCs remain concerned that the integration of TSI-conformant or cross-accepted European products into the legacy UK system may create additional risk, that the deployment plans for TSIs should be economically driven and that the thresholds for third party verification and authorisation remain at an appropriately high level.

There are a number of on-going cross industry actions involving RSSB, ATOC, ORR and DfT to address these concerns.

Political: The role of the Regulator

Over time the role of the rail industry regulator is likely to change which may allow for industry changes giving opportunities for improvement or resulting in risk increases. The DfT report: *Reforming our Railways: Putting the Customer First* says;

> *".. rigidly defined contracts let in the past have left franchisees with little flexibility as to how outputs should be delivered..."*
>
> *"...We are therefore adopting a more flexible approach to franchise contracts, with a shift from detailed inputs to broader outputs focused on passenger satisfaction."*
>
> *"...Government believes there are clear benefits to be gained from moving towards a more unified regulatory structure for the railway."*
>
> *"...Over time our ambition is to progressively move the ORR to the heart of whole industry efficiency and performance, taking Government out of day-to-day industry business."*

Political: Compliance with accessibility legislation

During CP5, compliance with the *Persons of reduced mobility – Technical specification for interoperability* (PRM-TSI) will require considerable investment in older trains and infrastructure. Depending on how this is implemented there is the potential for positive or negative changes to safety. For example, changes made to the PTI could, in some circumstances, have the potential to increase PTI risk.

Overall this is not expected to have significant risk impacts though and any required changes are well understood so risk should not be adversely affected.

Political: UK identity

There are a number of potential changes to the UK identity which will occur in the next few years. This includes Scottish independence, EU membership referendums and greater devolution of Westminster powers.

A vote in favour of independence for Scotland would have far-reaching consequences for all parts of the UK; even if Scotland remains within the UK there is likely to be a much greater degree of devolution. Possibly more powers devolved to the English regions creating a properly federal state.

Current opinion polls suggest that in a referendum a majority would vote to leave the EU. This could lead to the possibility of Scotland retaining membership and the residual UK ceasing to be a member; if that were the case it is hard to see how an uncontrolled border could be maintained.

It is also not clear how the existing body of EU legislation would be applied in a non-member state.

How such a hypothetical scenario might affect risk on the railway is currently unclear. As a large body of railway related safety legislation stems from EU directives, clearly there would be some affect in this area. A closed border between England and Scotland might create difficulties with illegal immigration and consequently additional trespass risk for the railway.

Political: Drink driving limits

The UK has one of the highest drink driving limits in the world. The Scottish government is currently looking at halving the drink driving limit and it is expected that similar actions will be taken in the rest of the UK. There is potential for this to result in:

- fewer level crossing incidents and road vehicle incursions;
- increased numbers of people using the railway while under the influence.

Economic Factors

High levels of economic uncertainty remain about the prospects for the UK economy. There is a strong link between economic growth and travel demand (the recent recession reduced total travel - mainly cars - for three years in a row). There are also increasing levels of financial inequality.

This affects equality of access to rail services (and other travel), and also the day-to-day operation of rail. It could also result in funding changes, changes in rail travel demand amongst other potential changes.

Whilst the main impacts on the railway are likely to be financial and operational there are likely to be secondary impacts on the safety of the railway resulting from these changes.

Societal: Workforce risk in a 24/7 railway

The progress towards a 24/7 society has meant that the window available for engineering work has shortened and there is a requirement to complete more work in less time. Modern track machinery and inspection equipment can dramatically improve the efficiency of the work but inevitably a balance has to be struck. Over time there will inevitably be more pressure for red zone and degraded mode working.

Consequences of this are an increase in risk to workforce and, indirectly, an increase in risk to all rail users if work is not carried out correctly due to time pressures.

Societal: Passenger demand

There is an ongoing increase in annual passenger journeys, which is expected to continue. This will affect crowding on trains and stations and associated safety impacts. More train services will result in less train separation and a requirement for this to be safely managed.

A busier railway also poses challenges in other areas such as infrastructure maintenance and train management. More trains and increased wear and tear introduces the possibility of increased risk. This also results in a larger workforce population being required, adding further potential risk increases.

Societal: Violent crime

Violent crime rates have been dropping worldwide in recent years and for the last decade in the UK. Provided this trend continues this should result in an ongoing reduction in the number of assaults on the railway.

Technological factors: Driverless cars

Driverless cars are currently in development within a number of organisations. For the railway, technology that improves road driving standards could reduce vehicle incursions, level crossing accidents and bridge strikes but if the technology were subject to catastrophic failure then the risk could increase.

Technological: European Rail Traffic Management System (ERTMS)

The national ERTMS programme is also a cross-industry project led by Network Rail. The introduction of ERTMS will replace traditional railway signals with in-cab computer displays. It includes an Automatic Train Protection (ATP) system and continual speed supervision, reducing the risk from train collisions and over-speeding.

The Cambrian Line, which runs from outside Shrewsbury to Aberystwyth and Pwllheli, entered service with ERTMS Level 2 (and without conventional line-side signals) in March 2011. Work is currently underway to install ERTMS in the Thameslink core area, and Network Rail also plans to introduce it to sections of the Great Western main line (where it will initially be operated in parallel with line-side signals), on the southern part of the East Coast main line, and on part of the Midland main line. The plans for wider national rollout are being developed for consistency with a targeted signalling renewal policy, Network Rail's operational strategy and the industry's train fleet fitment programme.

The industry recognises that this is a long-term project and it will be many years before a substantial proportion of the rail network is operating with ERTMS. To ensure that on-going train protection requirements are met in the interim, in November 2009, the RSSB Board approved a long-term strategy requiring industry co-operation to maintain and, where reasonably practicable, develop the existing Train Protection and Warning System (TPWS).

Technological: Obstacle detectors

Obstacle detection systems can detect obstructions capable of causing substantial damage to a train, or to assist the signaller in charge of a CCTV-controlled crossing. Such a system has to be sensitive enough to differentiate between a significant derailment threat (such as a car) and an insignificant one (such as a shopping basket or small animal) in order to avoid unacceptably high levels of safe-side (false) activations.

In 2009, trials of Britain's first level crossing obstacle detection system began in Filey. The primary radar-based system was subsequently enhanced with a complementary light detection and ranging (LIDAR) system that is able to check the crossing periphery and also identify ground-level obstructions, such as someone who has fallen.

Sixteen manually controlled barrier crossings with obstacle detection are in operation (as of January 2014). Network Rail plans to have installed obstacle detection at around 300 level crossings by the end of CP5, in most cases replacing life-expired CCTV equipment. It also continues to explore alternative obstacle detection technologies.

Technological: Automated Track Inspection Technologies

One of the new technologies being piloted with the intention of improving asset management is Plain Line Pattern Recognition (PLPR), which uses the New Measurement Train (NMT) as a means of monitoring the condition of the track without the need for traditional patrolling and visual inspection. PLPR has been developed to replace basic visual inspection of plain line track, thus reducing the number of infrastructure workers having to work on or near the line. The system consists of four train rigs which cover 80% of the network (15,000 miles) every fortnight; seven high definition cameras take up to 70,000 pictures a second, along with 3-dimensional and thermal images. Computer algorithms identify areas of current and future concern and the analysis is sent to infrastructure workers with GPS coordinates so crews can be deployed to fix the identified track faults.

Environmental: Climate change

The UK is experiencing statistically significant changes in its climate including:

- higher average temperatures;
- less summer rainfall;
- more winter rainfall;
- more intensive heavy rainfall events;
- rising sea level around the coast (10cm increase since 1901).

Over the last few years there have been a notable number of floods and landslips with line closures and extensive damage in many areas. A particularly striking example was the seawall collapse at Dawlish in 2014. Such events have the continuing potential to affect the UK railway in terms of both safety and performance.

2.5.3 Other industry groups

In addition to SSRG and its subgroups, there are a large number of other industry bodies that work together in support of current and future GB rail operations. A selection are outlined below, but for a full overview, the reader is referred to the RSSB website: http://www.rssb.co.uk/groups-and-committees.

Rail Delivery Group and the Industry Strategic Business Plan

The Rail Delivery Group (RDG) comprises the owners of passenger and freight train operating companies and Network Rail. It provides leadership to the rail industry on system-wide issues and co-ordinates the objectives of cross-industry groups, including the Technical Strategy Leadership Group (see below), the National Task Force and the Planning Oversight Group, which is the industry's senior planning body.

Under the aegis of the RDG, the railway published its Industry Strategic Business Plans (ISBPs) in January 2013: one covers England and Wales, the other Scotland.

These documents set out the industry's plans for CP5. The plans are designed to deliver the requirements set out by the Government in its High Level Output Specification (HLOS) and to align with the shared long-term vision for the railway.

The HLOS for CP5 does not include quantified safety targets, but:

> *requires the industry to continue to improve its record on passenger and worker safety through the application of the "so far as reasonably practicable" approach and to ensure that current safety levels are maintained and enhanced by focusing domestic efforts on the achievement of European Common Safety Targets.*

It also states the government's desire for a reduction in risk from accidents at level crossings, with ring-fenced funding being made available for that purpose.

The ISBPs summarise the key challenges facing the industry, the strategies and plans it will implement over the five-year period, and the outputs it expects to deliver. Some of the main messages in terms of safety are:

- Investment in new rolling stock and infrastructure, including station improvement works, is expected to reduce the risk to passengers by around 9% on a per journey basis during the course of CP5.

- Investment in safe access equipment for those working on the track, improved isolations of traction power and investment in plant safety will contribute to a reduction in workforce risk.
- Risk-based interventions to improve level crossing safety, including crossing closures, increased use of enforcement cameras, and the replacement of whistle boards with local warning systems at higher-risk locations are expected to result in an 8% reduction in the risk from level crossing accidents.

The ISBPs are available from the Network Rail website: http://www.networkrail.co.uk/publications/industry-strategic-business-plan-for-cp5/.

Technical Strategy Leadership Group and the Rail Technical Strategy

The Rail Technical Strategy sets out a 30-year vision for the railway. It aims to assist the industry's strategic planning processes, informing policy makers and funders about the potential benefits of new techniques and technologies and provide suppliers with guidance on the future technical direction of the industry. A new edition of the Rail Technical Strategy was released last year (RTS 2012) based around the '4C' challenges of increased capacity, reduced carbon, lower costs and improved customer satisfaction.

The Technical Strategy Leadership Group (TSLG), a cross-industry expert body facilitated by RSSB, is charged with developing and championing the implementation of the Rail Technical Strategy. TSLG oversees the work of the industry's Systems Interface Committees and is also the client group for the Rail Industry Strategic Research Programme.

The implementation of RTS 2012 will involve the sustained application of effort across the whole of the railway sector, including its suppliers, over the 30-year period. This cannot be done by one single company, so TSLG brings together experts from the whole industry as well as government and academia to ensure it can reflect consensus on the future strategy. TSLG provides leadership and support, focusing on the gaps and maintaining the momentum for change, although it is expected that most of the initiatives will flow through regular company and industry business planning structures.

For more information on the 30-year vision for the railway, see the future railway website: http://www.futurerailway.org.

Enabling Innovation

The Enabling Innovation Team (EIT) has been established to accelerate innovation in the GB railway. The EIT focuses on moving business solutions and technologies from prototype through to demonstration and eventual implementation. It aims to see innovation embedded as part of everyday business within the rail industry, concentrating on system-wide innovation opportunities where the parties involved are not able to proceed on their own. Its objectives are to improve the efficiency of GB railways by addressing rail business challenges as well as to grow worldwide opportunities for the GB rail supply chain. In the words of the EIT Director:

> *Until now, there has been no dedicated cross-industry team designed to match the longer term business challenges to innovative solutions and, where necessary, to provide funding. This is where we come in.*

The EIT is hosted by RSSB and is funded initially by a grant from DfT. This grant will be used by EIT as a Rail Innovation Fund to support innovation demonstrator projects. Among the priority business challenges that are being considered initially are: customer experience, remote condition monitoring, the "radical train" and electrification. For more information about

these challenges of the Enabling Innovation Team in general, see the EIT section of the future railway website: http://www.futurerailway.org.

Research and development

RSSB manages a cross-industry programme of research and development (R&D) on behalf of the railway industry. It is funded by the 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, the engineering interfaces within the railway, and the interfaces with other parts of the community.

RSSB also manages the rail industry's strategic research programme on behalf of TSLG. Strategic research aims to support industry and its stakeholders in the delivery of 'step changes' in industry strategy within 30 years, as outlined in the RTS. TSLG directly sponsors research projects and programmes to help industry realise the RTS but also has oversight of other cross-industry research sponsored by other groups where projects contribute to the longer-term vision. This includes oversight of research sponsored by the Systems Interface Committees, whose chairs also sit on TSLG.

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

The Rail Research UK Association (RRUKA) is a partnership between the railway industry and UK universities, which seeks to enhance the already strong collaborative relationship between academia and the industry. A RRUKA event in March 2013 brought together 18 industry organisations and 18 universities to explore methods for predicting the future risk profile for the railway. A better understanding of this would allow rail companies to plan for and mitigate the effects of new or changing hazards. Participants were encouraged to propose creative solutions to the problem of risk prediction, and funding is being made available for those feasibility studies and projects with the most promise. For more information see the RRUKA website: http://rruka.org.uk/.

The Sustainable Rail Programme

The Sustainable Rail Programme (SRP) supports the industry in addressing the risks and opportunities of sustainable development. It focuses on key strategic issues, such as carbon, and on embedding sustainability at the heart of the industry. In 2009, it published the *Rail Industry Sustainable Development Principles.* These 10 principles are fundamental to the role that rail can play in a sustainable transport system, and fundamental to the sustainability of rail itself. The Rail Industry Sustainable Development Report, published in 2011, outlined the industry's performance against the Sustainable Development Principles, highlighting a number of case studies. It also set out the key performance indicators against which the industry will monitor future sustainable development performance and reported on how the industry has performed against the commitments it made in 2007. The Programme has also launched an online self-assessment tool to enable organisations from across the industry to judge their own performance against the principles and help them plan their future strategy. This can be found at: www.sustainablerailprogramme.co.uk.

2.6 Safety overview key safety facts

Overview	2009/10	2010/11	2011/12	2012/13	2013/14
Fatalities					
Passenger	5	7	5	4	4
Workforce	3	1	1	2	3
Public	60	33	47	42	29
Total	**68**	**41**	**53**	**48**	**36**
Major injuries					
Passenger	234	251	259	312	270
Workforce	123	122	128	114	126
Public	38	36	40	42	44
Total	**395**	**409**	**427**	**468**	**440**
Minor injuries					
Passenger	5308	5600	5954	6382	6307
Workforce	5327	5379	5432	4757	4913
Public	190	186	186	176	162
Total	**10825**	**11165**	**11572**	**11315**	**11382**
Shock/trauma					
Passenger	207	226	262	238	235
Workforce	1169	1156	1239	964	1001
Public	4	4	3	6	2
Total	**1380**	**1386**	**1504**	**1208**	**1238**
Fatalities and weighted injuries					
Passenger	38.76	42.95	42.64	47.44	43.10
Workforce	25.19	23.28	24.41	22.81	25.16
Public	64.26	37.11	51.49	46.69	33.85
Total	**128.21**	**103.34**	**118.54**	**116.94**	**102.10**
Suicide and attempted suicide					
Suicides	238	207	249	246	279
FWI	240.7	210.7	251.4	249.5	284.5

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 has compared 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).

2013/14 Headlines

- For all 15 trajectories set out in the 2009-2014 SSP, risk satisfies the trajectory.
  - For passenger accidents at the PTI, while the risk from the category as a whole satisfies the trajectory, the risk from boarding/alighting events as a subset, has risen to lie above the level expected by the trajectory.
- At the end of CP4, the reductions in passenger and workforce risk have met the targets for improvement set by the DfT HLOS.
- UK performance is acceptable in all of the areas identified by the European Railway Agency via the NRVs.

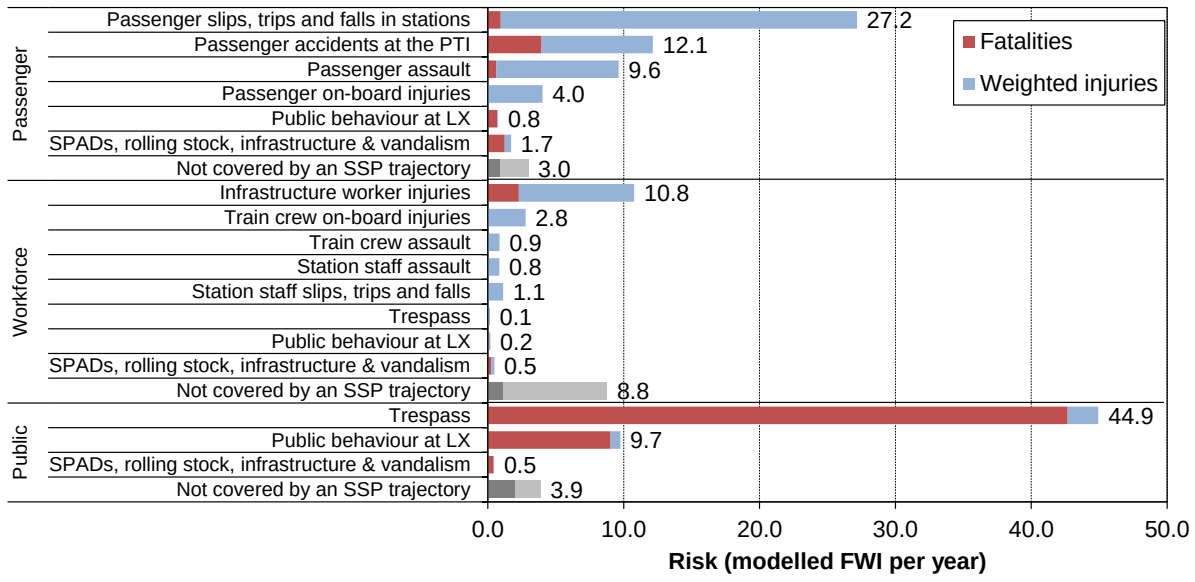
Performance at a glance

2009–2014 Strategic Safety Plan	Passenger slips, trips and falls in stations Passenger accidents at the platform-train interface Passenger injuries on board trains Train crew injuries on board trains Station staff slips, trips and falls Risk to infrastructure workers Assaults on passengers Assaults on train crew Assaults on station staff Public behaviour at level crossings Trespass SPADs Train accidents due to infrastructure failure Train accidents due to rolling stock failure Vandalism	Performance satisfies trajectories – ie is within or below trajectory range.
High Level Output Specification	Passenger risk Workforce risk	Performance satisfies HLOS targets.
National Reference Values	Passengers: NRV 1.1 and NRV 1.2 Employees: NRV 2 Level crossing users: NRV 3.1 and NRV 3.2 Others: NRV 4 Unauthorised persons: NRV 5 Whole society: NRV 6	Performance is acceptable in every area covered by the NRVs. (NRV 3.2 and NRV 4 are not assessed due to data quality factors across Member States).

3.1 Trajectories of the 2009-2014 SSP

The 2009-2014 SSP defined 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 SRM-modelled risk as of April 2009. 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 8. Risk profile by SSP trajectories (total FWI and fatalities)



Source: SRMv8

- The SSP trajectories cover 95% of the modelled risk to passengers, 66% of the modelled risk to the workforce and 93% of the modelled risk to members of the public.
- 47% of passenger modelled FWI risk arises from slips, trips and falls, with passenger accidents at the PTI being the next largest contributor. PTI accidents are the largest contributor to the modelled passenger fatality risk.
- Infrastructure worker injuries are the largest contributor to the workforce risk profile, at 41%.
- Most of the public modelled risk arises from trespass, with a notable amount being due to public behaviour at level crossings.

3.1.1 Progress against the SSP trajectories

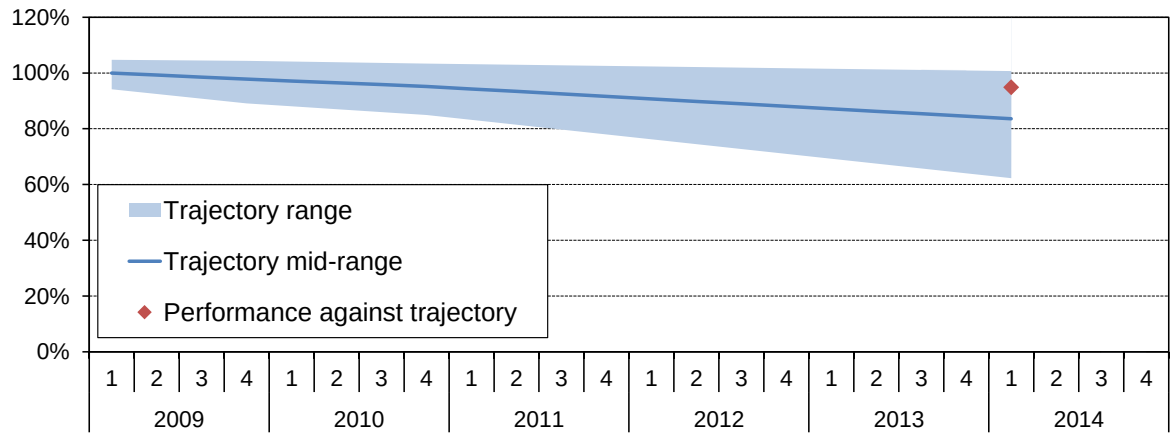
The SRM was used as the means of measuring the performance of the industry against the SSP trajectories over CP4. SRMv6.7[7] was used for the beginning of CP4, and SRMv8 has been used to assess the risk as of the end of 2013/14. The risk values are normalised by appropriate normalisers, which are shown in the chart title. For some trajectories, two charts are shown. This has been done in those cases where the events that are covered by the trajectory fall into two distinct types, for example, train accidents and personal accidents.

[7] SRMv6.7 is an update of SRMv6, using data relevant to the SRMv6 period but with modelling improvements relevant to SRMv8.

Risk to passengers from slips, trips and falls in stations

The SRMv8 modelled risk from passenger slips, trips and falls at stations is 27.2 FWI per year, which is around 19% of the total system risk.

Chart 9. Passenger slips, trips and falls in stations (normaliser: passenger journeys)

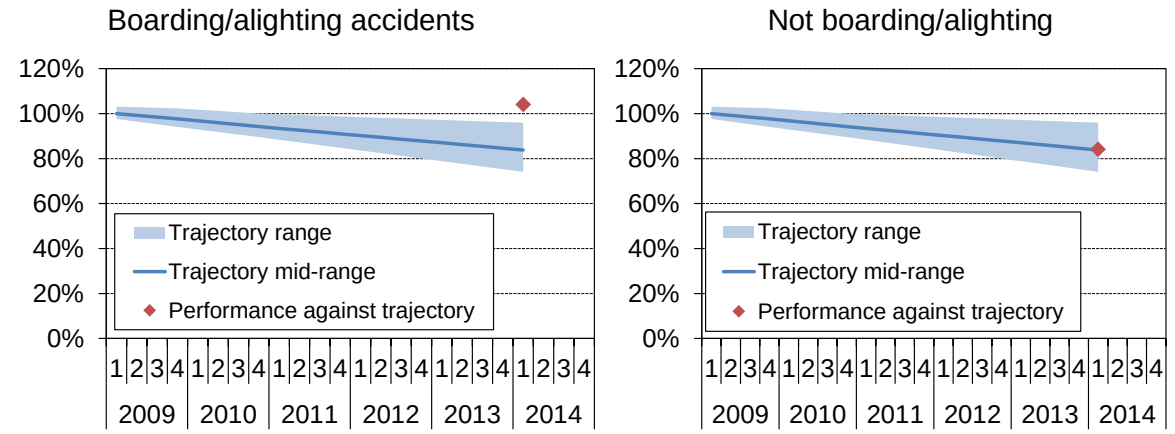


- The 2009-2014 SSP projected a best estimate improvement of around 16% by the end of March 2014. Based on the change in SRM estimates between v6.7 and v8, normalised risk falls within the SSP trajectory range, with an achieved reduction of 5%.

Risk to passengers at the platform-train interface

Passenger accidents at the PTI comprise accidents during boarding or alighting, and other types, such as falls from the platform edge. The SRMv8 modelled risk for both groups combined is 12.1 FWI per year, which is around 8% of the total system risk.

Chart 10. Passenger accidents at the platform-train interface (normaliser: passenger journeys)

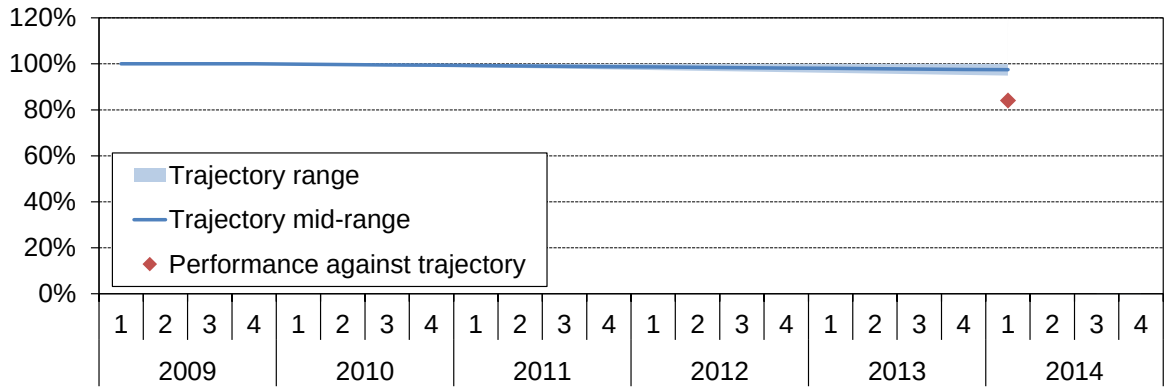


- The 2009-2014 SSP projected a best estimate improvement of around 16% by the end of March 2014. Based on the change in SRM estimates between v6.7 and v8, normalised risk lies outside the trajectory for boarding/alighting accidents, and is better than the trajectory for other PTI accidents. The combined performance satisfies the trajectory, with an achieved reduction of 6%.

Risk to passengers from on-board injuries

The SRMv8 modelled risk from passenger injuries on board trains is 4.0 FWI per year, which is around 3% of the total system risk.

Chart 11. Passenger injuries on board trains (normaliser: passenger kilometres)

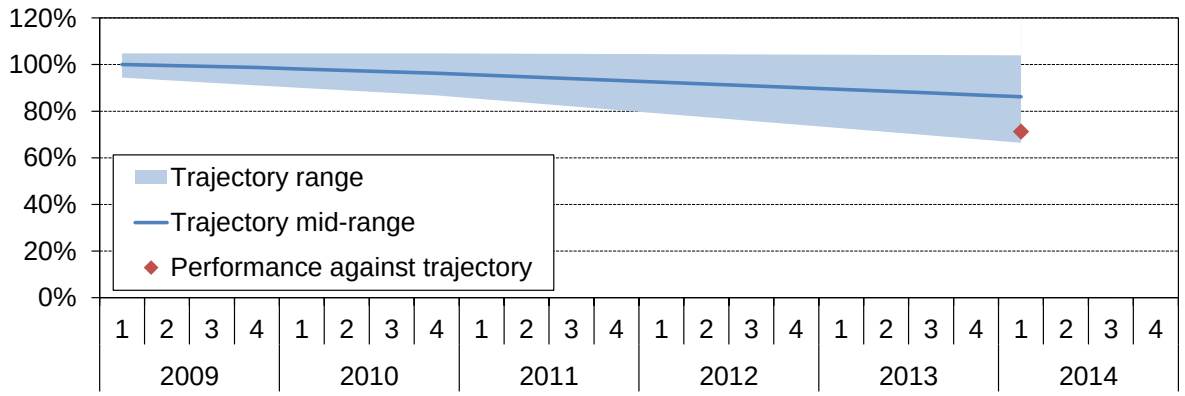


- The 2009-2014 SSP projected a best estimate improvement of around 3% by the end of March 2014.
- Based on the change in SRM estimates between v6.7 and v8, normalised risk is better than the SSP trajectory range, with an achieved reduction of 16%.

Risk to train crew from on-board injuries

The SRMv8 modelled risk from train crew injuries on board trains is 2.8 FWI per year, which is around 2% of the total system risk.

Chart 12. Train crew injuries on board trains (normaliser: train crew hours)

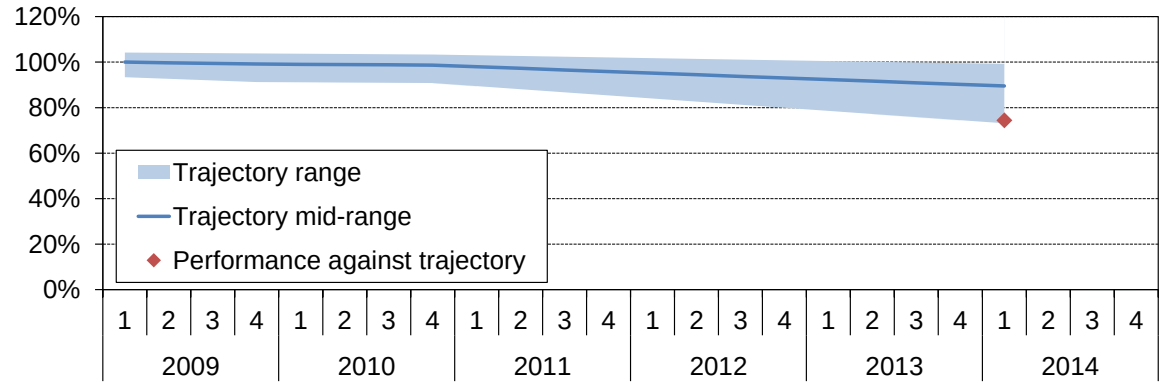


- The 2009-2014 SSP projected a best estimate improvement of around 14% by the end of March 2014.
- Based on the change in SRM estimates between v6.7 and v8, normalised risk falls within the SSP trajectory range, with an achieved reduction of 29%.

Risk from SPADs

The SRMv8 modelled risk from SPADs is 0.7 FWI per year, which is around 0.5% of the total system risk. All of this is train accident risk.

Chart 13. SPADs (normaliser: train kilometres)

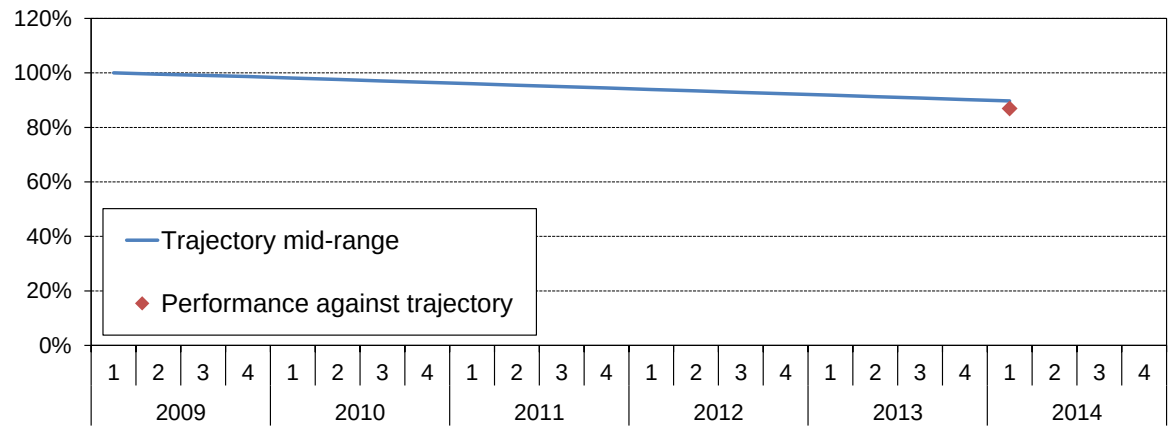


- The 2009-2014 SSP projected a best estimate improvement of around 10% by the end of March 2014.
- Based on the change in SRM estimates between v6.7 and v8, normalised risk falls within the SSP trajectory range, with an achieved reduction of 26%.

Risk to infrastructure workers

The SRMv8 modelled risk from infrastructure worker injuries is 10.8 FWI per year, which is around 8% of the total system risk.

Chart 14. Infrastructure worker injuries (normaliser: infrastructure worker hours)

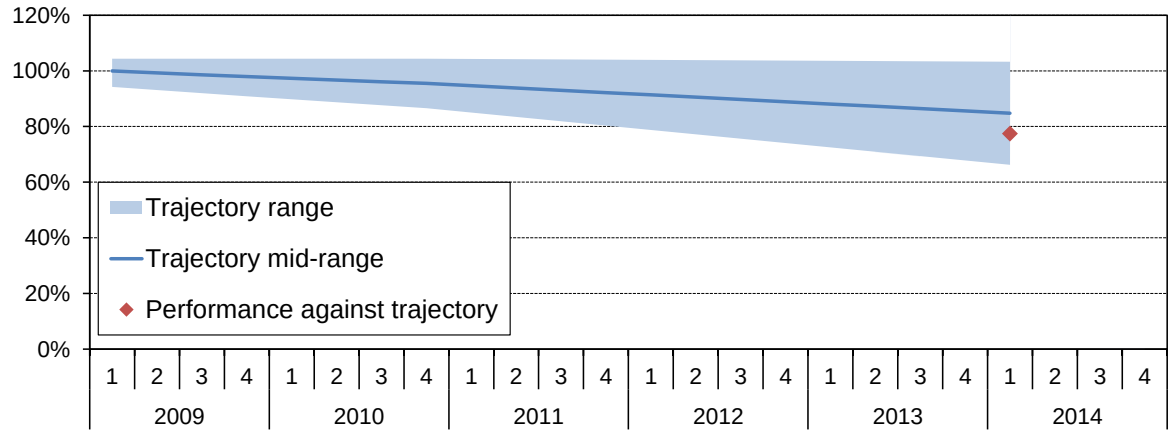


- The 2009-2014 SSP projected a best estimate improvement of around 10% by the end of March 2014.
- Based on the change in SRM estimates between v6.7 and v8, normalised risk is better than the SSP trajectory, with an achieved reduction of 13%.

Risk to station staff from slips, trips and falls

The SRMv8 modelled risk from station staff slips, trips and falls at stations is 1.1 FWI per year, which is around 0.8% of the total system risk.

Chart 15. Station staff slips, trips and falls (normaliser: station staff hours)

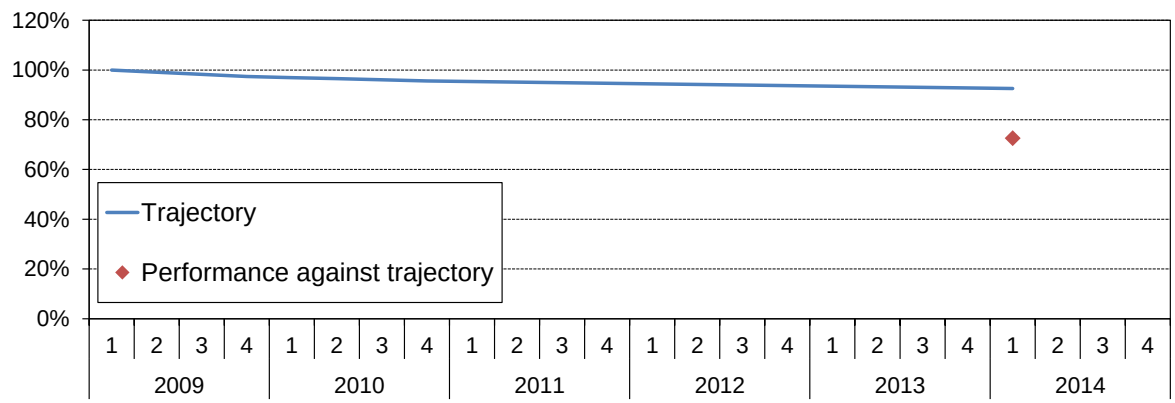


- The 2009-2014 SSP projected a best estimate improvement of around 15% by the end of March 2014.
- Based on the change in SRM estimates between v6.7 and v8, normalised risk is within the SSP trajectory range, with an achieved reduction of 23%.

Risk from train accidents caused by infrastructure failure

The SRMv8 modelled risk from infrastructure failure accounts for 1.2 FWI per year, which is around 0.8% of the total system risk. Of this, 1.1 FWI is train accident risk, with the remaining 0.1 FWI arising from personal accidents, such as slips, trips and falls on substandard surfaces.

Chart 16. Infrastructure failure (normaliser: train kilometres)

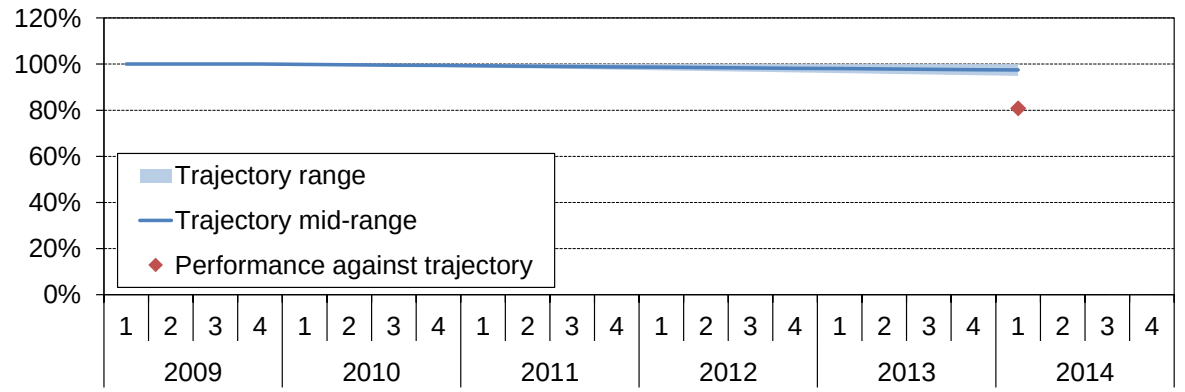


- The 2009-2014 SSP projected a best estimate improvement of around 7% by the end of March 2014.
- Based on the change in SRM estimates between v6.7 and v8, normalised risk is better than the SSP trajectory range, with an achieved reduction of 27%.

Risk from train accidents caused by rolling stock failure

The SRMv8 modelled risk from rolling stock failure is 0.4 FWI per year, which is less than 0.4% of the total system risk. The majority of this is train accident risk.

Chart 17. Rolling stock failure (normaliser: train kilometres)

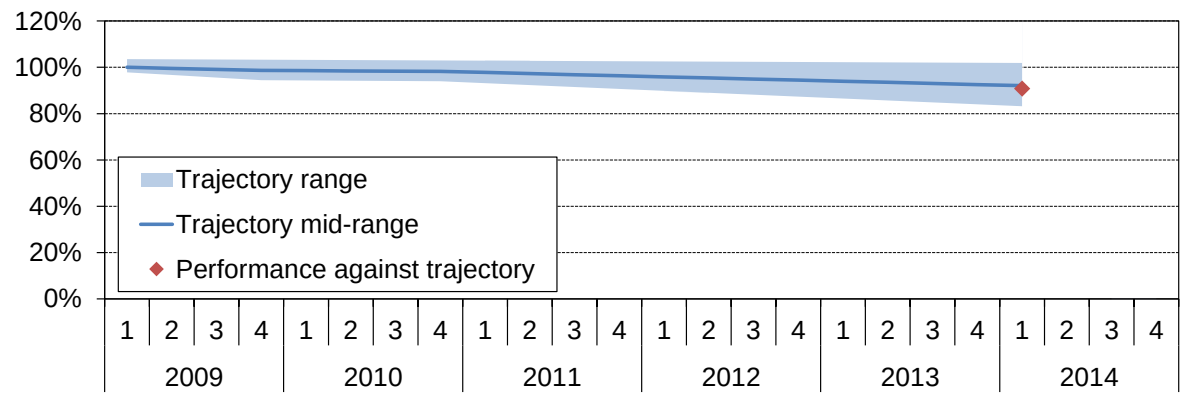


- The 2009-2014 SSP projected a best estimate improvement of around 3% by the end of March 2014.
- Based on the change in SRM estimates between v6.7 and v8, normalised risk is better than the SSP trajectory range, with an achieved reduction of 19%.

Risk to passengers from assault

The SRMv8 modelled risk from assaults on passengers is 9.6 FWI per year, which is around 7% of the total system risk.

Chart 18. Passenger assaults (normaliser: passenger journeys)

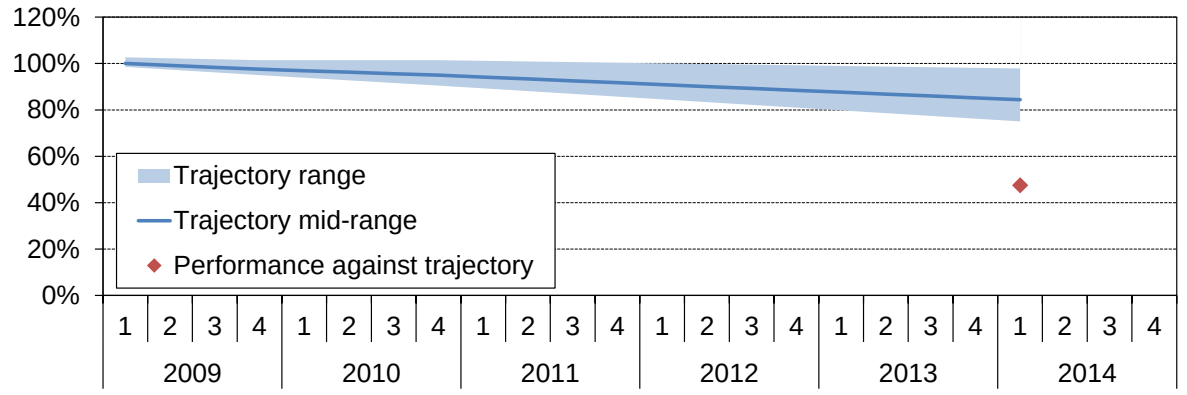


- The 2009-2014 SSP projected a best estimate improvement of around 8% by the end of March 2014.
- Based on the change in SRM estimates between v6.7 and v8, normalised risk is within the SSP trajectory range, with an achieved reduction of 9%.

Risk to train crew from assault

The SRMv8 modelled risk from assaults on train crew is 0.9 FWI per year, which is around 0.6% of the total system risk.

Chart 19. Train crew assaults (normaliser: train crew hours)

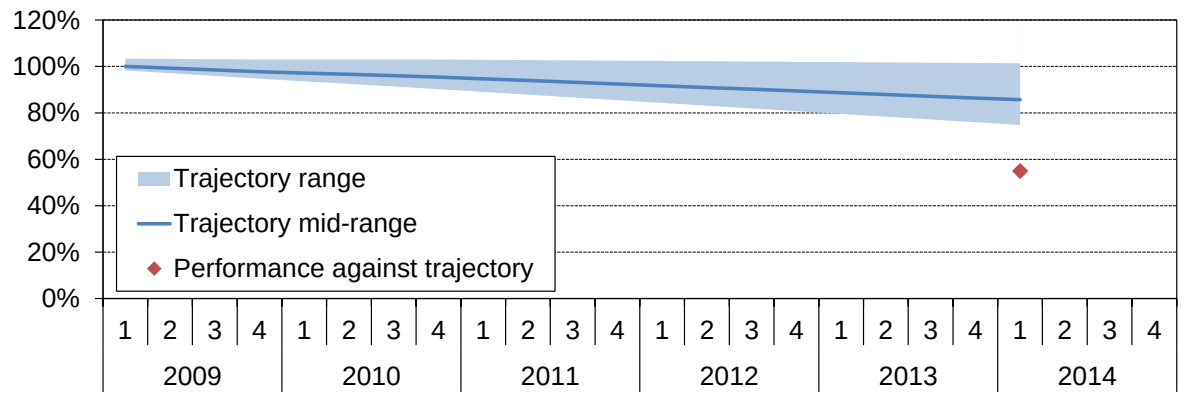


- The 2009-2014 SSP projected a best estimate improvement of around 16% by the end of March 2014.
- Based on the change in SRM estimates between v6.7 and v8, normalised risk is better than the SSP trajectory range, with an achieved reduction of 53%.

Risk to station staff from assault

The SRMv8 modelled risk from assaults on station staff is 0.8 FWI per year, which is around 0.6% of the total system risk.

Chart 20. Station staff assaults (normaliser: station staff hours)

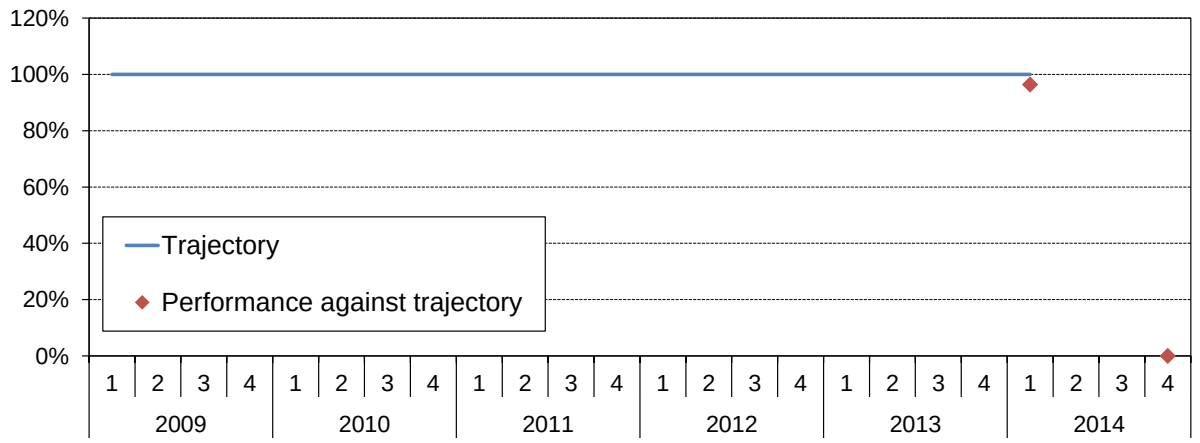


- The 2009-2014 SSP projected a best estimate improvement of around 14% by the end of March 2014.
- Based on the change in SRM estimates between v6.7 and v8, normalised risk is better than the SSP trajectory range, with an achieved reduction of 45%.

Risk from trespass

The SRMv8 modelled risk from trespass accounts for 45.1 FWI per year, which is around 31% of the total system risk.

Chart 21. Trespass (normaliser: train kilometres)

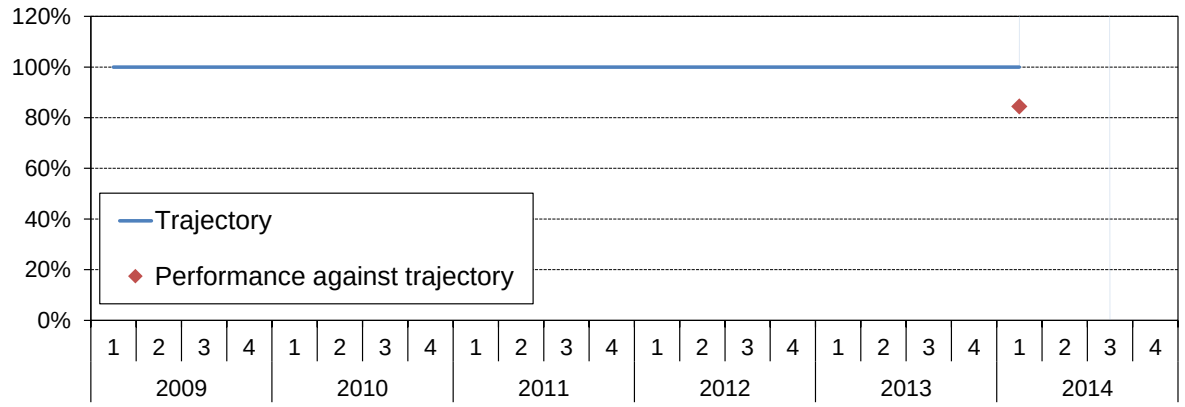


- The 2009-2014 SSP projected a level trend in trespass by the end of March 2014.
- Based on the change in SRM estimates between v6.7 and v8, normalised risk is better than the SSP trajectory, with an achieved reduction of 4%.

Risk from vandalism

The SRMv8 modelled risk from vandalism is 0.4 FWI per year, which is around 0.3% 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 22. Vandalism (normaliser: train kilometres)

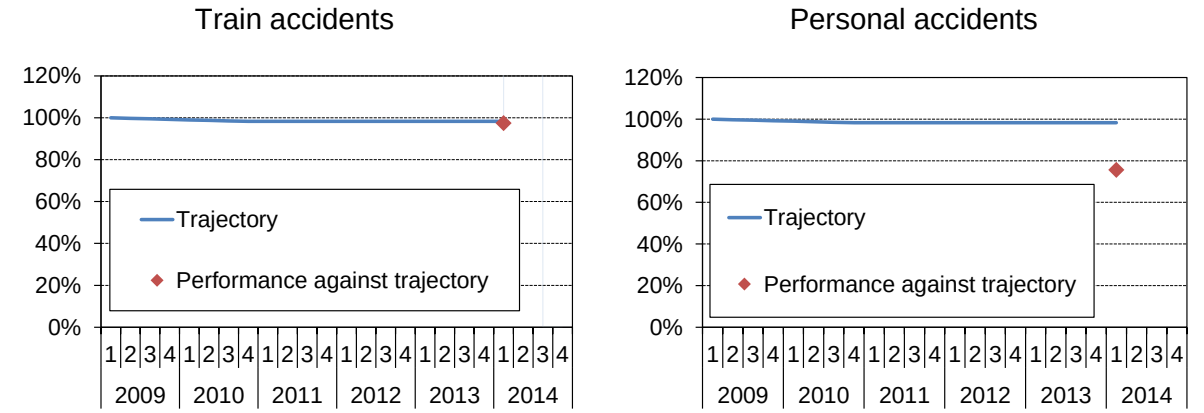


- The 2009-2014 SSP projected a level trend in vandalism risk by the end of March 2014.
- Based on the change in SRM estimates between v6.7 and v8, normalised risk is better than the SSP trajectory, with an achieved reduction of 16%.

Risk from public behaviour at level crossings

The SRMv8 modelled risk from public behaviour at level crossings accounts for 10.7 FWI per year, which is around 7% of the total system risk. Of this, 3.2 FWI arises from train accidents (2.9 of which occurs to members of the public) and 7.5 FWI arises from personal accidents.

Chart 23. Public behaviour at level crossings (normaliser: train kilometres)

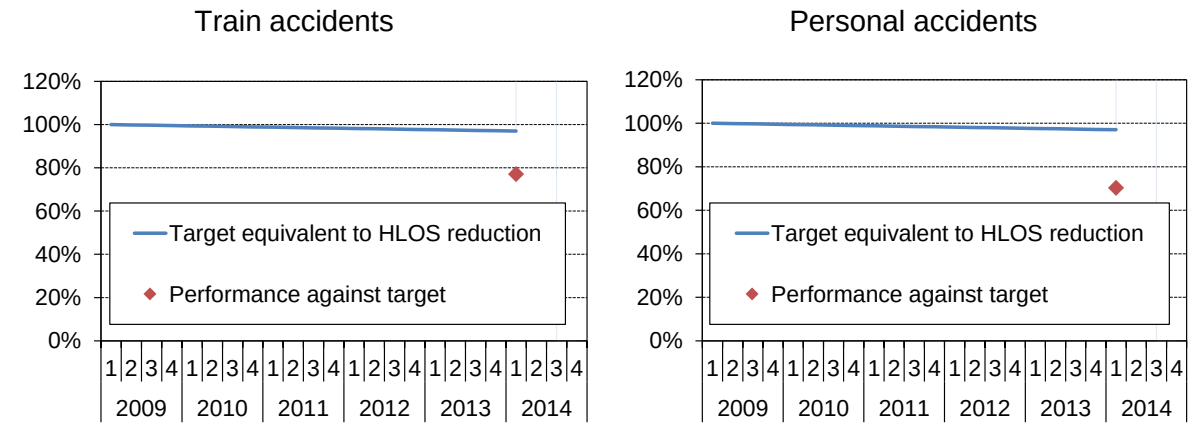


- The 2009-2014 SSP projected a best estimate improvement of around 2% by March 2014.
- Based on the change in SRM estimates between v6.7 and v8, normalised risk is in line with or better than the SSP trajectories with a 3% reduction for train accident risk and a 24% reduction for pedestrian accident risk.

Trends in performance within categories not covered by an SSP trajectory

Around 15.6 FWI arises from causes that are not covered by an SSP trajectory; this is 11% of the total system risk, excluding suicide. Of this, around 2.0 FWI arises from train accidents, and around 13.6 FWI arises from personal accidents.

Chart 24. Categories not covered by an SSP trajectory (normalisers: train kilometres for train accidents and passenger journeys for personal accidents)



- 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 change in SRM estimates between v6.7 and v8, normalised risk arising from areas that are not covered by SSP trajectories has reduced by 23% for train accidents and by 30% for personal accidents.

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 ran from 1 April 2009 to 31 March 2014.

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

The HLOS metrics are:

Passenger metric:	Baseline at April 2009:	1.011 FWI per billion passenger kilometres
	Target at March 2014:	0.981 FWI per billion passenger kilometres
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 was agreed by the DfT, the ORR and the industry that the safety metrics would be monitored using the SRM.

3.2.1 HLOS exclusions

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[8]
- Verbal abuse and threats

3.2.2 HLOS assessment

Based on SRMv8, the passenger safety metric for the March 2014 assessment is 0.980 FWI per billion passenger kilometres. This represents a decrease of 3.1% compared with the baseline metric.

Based on SRMv8, the workforce safety metric for the March 2014 assessment is 0.110 FWI per million workforce hours. This represents a decrease of 18.7% compared with the baseline metric.

Chart 25 and Chart 26 depict the assessments at the end of CP4: both passenger and workforce risk met the requirements of the HLOS targets.

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

Chart 25. Progress against HLOS target for passenger risk (FWI per billion passenger kilometres)

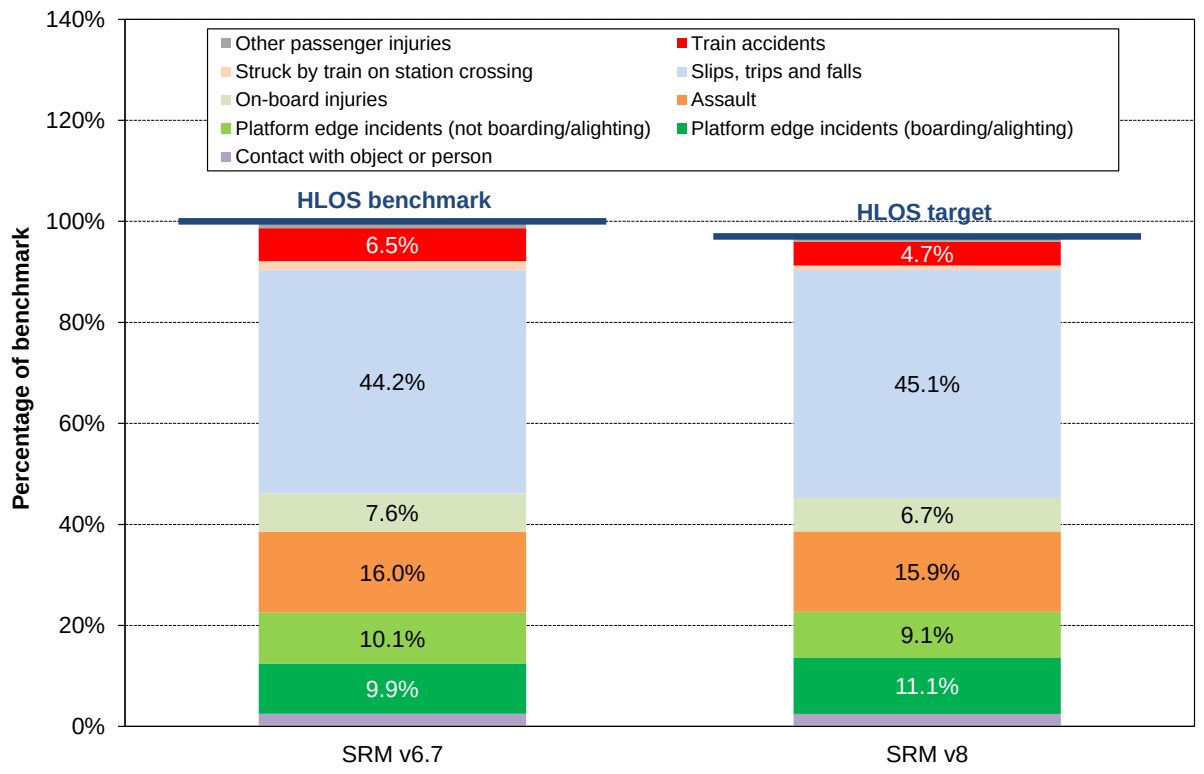
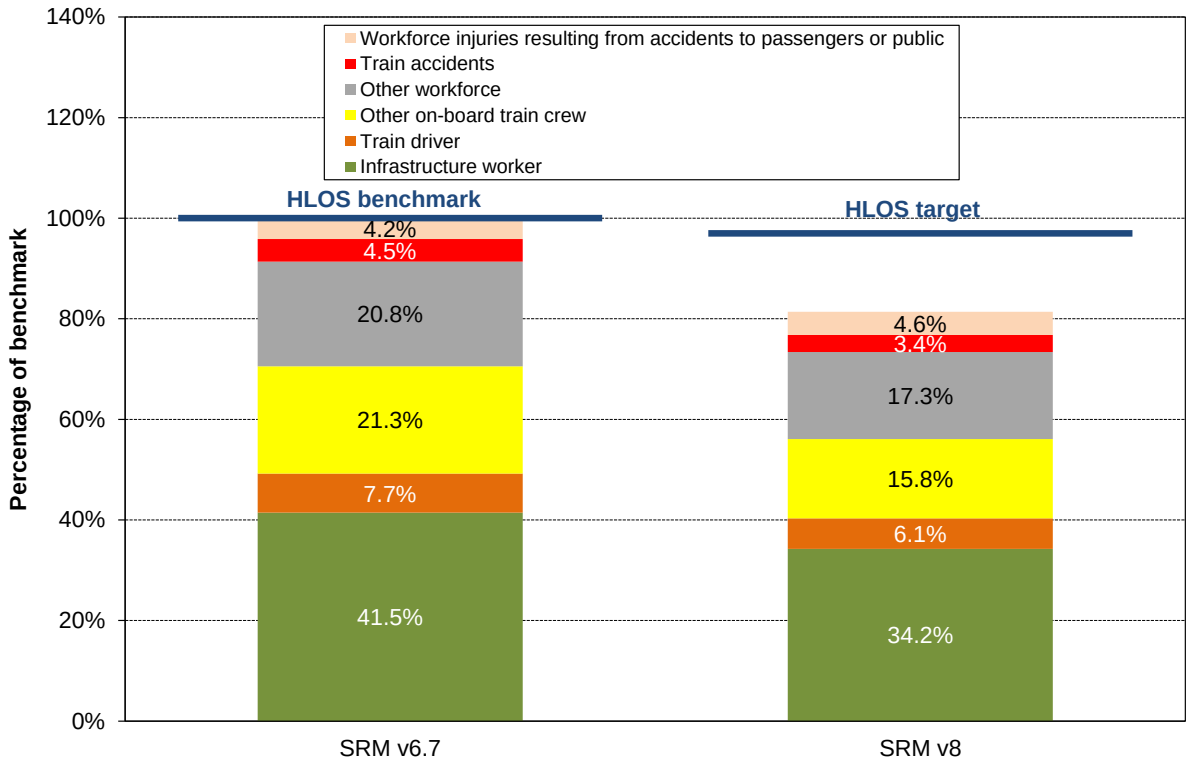


Chart 26. Progress against HLOS target for workforce risk (FWI per million workforce hours)



3.3 Common Safety Targets and National Reference Values

The Railway Safety Directive states the requirement for Member States to ensure that safety is generally maintained and, where reasonably practicable, continuously improved. The European Railway Agency (ERA) is mandated to develop Common Safety Targets (CSTs) and National Reference Values (NRVs) to monitor the performance of Member States in this area.

The NRVs are designed to reflect observed baseline levels of safety in each Member State. NRVs are calculated based on a form of weighted average performance over a period of time; this reduces the effect of 'outliers', in recognition of the potentially distorting effect of a single multi-fatality event. The current (second) set of NRVs are based on the six-year period 2004 to 2009; the first set were based on the four years from 2004 to 2007.

The ERA is monitoring each Member State's performance against its NRVs to determine whether levels of safety are at least being maintained in each category. The level of performance is assessed using the Common Safety Indicators (CSIs) that National Safety Authorities submit to the ERA as part of their annual safety reports. [9]

While the rest of the ASPR presents statistics on data for GB mainline railway, the analysis in this section covers UK as a whole, as it is at this level that the CSIs, CSTs and NRVs are set.

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 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 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.[10]

3.3.1 The second set of NRVs

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

The person type categories align with those 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; this is more restrictive than the RSSB/RIDDOR definition.

[9] 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.

[10] ERA plans to develop a revised set of CSTs by mid-2015 based solely on CSI data. It will also revise the assessment method, which has shown limitations when assessing risk levels in states with very low numbers of accident victims in particular categories.

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 assessment of overall safety performance.

Table 3 shows the second set of NRVs and CSTs, as they apply to the UK. The column *NRV rank* shows where the UK's NRV ranks among the EU-25 countries.[11]

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 SRMv7.5 estimate of the risk to passengers from accidents that are within the scope of European reporting.

Table 3. NRV and CST definitions and values[12]

NRV Category	NRV number	Definition	UK NRV		NRV rank in EU-25	CST
			Second set	First set		
Passengers	NRV 1.1	Number of passenger FWSI per billion passenger train kilometres.	2.73	6.22	1	207
	NRV 1.2	Number of passenger FWSI per billion passenger kilometres.	0.0276	0.0623	1	1.91
Employees	NRV 2	Number of employee FWSI per billion train kilometres.	5.17	8.33	3	77.9
Level crossing users	NRV 3.1	Number of road vehicle occupant and pedestrian FWSI per billion train kilometres.	23.5	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 kilometres.	7.00	6.98	n/a	35.5
Unauthorised persons on railway premises	NRV 5	Number of unauthorised person FWSI per billion train kilometres. Note: This excludes suicides.	84.5	94.7	5	2045
Whole society	NRV 6	Total number of passengers, employee level crossing user, other and unauthorised person FWSI per billion train kilometres.	120.0	131.0	2	2587

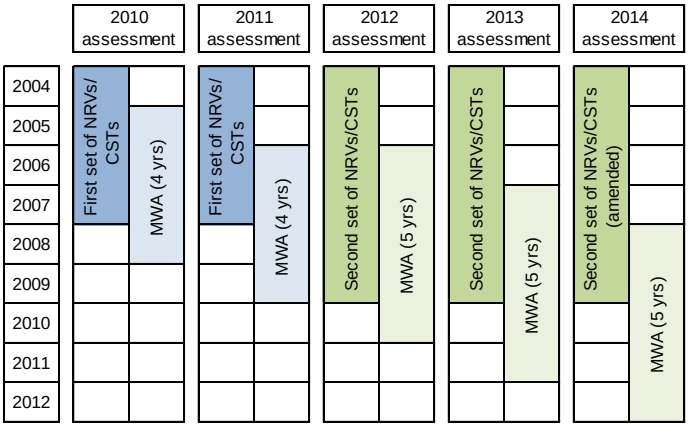
[11] Norway, which sits outside the EU but collaborates with the European Railway Agency and EU member states on matters of railway safety, has NRVs that are lower than the UK's in the categories of employees, level crossing users and whole society.

[12] NRV 3.2 has been omitted from the assessments of the first and second set of NRVs because of concerns about the quality and consistency of normalising data across the member states. For NRV 4, assessment was first published in the 2013 report. It is not appropriate to rank the UK on this NRV because the data behind its calculation was not based on the UK (there being insufficient events for the UK over the period of its calculation). The NRV for Ireland is based on the UK, as insufficient data for Ireland was available.

3.3.2 Assessing performance against the NRVs

The ERA assesses performance against each NRV on the basis of the latest available calendar year's performance and a moving weighted average (MWA) over a defined period. The periods used for the calculation of the NRVs/CSTs and MWAs are shown in Figure 1.

Figure 1. ERA NRV/CST assessment schedule



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, the ERA will still conclude that 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 (EC).
- 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 EC 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 ensures that the mainline railway can achieve its CSTs.

3.3.3 Current performance against the NRVs

The second set of NRVs are based on the six years of data from 2004 to 2009. The ERA's results of the third assessment of the second set of NRVs, published in March 2014 was based on the five years of data 2008 to 2012, and showed that all states met their NRVs in all categories, apart from:

- Bulgaria (employees, level crossing users)
- Croatia (others)
- Romania (employees, others)
- Slovakia (employees)
- Sweden (employees)

ERA states, in the report, that the results determined for the category of 'others' are judged to be unreliable, due to poor data quality, but goes on to say that despite continued limitations on the data used for assessments, the results of the report should be considered valid, and the above states should carry out further investigation into the results.

UK data for 2013 has not yet been submitted to the ERA (it will feature in the ERA's 2015 assessment), but the following charts present provisional performance estimates based on the data that has been collated by RSSB on behalf of 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 continues to be at an acceptable level in all measured NRV categories.

NRVs for passenger safety

- The UK has the lowest NRVs for passenger safety of all EU states.
- The NRVs relating to passenger safety cover passenger FWSI 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 injuries that occurred in the train accidents at Ufton and Grayrigg respectively.
- The second set of NRVs represent a level of passenger risk that is substantially lower than the SRMv8 estimate. Consistently meeting these NRVs will therefore be a considerable challenge for the UK railway. Nevertheless, performance since 2008 has been within the NRV.

Chart 27. Passenger safety: NRV 1.1

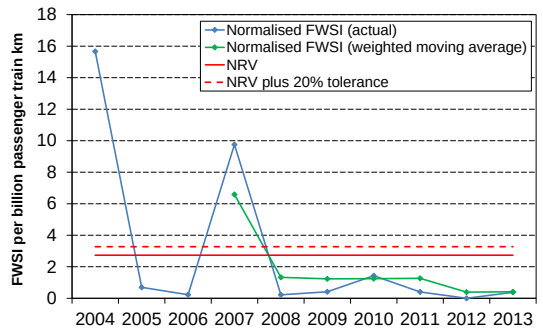
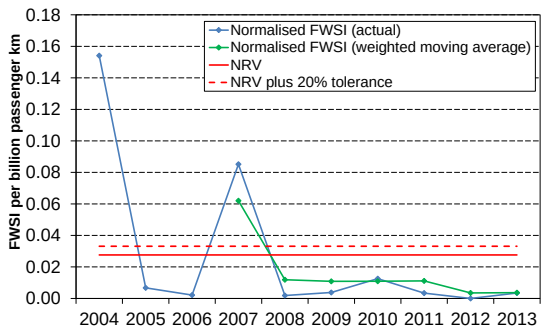


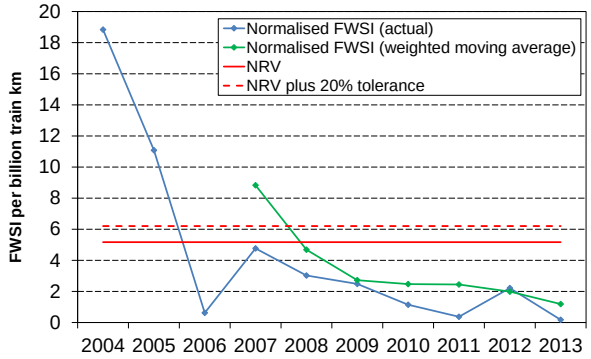
Chart 28. Passenger safety: NRV 1.2



NRV for employee safety

- Most FWSI in this category arises from infrastructure workers being struck by trains.
- Performance in 2013 was within the NRV (there were no workforce fatalities during the year within European reporting scope).
- In 2004, there were particularly high numbers of both fatalities and serious injuries to infrastructure workers.
- When compared to estimates from SRMv8, the employee NRV is a good estimate of the underlying level of risk to employees from accidents within the scope of European reporting.

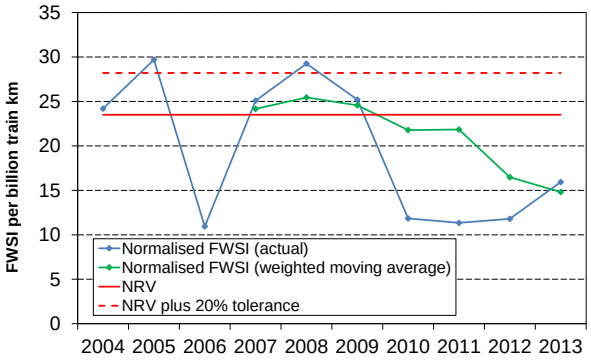
Chart 29. Employee safety: NRV 2



NRV for level crossing safety[13]

- The UK has the lowest NRV for level crossing safety of all EU Member States.
- This NRV covers both pedestrians and road vehicle occupants involved in collisions with trains on level crossings (but not train occupants).
- There were a relatively low number of level crossing user fatalities in 2010 to 2012, and performance is currently within the NRV. In some previous years, the weighted moving average of normalised FWSI had exceeded the NRV but fallen within the 20% tolerance limit.

Chart 30. Level crossing safety: NRV 3.1



- When compared to estimates from SRMv8, 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.
- The 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.

[13] Although ERA notes that data quality is improving, because of on-going concerns about the quality of information being supplied by some member states, it continues 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 section). ERA will begin using CSI data once they have sufficient confidence in its quality. See also the footnote 9 on page 38.

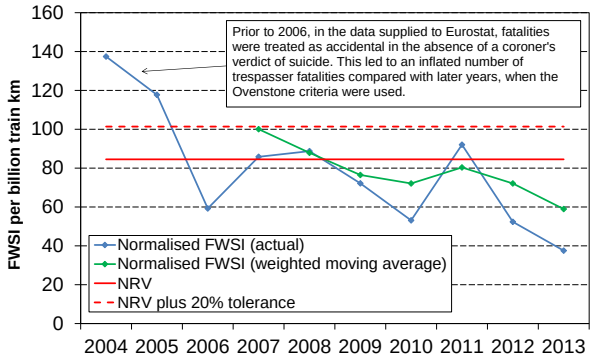
NRV for other persons[14]

- 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. However, because of the limitations on the data classifications of the Eurostat data used by ERA (see footnote 13 on page 45), the ERA data does not accurately reflect the numbers falling into this category.
- The NRV of 7.0 FWSI per year was not based on UK data because there were too few incidents for its calculation.

NRV for unauthorised persons[15]

- This NRV covers the risk from trespassers being struck by trains, and from 'train surfers'.
- Performance in both 2012 and 2013 was within the NRV. This follows 2011 where performance was above the NRV but within the 20% tolerance limit: the number of trespass fatalities in that year was relatively high. The weighted moving average has consistently been within the NRV since 2008.
- 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 9 in Section 3.3).

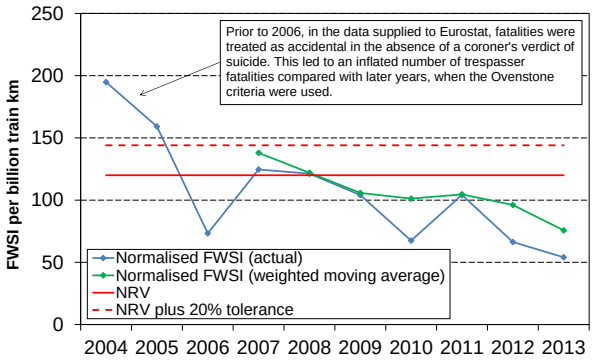
Chart 31. Safety of unauthorised persons: NRV 5



NRV for the whole of society

- The UK NRV value in this category is the second lowest of all Member States.
- 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 2013 was within the NRV.
- Unauthorised persons (that is, trespassers) are the dominant contributor to this risk category. Changes in the risk to passengers, staff, level crossing users and others are likely to have relatively little impact.

Chart 32. Whole society safety: NRV 6



[14] See footnote 13. The analysis of performance against this NRV is insufficiently meaningful for review, given the limitations on the data behind it.
[15] See footnote 13.

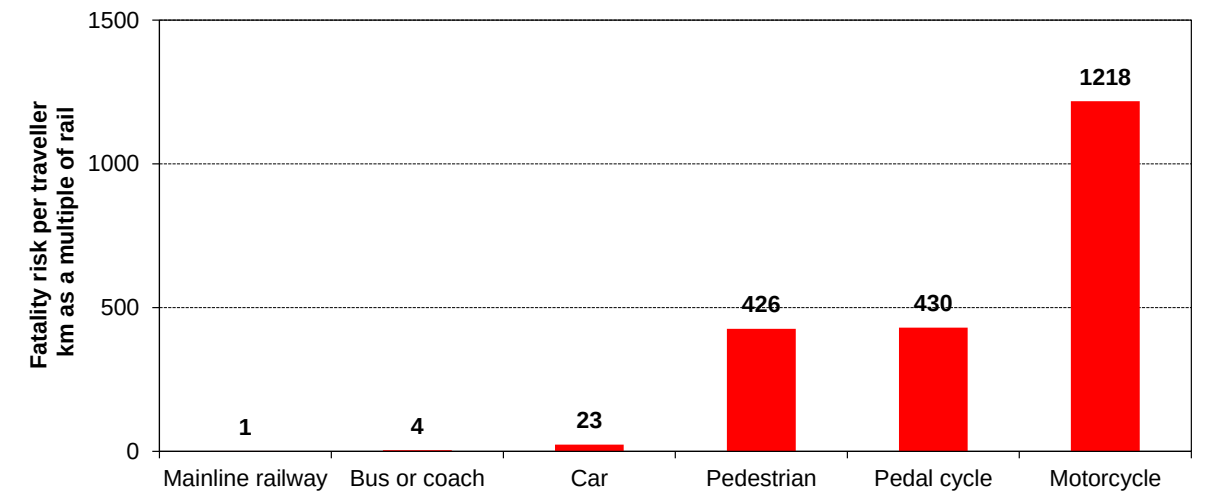
4 Benchmarking railway performance

This chapter looks at railway safety in the wider context. It uses a range of data sources[16] to examine the safety of other transport modes, of railways in other countries, and in other industries, and compares them with the mainline railway in Britain.

2013/14 Headlines

- Competition between different modes of transport remains intense. The factors that increasingly influence transport choices include speed, cost, comfort, convenience, safety and 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. There have been marked improvements in road safety in recent years, with a 48% reduction in fatality rate between 2006 and 2012.
- Safety on the UK's railways compares favourably with other EU countries. International railways differ in terms of infrastructure, rolling stock, working practices and the external hazards to which they are exposed.
- Train drivers, infrastructure workers and station staff appear to be exposed to a broadly similar level of risk to workers in comparable occupations. Data quality varies between different occupational groups.
- RSSB is engaged in a number of workstreams that enable operators to compare their own performance with the wider industry, and aid safety management.

Benchmarking at a glance



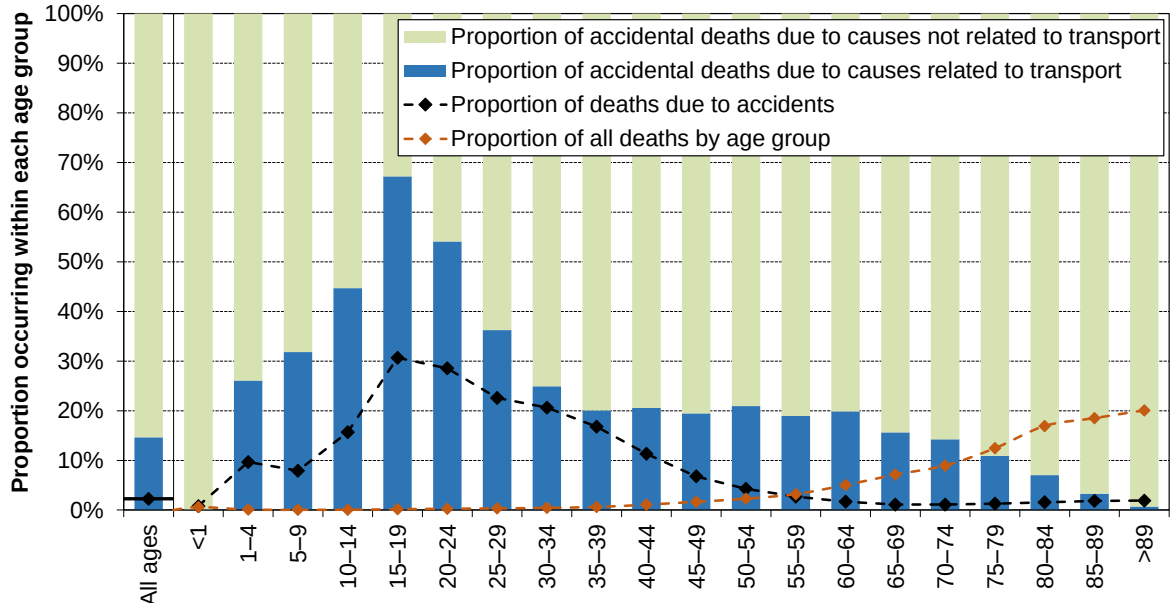
Sources: See Section 4.2.2

[16] All analyses in this chapter use the latest data available. In a number of cases – for example, when the source is Transport Statistics Great Britain – this is from the calendar year 2012.

4.1 Transport risk in general

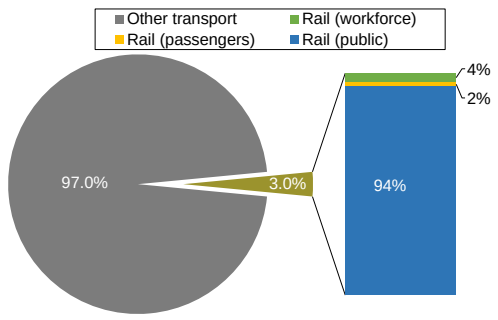
According to the National Travel Survey (NTS), the average Briton spends just over one hour per day travelling. According to the Office of National Statistics (ONS) transport accidents account, in total, for around 15% of all accidental deaths, with accidents accounting for just over 2% of the total number of deaths. The majority (93% in 2012) of transport deaths result from road traffic accidents, rather than rail, sea or air.

Chart 33. Proportion of deaths due to accidents, by age and cause, 2012



- Among the population as a whole, accidents cause 2.3% of the total number of deaths. Other deaths are due mostly to 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 2.3%. Nearly one third (31% in 2012) of deaths in the 15-19 age group are accidental, the highest proportion within any age group; of these, just over two-thirds are due to some form of transport.
- 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 (2%). Of those that are accidental, the proportion resulting from transport accidents decreases with age; as people get older, there is a tendency to travel less, and an increasing vulnerability to accidents in other locations, such as the home.
- Of all the accidental fatalities that involved transport in 2012, 3.0% involved rail transport; the majority of these deaths were members of the public engaged in trespass.

Chart 34. Accidental transport fatalities, 2012

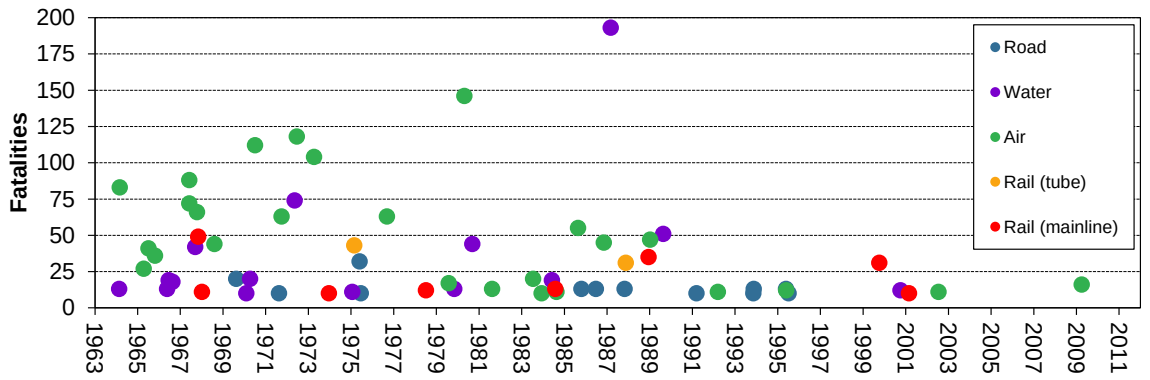


Data sources: Office for National Statistics for accident rates by age (in *Mortality statistics – deaths registered in 2012*) and population estimates. Figures in Chart 33 relate to England and Wales only.

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. Since 1963, 292 passengers have died in train accidents. In contrast, 801 car occupants died in road accidents in 2012 alone, yet there is a disproportionate amount of media coverage of railway accidents. One reason is that a single train accident has the potential to result in many casualties. Over the past 50 years, roughly two thirds of British accidents with ten or more fatalities have been transport-related.

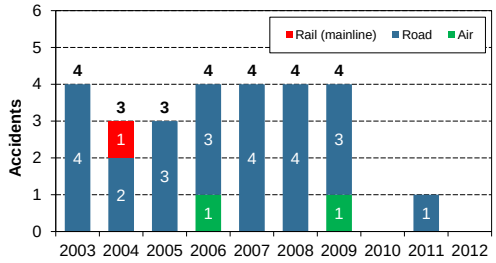
Chart 35. Transport accidents with ten or more fatalities 1963 to 2012



Rail (mainline) accidents: Hither Green (1967), Hixon (1968), West Ealing (1973), Taunton (1978), Polmont (1984), Clapham Junction (1988), Ladbroke Grove (1999), Great Heck (2001)

- Since 1963, there have been eight accidents on the mainline railway that have resulted in ten or more fatalities. These represent around 14% of all such transport accidents, and roughly 8% of the resulting casualties.
- The two accidents with the highest consequences were the air crash in Tenerife, Canary Islands in 1980, and the capsize of Herald of Free Enterprise at Zeebrugge, Belgium in 1987.
- In recent years, high-consequence accidents in all modes have become less frequent. There has been one transport accident between 2003 and 2012 with ten or more fatalities; this was an accident involving North Sea helicopters carrying off-shore workers.
- Most accidents with five or more fatalities occur on the roads; there were none in 2012.
- There have been two train accidents with passenger fatalities since 2003: Ufton level crossing 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 level crossing was due to a car deliberately parked on a level crossing by a driver intent on committing suicide.

Chart 36. Accidents with five or more fatalities



Data sources: A W Evans (HSE Research Report 073) Transport fatal accidents and FN-curves 1967-2001, Railways Archive, Aviation Safety Network and Stephen E. Roberts Fatal work-related accidents in UK merchant shipping 1919 - 2005 for historical data; MAIB 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. Confirmed acts of terrorism have been excluded. No accidents with ten or more fatalities were found to have occurred on the road network between 1963 and 1968.

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 corresponds to fewer than three fatalities per year.

Road

In 2012, 1,754 people were killed in road traffic accidents. 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 comparatively higher level of risk. 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. Differences in risk levels can be seen in the accident statistics for different demographic groups. Proportionately, around three times as many 18 and 19-year-olds are killed in car accidents as those in the 40-59 age group. Driving on motorways is around six times safer than driving on urban roads on a per kilometre basis.

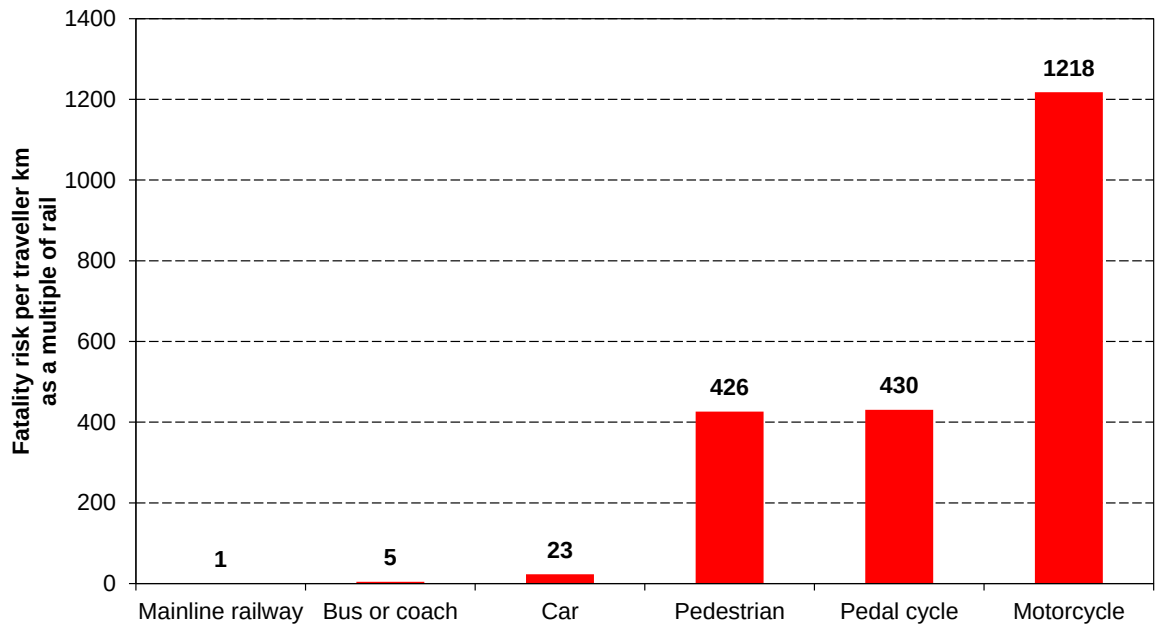
Air

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 very high consequence. Given the limited number of accidents, 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 British 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.

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 37. Traveller fatality risk for different transport modes (relative to rail)[18]



- The motorcycle is by far the highest risk mode of popular transport, with a fatality risk per kilometre three orders of magnitude greater than rail.
- Car travel is around 20 times less safe, on average, than making a rail journey of the same length.
- Bus and coach travel is around five times safer than making the same journey by car, but less safe than rail.
- Rail transport has the lowest traveller fatality risk per kilometre. It has a similar level of risk, per trip or per hour, to bus and coach travel. 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.

Table 4. Traveller fatality risk – other metrics

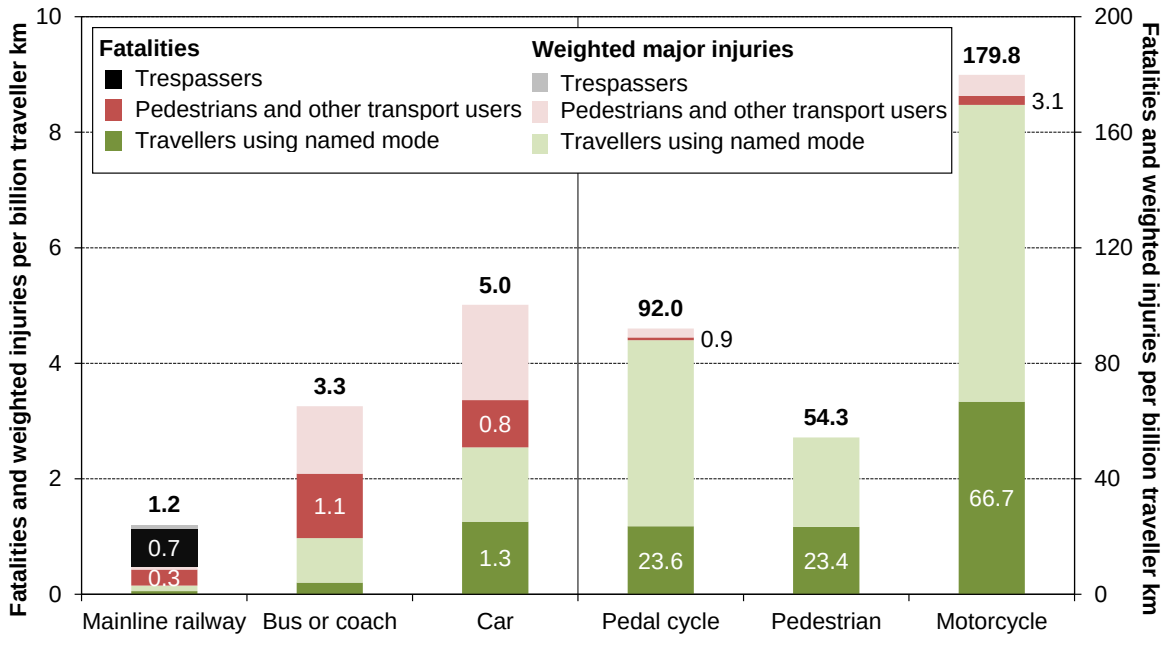
	Fatality risk per bn traveller…		
	km	hours	trips
Mainline railway	0.05	3	2
Bus or coach	0.20	3	2
Car	1.26	51	17
Pedestrian	23.36	99	24
Pedal cycle	23.59	317	112
Motorcycle	66.73	2713	1134

[18] Aviation risk is omitted, due to difficulties in obtaining robust estimates (see previous page).
Data source: SRMv8 for rail (based on data to September 2013), DfT for other modes (*Transport Statistics Great Britain 2013* for headline rates and *Reported Road Casualties Great Britain 2012* for casualties to other road users, normalised by data obtained from the National Travel Survey). A three-year average (2010-2012) was used to estimate casualty rates for bus and coach occupants, a single year (2012) for other forms of road transport. In 2012, there were 1,754 road accident fatalities: 420 pedestrians, 118 pedal cyclists, 328 motorcyclists (including 12 passengers), 801 car occupants (including 259 passengers), 11 bus and coach passengers and 76 other road users (mostly occupants of goods vehicles).

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 maintains its safety advantage over other forms of motorised transport. This remains the case, even when trespass injuries are included.

Chart 38. Traveller total risk for different transport modes



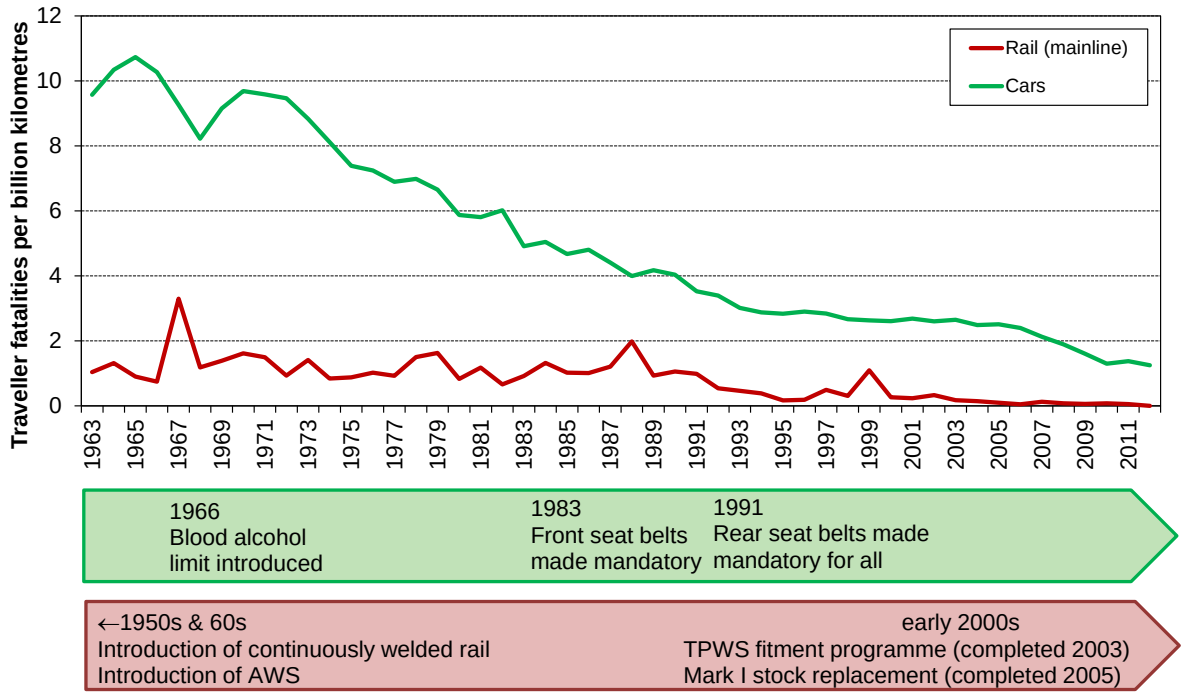
- Buses and coaches present a relatively high risk to pedestrians and other transport users. They are heavy vehicles that often operate on busy streets.
- Bus and coach travellers also have a higher rate of major injury than those on trains.
- Excluding trespassers, more pedestrians and other road users 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 situation reverses if trespassers are included as interactions between them and trains occur more frequently on the running line.
- The fatality rate of other road users in accidents involving motorcycles (3.1 fatalities per billion traveller kilometres) 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 people injured in accidents that 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.

4.2.3 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 39. Safety trends in rail and car travel 1963 to 2012



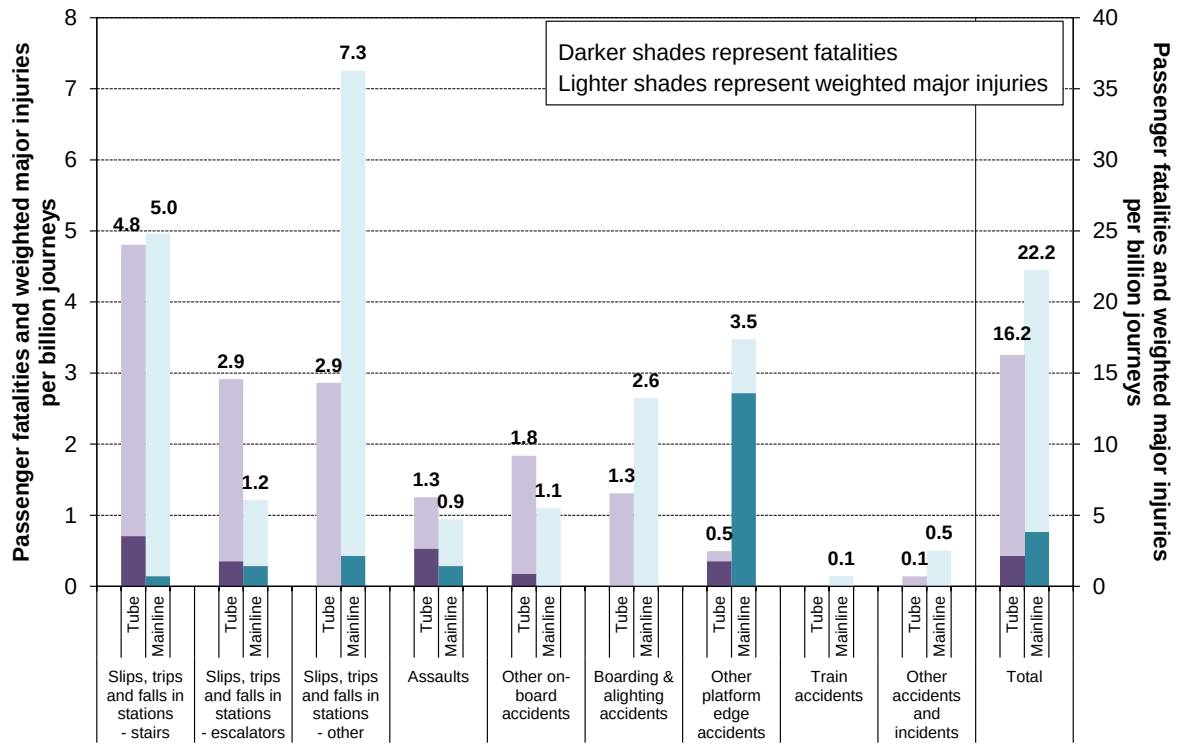
- There have been substantial improvements in the safety of both road and rail transport over the past five decades, although car travel has only recently reached a level of safety similar to that of rail travel around 30 years ago.
- The safety of car travel improved at a faster rate than rail safety between the early 1970s and the early 1990s.
- From the early 1990s to the mid-2000s, the gap widened again (in relative terms). There were major safety improvements on the railway, while the safety of car occupants improved at a much slower rate (around 1% per year).
- Improvement has generally been gradual rather than via any step change. 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.
- There was substantial improvement in car safety between 2006 and 2010, which has since been consolidated, with the result that, in 2012, the fatality rate for car occupants was 48% lower than in 2006, and was at the lowest level seen in modern times.

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 37, in which rail safety is based on data from SRMv8. 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.

4.2.4 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 (LUL) is broadly similar to the number made on the national rail network. Each was used for more than one billion journeys in 2012/13.

Chart 40. Fatality/weighted injury profile for the mainline railway and LUL 2008/09-2012/13



- Measured by FWI per passenger journey, LUL 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 notably more prevalent on the tube is slips, trips and falls on escalators. However, there are more than 400 escalators on the network's 270 stations, many more than on the mainline rail network.
- During the period covered by the chart (2008/09 to 2012/13) there were no passenger fatalities in train accidents on either the Underground or mainline railway.

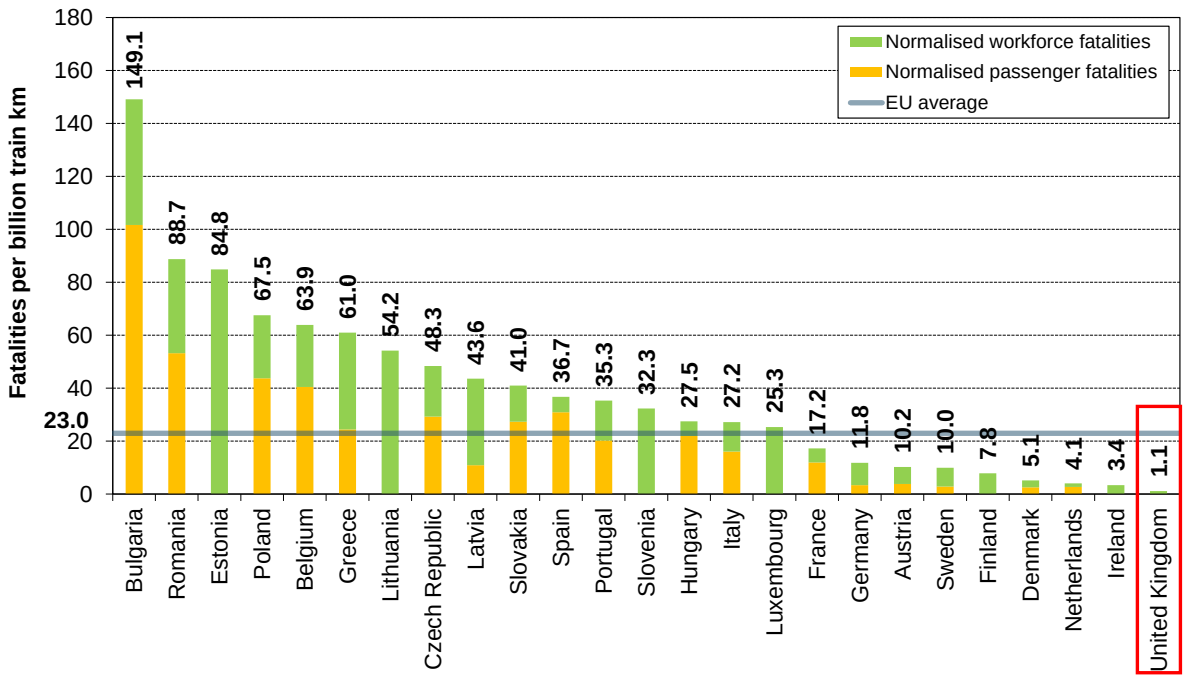
Data sources: Accident data for the LUL supplied by Transport for London. Data for both the mainline railway and LUL is based on the five-year period 2008/09-2012/13. Normalising data is from ORR (*National Rail Trends*) and DfT (*Transport Statistics Great Britain 2013*). Major injuries are given a 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.

4.3 International comparisons

4.3.1 Comparing rail safety within the EU

The European Railway Agency (ERA) assesses the safety performance of European railways against a set of Common Safety Targets (CSTs) and state-specific National Reference Values (NRVs). See Section 3.3 for more information.

Chart 41. Passenger and workforce fatality rates on European Union railways 2008-2012



- Passenger and workforce fatality rates in the UK were well below the EU average over the five-year period 2008-2012. There have been no passenger fatalities in train accidents on the UK mainline since 2007. The ERA uses data from a rolling five-year period to assess performance against the NRVs and CSTs.
- In general, countries in northern and western parts of Europe have safer railways than those further south and east.
- A single multi-fatality accident can have a significant effect on the fatality rate, especially for smaller countries such as Belgium, where 18 people were killed in the crash between two commuter services at Halle, near Brussels, in February 2010.
- Table 5 shows that the UK ranks highly among the EU-25 countries across all NRVs.

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	3
Level crossing users	NRV 3.1	1
	NRV 3.2	n/a
Others	NRV 4	n/a
Unauthorised persons	NRV 5	5
Whole society	NRV 6	2

Data source: Eurostat. The data covers the five-year period 2008-2012. 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) 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; the other two member states, Malta and Cyprus, no longer have railways.

4.3.2 Railway safety worldwide

Though railways beyond Britain differ in terms of infrastructure, rolling stock, working practices, and the external hazards to which they are exposed, lessons can still 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.

Table 6 lists all identified train accidents in 2013/14, in which five or more passengers or workforce were killed. Two of these events occurred in Europe including the derailment in Santiago de Compostela, Spain in July 2013, in which 79 people died.

The table excludes the majority of collisions between trains and road vehicles at level crossings, as most casualties in these accidents are road users.

Table 6. Worldwide train accidents in 2013/14 with five or more fatalities

Date	Place, country	Fatalities	Accident type	Key issues
12/07/2013	Bretigny-sur-Orge, **France**	6	Derailed passenger train mounts platform	Pointwork fault.
24/07/2013	Santiago de Compostela, **Spain**	79	Derailment (Passenger)	Overspeeding; change from automatic protection to conventional signalling; driver distraction.
25/08/2013	Villahermosa, **Mexico**	6	Derailment (freight)	Possible speeding in heavy rain.
02/11/2013	Vijainagaram, **India**	8	Passengers on line	Suspected on-board fire led passengers to evacuate from train to adjacent running line.
09/12/2013	Bintaro, **Jakarta**	5	Collision (passenger) with lorry	Collision with lorry carrying dangerous goods at level crossing.

Note: Excludes train accidents with fewer than five passenger or workforce fatalities.

In addition to the above, on 6 July 2013, a train carrying petroleum crude oil operated ran away on a line unprotected by signals and track circuits. It derailed in the town of Lac-Mégantic, Quebec in Canada, and a fire and explosions ensued. Forty-seven members of the public were killed and around 2,000 were evacuated. For more information, see the Learning from Operational Experience Annual Report.

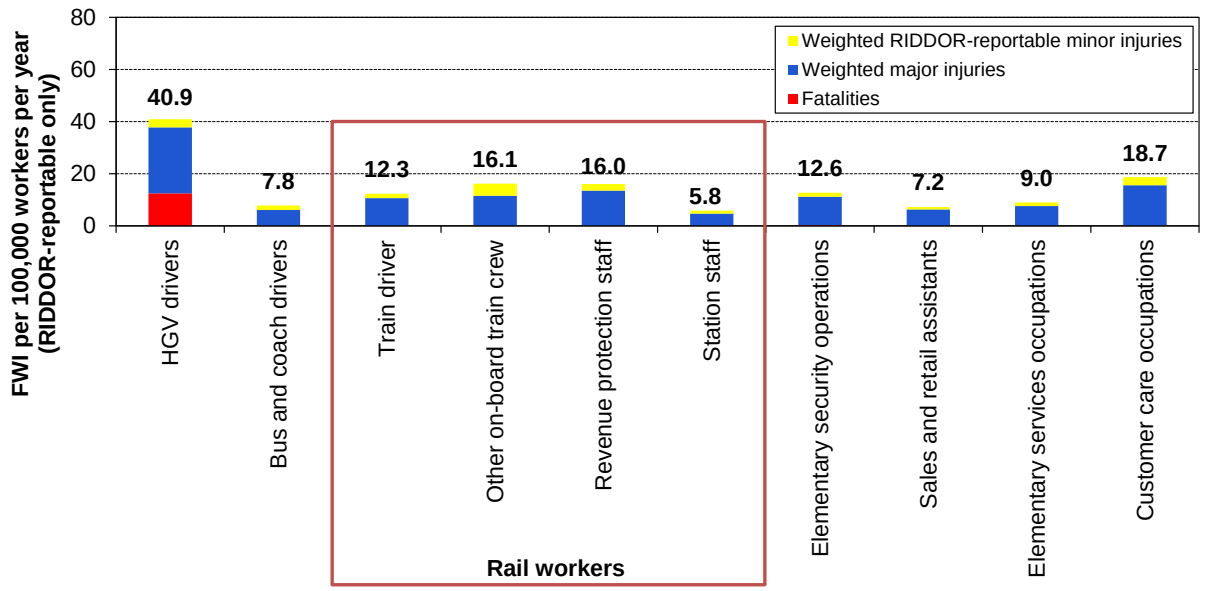
4.4 Occupational risk: comparisons with other industries

The *Health and Safety at Work etc Act 1974* requires employers to ensure, so far as is reasonably practicable, the health, safety and welfare of employees at work.[19]

4.4.1 Safety at work: train drivers and station staff

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

Chart 42. Train crew and station staff risk compared with other occupations in 2012/13[20]



Data sources: see footnote for Section 4.4.2.
RIDDOR-reportable minor injuries in this chart relate to injuries comprising more than seven days incapacitation. See footnote 20 for more information.

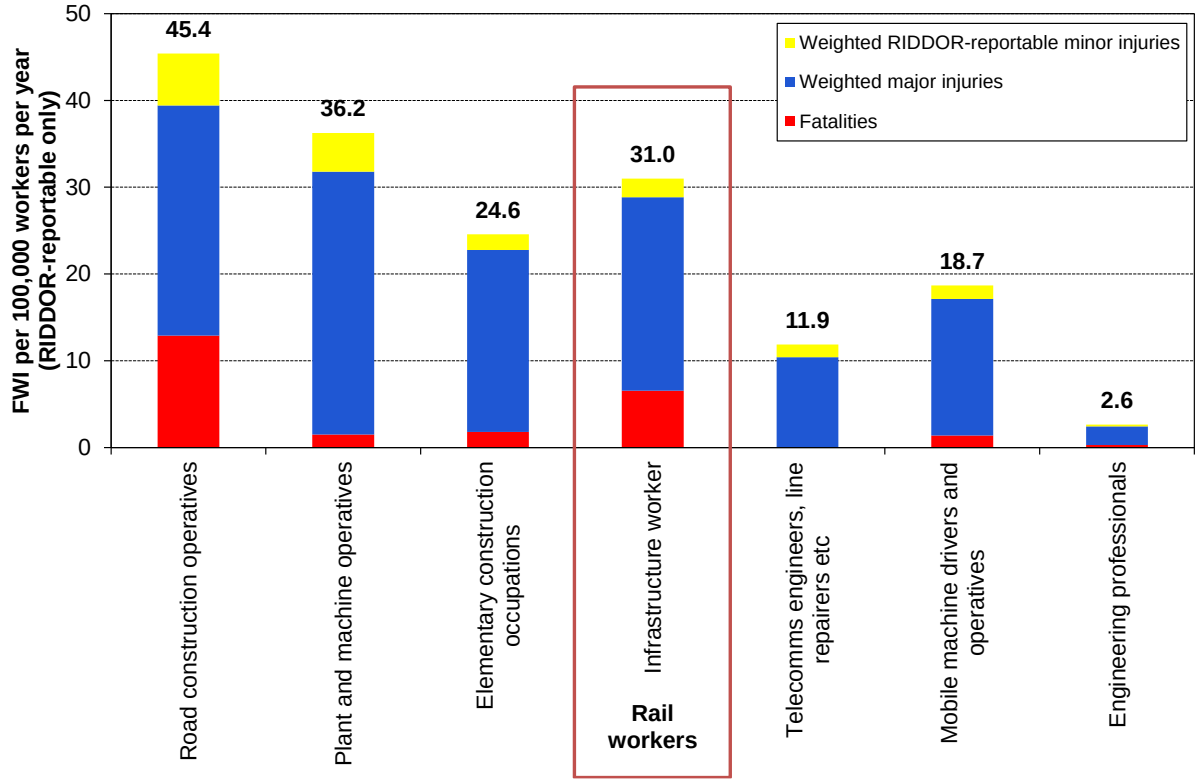
- Train drivers have a lower level of risk than the drivers of large road vehicles. HGV drivers have a higher fatality rate than bus and coach drivers as they are involved in more road accidents. Many major injuries to HGV drivers occur while loading and unloading or moving around depots and loading bays.
- Revenue protection staff also have a comparable level of risk to similar occupations involving security. This group is split between those that work on trains and in stations.

[19] The Act also requires employers to look after the safety of passengers and the public.
[20] Due to the change to the RIDDOR-reportable minor injury criteria, the analysis in this section has been created using only one year's worth of data. As a result, it is sensitive to annual fluctuations, particularly for occupations with relatively few workers. In future, more years will be added, which will decrease this sensitivity. This change will also affect the data in comparison with previous years. There has also been a change in the reporting methods for aircraft pilot and engineer injuries, which has affected this data's reliability as a comparator, it has therefore been omitted from this analysis.

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.

Chart 43. Rail infrastructure worker risk compared with other occupations 2012/13



RIDDOR-reportable minor injuries in this chart relate to injuries comprising more than seven days incapacitation. See footnote on page 57 for more information.

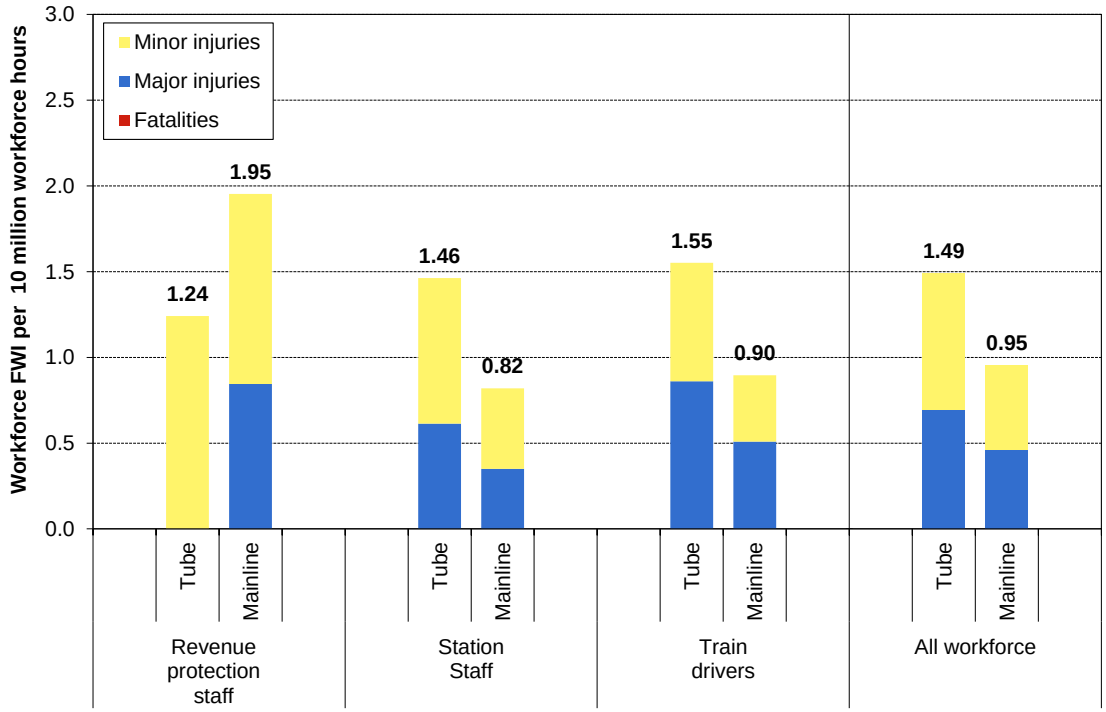
- Infrastructure workers appear to be exposed to a level of risk that is lower than road construction operatives, and plant and machine operatives, and greater than mobile machine drivers, telecoms engineers and other engineering professionals. However, there is a substantial element of uncertainty in the estimates for non-rail workers, due to differences in data quality.

Data sources: HSE 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 *Road accident statistics 2012*). 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) 2010. 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 than the railway. This may also explain the much larger risk contribution from RIDDOR reportable minor injuries to train crew and revenue protection staff. In April 2012 HSE extended the period for reporting injuries that lead to a worker being incapacitated for work from more than three days to more seven days. This may have improved levels of reporting. 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.

4.4.3 Safety at work: comparing the mainline railway and LUL.

Three workforce categories have been identified as comparable between LUL and mainline railway: similar daily duties and responsibilities mean that staff members face similar safety hazards. However the contrasting working environments and reporting methods lead to variability in the observed risk for each workforce category. Further steps are being taken to align and share more data in future.

Chart 44. Workforce fatalities and weighted injuries for the mainline and LUL 2008/09 to 2012/13



- Overall, mainline railway staff have lower rates of harm, measured by FWI per million workforce hours, than LUL staff. This is the case for station staff and train drivers, but not revenue protection staff.
- Some of the differences between the rates of harm for staff working stations may be explained by differences between working environments on LUL and mainline infrastructure, particularly the effects on the potential for assault. Mainline revenue protection staff also work on-board trains, as well as in stations and so are exposed to hazards while walking through the train.
- The differences seen in the rates of harm for train drivers may be explained by differences in the frequency of journeys; LUL drivers have shorter, more frequent journeys than mainline drivers, meaning they enter and exit the cab more often, increasing their exposure to hazards at the PTI.

Data sources: LUL data is supplied by Transport for London.

4.5 Managing safety 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 on-going developments are listed below.

Research into safety performance indicators (SPIs)

In 2013/14 the research project T953 *Enhancing and promoting the use of SPIs* was concluded. The project provides good practice guidance on developing and managing safety performance indicators. Experience gained from implementing the guidance has resulted in safety improvements and ancillary business benefits for the companies that have participated.

All the resources developed during this project can be found here:

http://www.rssb.co.uk/risk-analysis-and-safety-reporting/safety-intelligence/measuring-safety-performance

The main outputs from the research are a detailed guidance document, supported by further materials and case studies, alongside a shorter, condensed, guide.

RSSB will continue to support the industry in this area and are able to provide briefings, coaching and training to member companies that wish to implement an SPI programme.

SRM Risk Profile Tool

Along with the Safety Risk Model, RSSB also produces the Risk Profile Tool (RPT). This is updated and improved with each version of the SRM. The latest version of the RPT reflects version 7 of the SRM and an updated version will be produced.

The RPT provides a basic level of benchmarking at hazardous event and precursor level. For higher frequency events, where there is sufficient company SMIS data to estimate risk values, the risk can be compared with the national model, normalised to reflect the size of the company's operation. The RPT lists the top ten risks where the company is above and below the national average. The areas where the company is higher than the national average may be the ones where there is greatest scope for risk reduction.

Geo-referenced risk assessment

RSSB has initiated research into the development of a geo-referenced safety risk model (GeoSRM), which aims to provide risk information that is associated with individual routes, companies or locations. A pilot model is being developed, which is based on the SRM, with the hazardous events and their causes mapped to data on railway operations, assets and usage. The pilot will offer a new and intuitive way of visualising and quantifying the risk profile, via a web interface. Users will be able to view detail at a local level or focus on the bigger picture, switching easily between different perspectives. Comparisons can be made between different locations and geographies, for example risk can be compared from station to station, or from route to route. The relationship between the risk and key risk-influencing factors (such as the timetable) is being quantified for the first time in the models that underpin the tool.

The pilot model is initially based on the Wessex route and three risk areas: station slips, trips and falls, railway suicides and train derailments. This pilot will be developed and tested during 2014.

The development of the model is linked to the Network Rail ORBIS (Offering Rail Better Information Services) programme, which is changing the way Network Rail's asset information is collected, stored and utilised. In future, this should enable the model outputs to be more 'predictive', in that more of the factors driving changes to the risk profile in the future will be included within the model.

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5 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.[21] The exceptions are persons at stations who are not intending to travel, and 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: *Members of the public*).

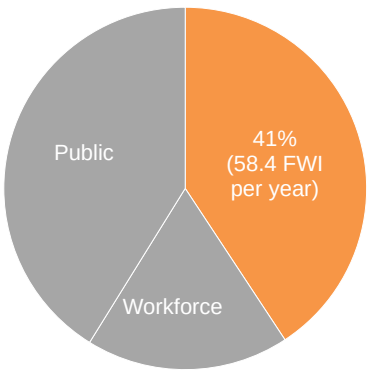
A detailed breakdown of passenger fatalities and injuries is presented in the key safety facts table at the end of this chapter.

2013/14 Headlines

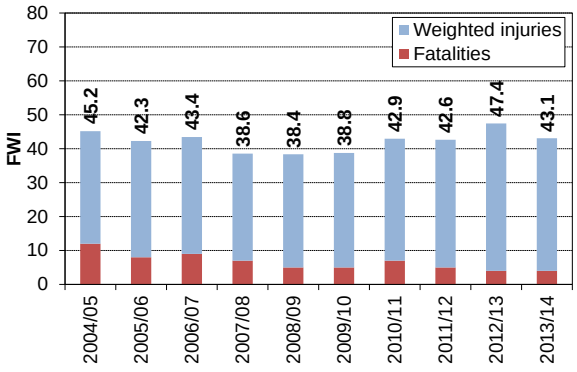
- There were 1.59 billion passenger journeys in 2013/14, a 6% increase from 2012/13. There has been a 53% increase in passenger journeys, a 44% increase in passenger kilometres, and a 10% increase in train kilometres over the past ten years.
- There were no passenger fatalities in train accidents for the seventh year running.
- There were four passenger fatalities, 270 major injuries, 6,307 minor injuries and 235 cases of shock/trauma reported. The four fatalities occurred in separate incidents at stations.
- The total level of passenger harm recorded in 2013/14 was 43.1 FWI, which was a 9% decrease on 2012/13, a year with an above average level of harm. When normalised by passenger journeys, the rate of FWI per passenger journey in 2013/14 showed a 14% decrease from the rate for 2012/13.
- The number of assaults recorded by BTP in 2013/14 increased slightly compared with the previous year. When normalised, the rate of assault has continued to reduce, and stands at around one per 450,000 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 and female travellers being more susceptible to slips, trips and falls; elderly people in particular have higher risk from falls on escalators. Higher rates of passenger harm occur during off-peak periods, when leisure travellers account for a higher proportion of journeys.

Passenger safety at a glance

Passenger risk in context (SRMv8)



Trend in passenger harm



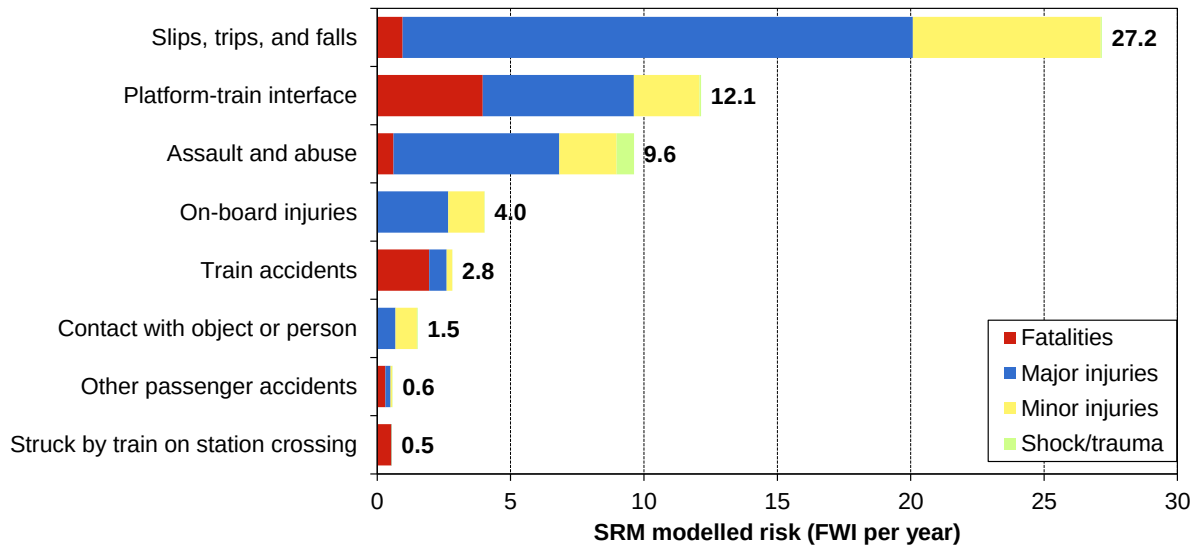
[21] This differs from the ERA definition of a passenger (used for the wider European statistical comparisons), which includes only people (other than workforce), who make a trip by rail and who are on board the train at the time of an accident, or who were boarding or alighting the train.

5.1 Passenger risk profile by accident type

Although the 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.

The breakdown of passenger risk in Chart 45 is taken from SRMv8 and therefore represents the modelled estimate of the underlying risk to passengers. In the remainder of this chapter, the charts are based on the levels of harm reported into SMIS, which, in any given year, may differ from SRM modelled values. This is mainly because the SRM includes risk from assaults, which are not routinely reported in SMIS (see below). Also, the SRM includes an estimate of the risk from events that may not have occurred during the year, such as train accidents involving passenger injuries. The types of events that are included in each accident type grouping shown in Chart 45 are described in Appendix 8.

Chart 45. Passenger risk by accident type: 58.4 FWI per year



Source: SRMv8

- Slips, trips and falls account for 47% of passenger FWI risk. Most of this risk arises from major injuries.
- Passenger accidents at the PTI account for the largest proportion of passenger fatality risk, at 48%. This category 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 5% of passenger FWI risk and 23% of passenger fatality risk, and are the next highest contributor to passenger fatality risk after accidents at the PTI.
- Assault on passengers is estimated to contribute 9.6 FWI per year, which is 16% of the passenger FWI risk. Passenger assaults are not regularly reported into SMIS (which recorded 0.9 FWI for passenger assaults in 2013/14), and the SRM estimate is therefore based on BTP data. This is another reason why the SRM-modelled risk is higher than the level of harm recorded in recent years.
- The category *other passenger accidents* includes events such as those arising from falls from height, exposure to hazardous substances, manual handling injuries and station fires.

5.1.1 Passenger fatalities and injuries in 2013/14

Around 1.59 billion passenger journeys were made in 2013/14. The following section summarises the fatalities and injuries that were recorded:

Fatalities

- There were no passenger fatalities in train accidents during 2013/14.
- There were four passenger fatalities in other, separate, incidents.

Table 7. Passenger fatalities in 2013/2014

Date	Location	Accident type	Territory	Description of incident
04/04/2013	Queen's Road Peckham	Platform-train interface	Kent	An elderly female passenger fell onto the tracks into the path of an approaching train. The passenger suffered a heart attack at the scene as a result of the accident. Although the train passed over the passenger, this was not the cause of the fatal outcome.
06/11/2013	East Croydon	Platform-train interface	Sussex	A male passenger stumbled and fell backwards from the platform onto the tracks. He was taken to hospital with suspected spinal injuries and later died. Alcohol was reported to be a potential factor in the incident.
21/12/2013	Mansfield Viaduct	Platform-train interface	London North Eastern	A male passenger on the track was hit by a through train. It is unclear how the person came to be on the line. It was reported that at one point the man was sitting with his legs over the platform edge, and alcohol was reported to be a potential factor in the incident.
01/03/2014	Shepherds Bush	Platform-train interface	Sussex	A train travelling through the station in the early hours of the morning reported striking a person on the track. CCTV appeared to show the person fall from the platform while under the influence of alcohol, a short while before the train approached.

Major injuries

- There were 270 passenger major injuries in 2013/14.
- 90% occurred at stations, and around three-quarters of these were slips, trips and falls.

Minor injuries

- There were 6,307 recorded minor injuries, 1,382 (22%) of which were Class 1 (ie the injured party went straight to hospital).
- Of the Class 1 minor injuries, 90% occurred at stations, with around three-quarters of these again being due to slips, trips and falls.

Shock and trauma

- There were 235 recorded cases of passenger shock or trauma, seven of which were Class 1 (ie occurred in a train accident or involved witnessing a fatality).

5.1.2 Passengers who engage in prohibited behaviour

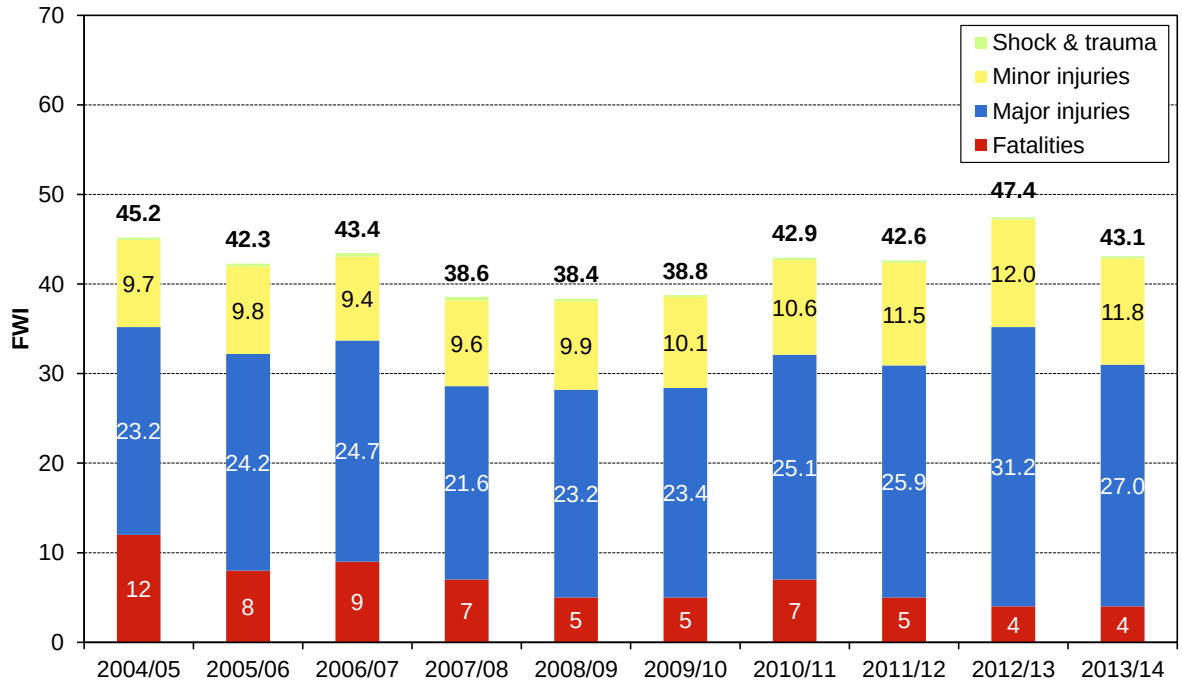
Each year, an additional number of passengers are accidentally injured or killed as a result of train surfing, deliberately exiting trains in running, or falling onto the railway while engaged in risk-taking behaviour. Incidents involving access of prohibited areas of the railway are categorised as trespass if that access was the result of deliberate or risk-taking behaviour. All such events are analysed under risk to members of the public.

An exception to this rule is at of level crossings, because level crossings are areas of the railway that are legitimately accessible by people for most of the time. Passenger trespass is covered in more detail in Section 7.4.

5.2 Trends in passenger harm by injury degree

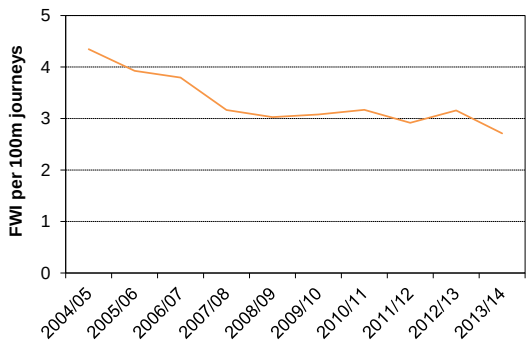
The average level of harm to passengers over the last ten years has been 42.3 FWI per year, of which 6.6 FWI relates to fatalities. As SMIS data does not contain complete information on passenger assault, it is likely that the level of harm to passengers is somewhat higher than this. The modelled risk from assault, as estimated by the SRM is 9.6 FWI, and is based on data obtained from BTP; trends in BTP assault data are analysed in Section 5.4.

Chart 46. Passenger FWI by injury degree



- The level of passenger harm recorded for 2013/14 was 43.1 FWI. This was 2% above the ten-year average.
- There were four passenger fatalities in 2013/14, which is the joint lowest number of passenger fatalities recorded over the ten-year period.
- Weighted major injuries dominate total passenger harm. The number of major injuries recorded in 2013/14 was 270. This was lower than for 2012/13, but 8% higher than the 10 year average.
- The trend in passenger harm should be seen against the context of rising passenger usage. Over the decade as a whole, there has been a reduction of 38% in the rate of harm normalised by passenger journeys. The majority of the reduction occurred during the first half of the decade, but between 2007/08 and 2012/13, the rate has been more or less stable at around 3.0 FWI per 100 million passenger journeys. The rate for 2013/14 shows a decrease from this average level.

Chart 47. Normalised FWI rate

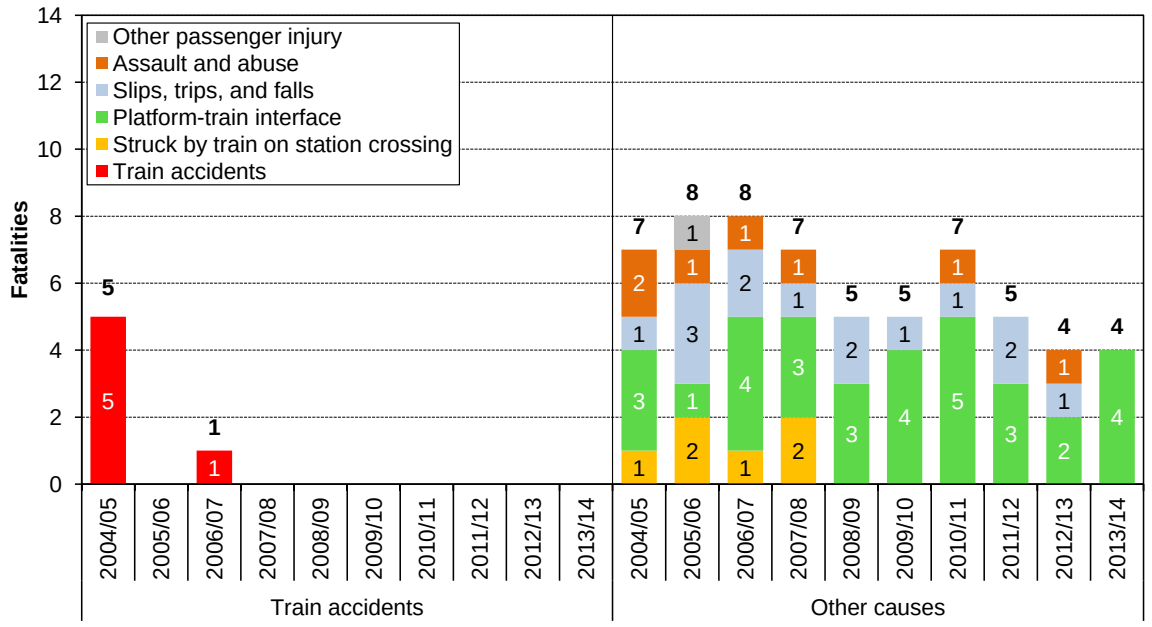


5.2.1 Passenger fatalities

There has been an average of 6.6 passenger fatalities per year over the last ten years; of these, 9.1% have occurred in train accidents. 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.[22]

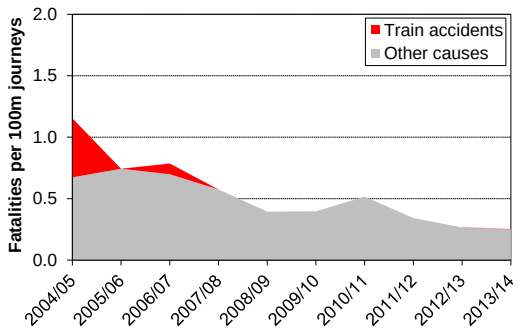
Excluding train accidents, over the last ten years, alcohol was recorded as a potential contributory factor in nearly 50% of all passenger fatalities.

Chart 48. Passenger fatalities by accident type



- The four passenger fatalities in 2013/14 all occurred in separate accidents in stations; all involved the PTI, but did not occur during boarding or alighting.
- 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 effect of train accidents on the fatality rate is illustrated in Chart 49. The last seven years have seen no passenger fatalities in train accidents.
- Over the past ten years, there have been no passenger fatalities as a result of accidentally falling from moving trains.[23] The risk associated with falls from moving trains has reduced significantly since the removal of Mark 1 (slam door) rolling stock and the use of central door locking on any remaining manually operated doors.

Chart 49. Normalised fatality rate

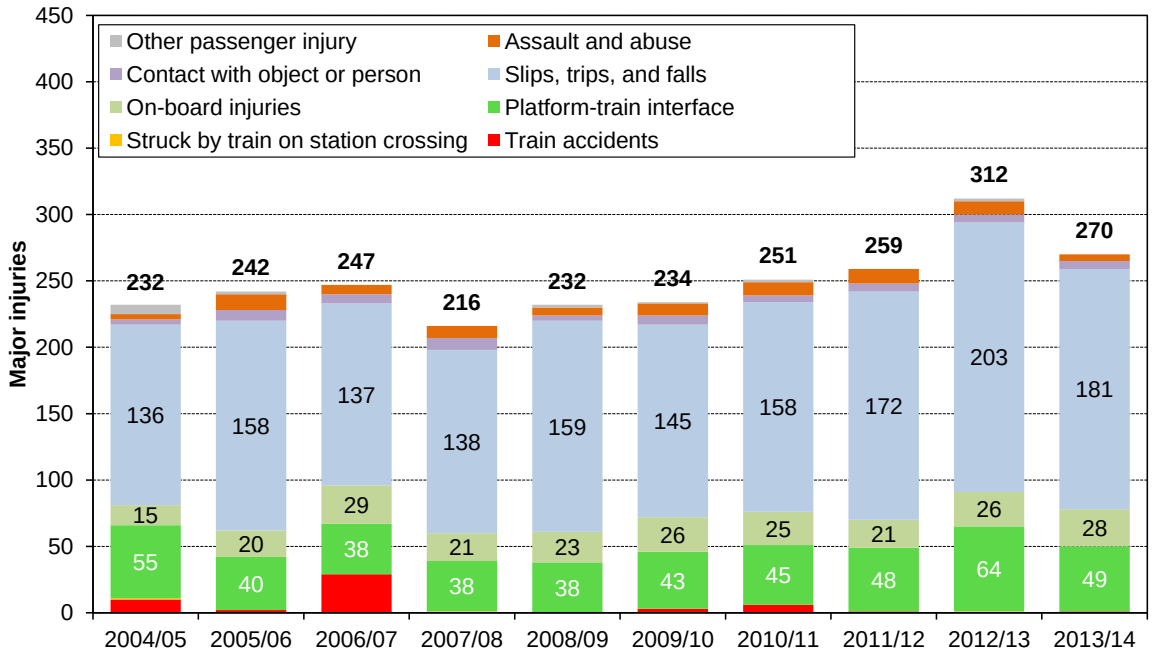


[22] Of the 8.3 fatalities per year estimated by SRMv8, 1.9 (23%) are estimated to occur in train accidents.
[23] Passengers who deliberately decide to exit a train in running are classed as engaging in trespass; these events are therefore covered under Chapter 7: *Members of the public*

5.2.2 Passenger major injuries

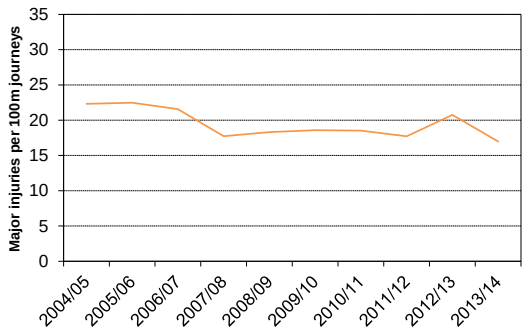
A passenger injury is categorised as major where it satisfies the description of major injuries laid out in the document RIDDOR 1995 Schedule 1.[24] There has been an average of 250 major injuries per year to passengers in the past ten years. Most major injuries occur to passengers when they are moving around the station – predominantly as a result of slips, trips and falls (accounting for 64% of all major injuries over the last ten years).

Chart 50. Passenger major injuries by accident type



- The number of major passenger injuries dropped in 2013/14 but was still at the second highest level seen in the analysis period.
- The majority of major injuries are due to slips, trips and falls. There were 181 major injuries due to slips, trips and falls in 2013/14, an 11% decrease from 2012/13.
- One person received a major injury in a train accident in 2013/14. This occurred as a result of a collision between trains, at a platform in Norwich station.
- Chart 51 shows that when normalised by passenger journeys, the rate of major injury has remained relatively static since 2007/08, with the exception of a peak in 2012/13.

Chart 51. Normalised major injury rate

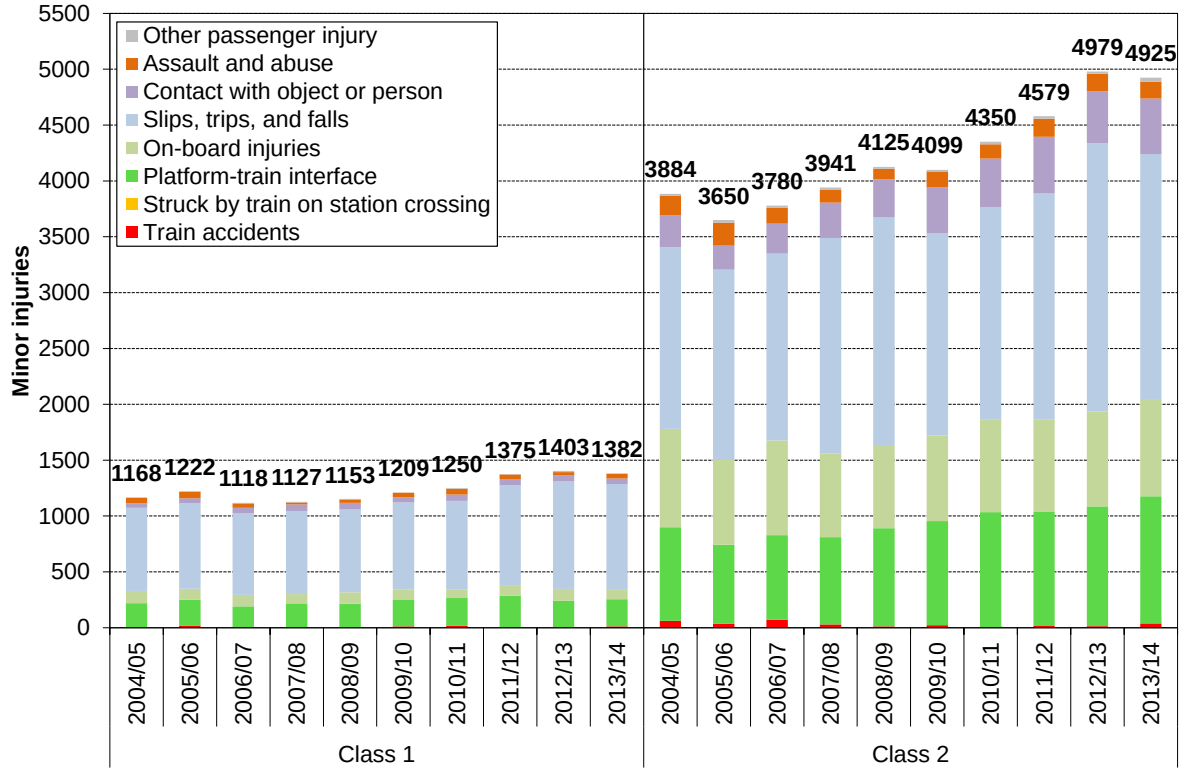


[24]RIDDOR refers to the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations, a set of health and safety regulations that mandates the reporting of, inter alia, work-related accidents. RIDDOR was originally issued in 1995, and has been amended twice since then – once in 2012 and again in 2013. The 2013 amendment removed the term major injury and introduce a new grouping called 'specified injury', having a slightly different scope. For continuity of industry safety analysis, the industry retains the original major injury classification. This includes losing consciousness, most fractures, major dislocations, loss of sight (temporary or permanent) and other injuries that resulted in hospital attendance for more than 24 hours. See Appendix 9 for further details.

5.2.3 Passenger minor injuries

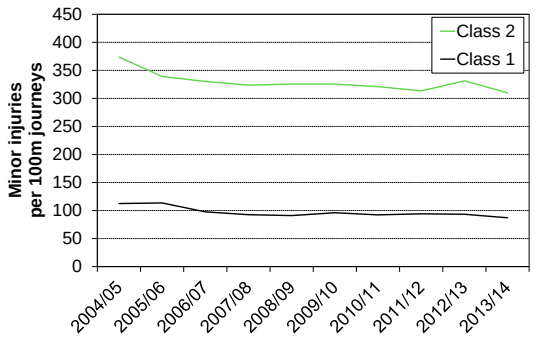
Passenger minor injuries are categorised as Class 1 if they are not major injuries, but the person is taken to hospital from the scene of the accident. Minor injuries that are Class 2 are generally of a less serious nature than those that are Class 1, and are consequently given a lesser weighting when calculating weighted injuries.

Chart 52. Passenger minor injuries by accident type



- The 1,382 Class 1 minor injuries occurring in 2013/14 represent a decrease of 1% compared with 2012/13.
- The number of Class 2 minor injuries in 2013/14 remained at a relatively high level compared with the previous ten years.
- When normalised by passenger journeys, the Class 1 and Class 2 minor injury rates decreased by 7% and 6% respectively in 2013/14 and are at the lowest levels in the analysis period.
- For different types of accident, the proportion of Class 1 and Class 2 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 11% of minor injuries since 2004/05 have been Class 1, and slips, trips and falls, where 30% have been Class 1.

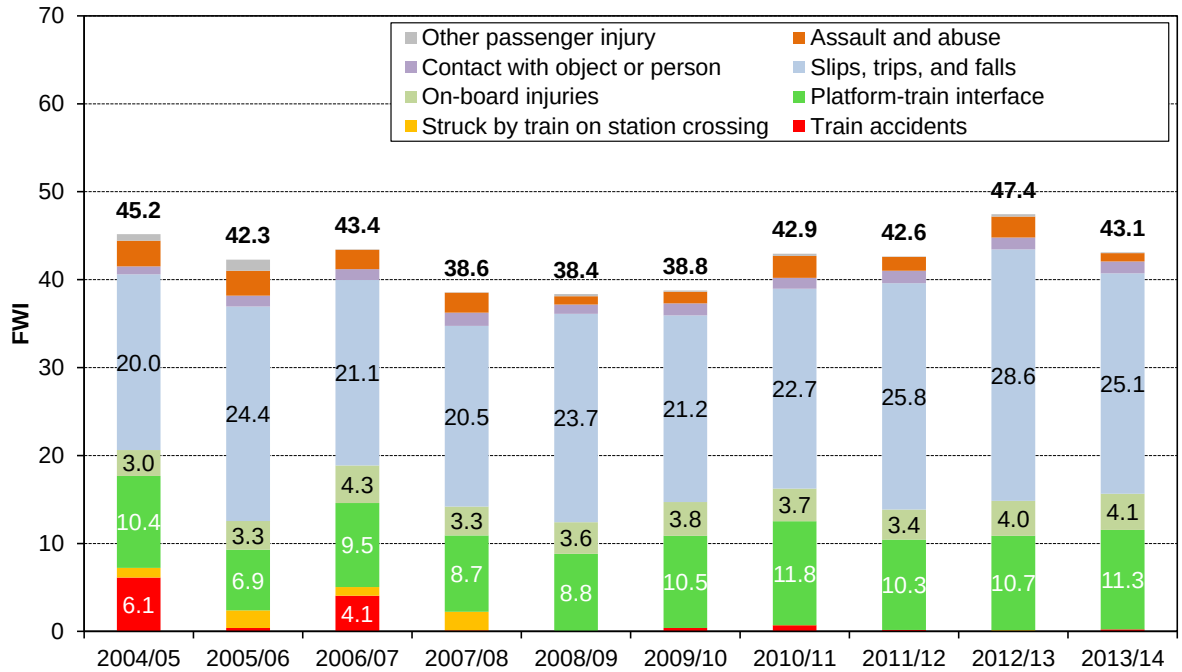
Chart 53. Normalised minor injury rate



5.3 Trends in passenger harm by accident type

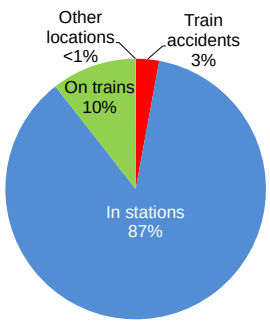
Analysis of passenger harm by accident type enables the causes of changing trends to be identified and considered further.

Chart 54. Passenger FWI by accident type



- The largest contributor to FWI is slips, trips and falls. The current year shows a 12% decrease in harm from slips, trips and falls compared with the previous year.
- The next largest contribution is from accidents at the PTI. The level of harm from PTI incidents recorded in 2013/14 was the highest it has been since 2010/11. There were four fatalities at the PTI in 2013/14.
- The contribution from train accidents is variable, reflecting their low-frequency, high-consequence nature. In 2013/14, the harm to passengers from train accidents was less than 0.1 FWI.
- Recorded levels of harm from assaults differ noticeably from the modelled risk of 9.6 FWI, as estimated by SRMv8. As noted previously, SMIS is not the main means of recording these events, which are more usually recorded by BTP.[25]
- The majority of passenger harm occurs in stations – around 87% since 2004/05, as seen in Chart 55.

Chart 55. FWI by location since 2004/05

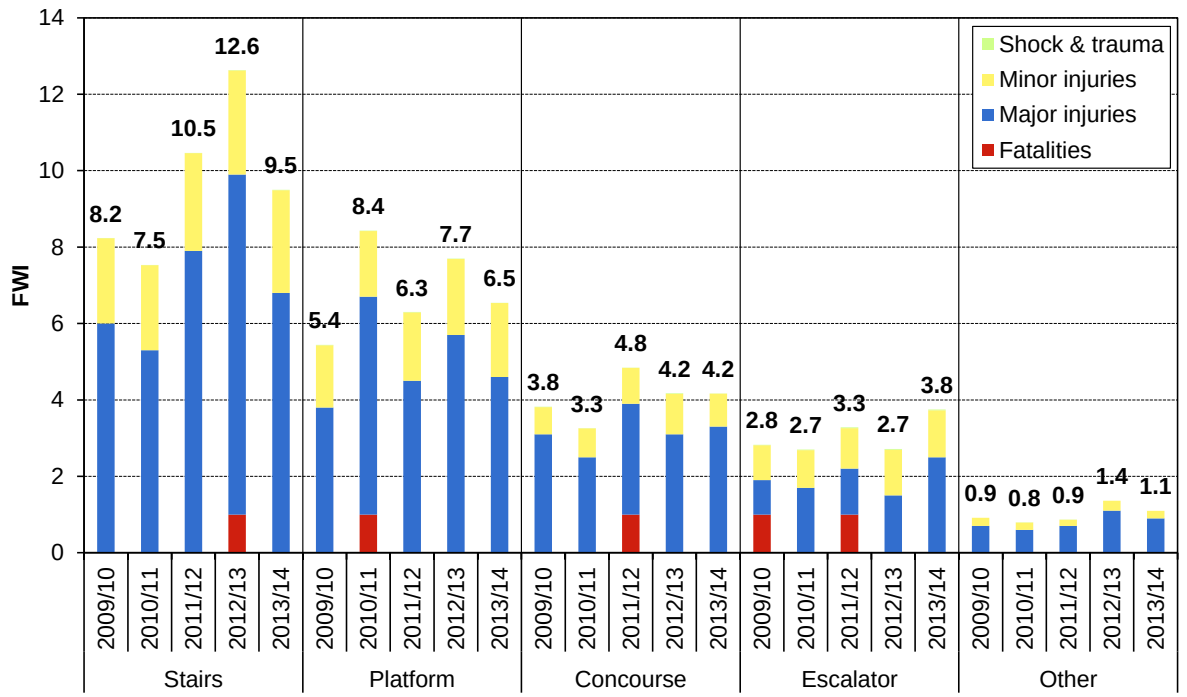


[25] See the report from research project T723: *Making the most of data associated with railway crime*, which is available on the RSSB website. This project considered the identification and analysis of various sources of railway crime intelligence, including BTP's CRIME and RSSB's SMIS systems, to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

5.3.1 Slips, trips and falls in stations

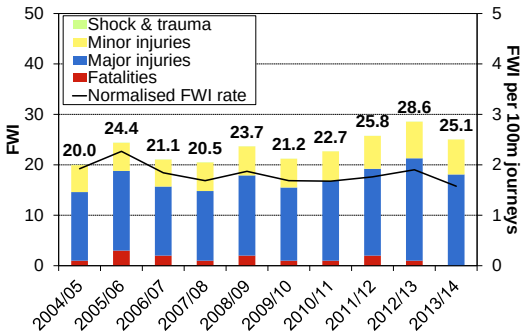
The average level of harm from slips, trips and falls over the last ten years has been 23.3 FWI per year, which is over half the average total harm to passengers over this period. Of the 23.3 FWI, 9.0 FWI has occurred on stairs, 6.8 FWI on the platform, 3.7 FWI on the concourse, 3.0 FWI on escalators, with the other areas of the station making up the remaining 0.9 FWI.

Chart 56. Passenger harm from slips, trips and falls



- Over the last 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. There was a 25% decrease in harm from accidents occurring on stairs in 2013/14, the high rate seen in 2012/13 was mainly due to a fatality and 22 more major injuries compared with 2013/14.
- After normalisation by passenger journeys, the FWI rate of slips, trips and falls in 2013/14 decreased by 17% and is at the lowest level in the analysis period.
- 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 two out of the past five years, falls on escalators led to the death of a passenger. In both cases, the person was elderly.
- The location *other* covers ramps, benches, and station crossings. The flat sections of subways and footbridges are included in the *platform* category.

Chart 57. Slips, trips and falls FWI



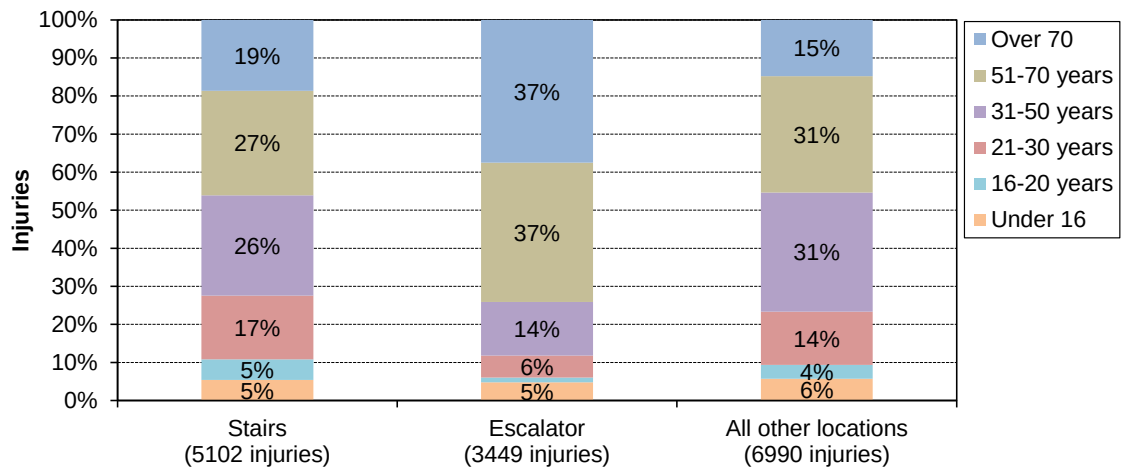
Slips, trips and falls on stairs and escalators

Passenger characteristics can be analysed to better understand slips, trips and falls on stairs and escalators. The last fatality to occur at either of these locations was at Leeds station in March 2013, when a male passenger suffered head injuries and later died as a result of a fall on the stairs to a platform.

Profile of passengers involved in slips, trips and falls on stairs and escalators

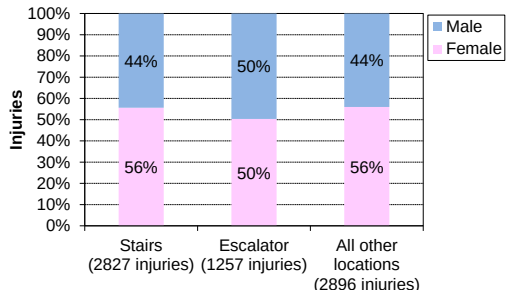
The chart below analyses the age profile[26] of all passenger slip, trip and fall injuries occurring on stairs, escalators and at all other locations. All of the passengers involved in fatal accidents on escalators since 2004/05 have been elderly.

Chart 58. Age profile of passenger slips, trips and falls by location 2004/05-2013/14



- The proportion of slip, trip and fall injuries on escalators involving older passengers is much higher than on stairs, which show a similar profile to all other locations. Seventy-four percent of slip, trip and fall injuries on escalators involve passengers over the age of 50, 37% involve those over 70. On stairs or at other locations, the corresponding proportions are lower, at around 45% and 15-19% respectively.
- Considering the relatively low number of passengers over the age of 70 that travel on trains, the proportion of slip, trip and fall injuries on escalators is even more skewed towards the elderly. The passenger age profile is analysed in more detail in Section 5.5.4.
- There is also a difference in the proportions of males and females being injured on stairs and escalators. Generally on stairs, as with other locations, more females are injured; on escalators the proportions are more equal. Passenger risk by gender is analysed in more detail in section 5.5.5.

Chart 59. Class 1 minor injuries[27] by gender and location 2004/05-2013/14



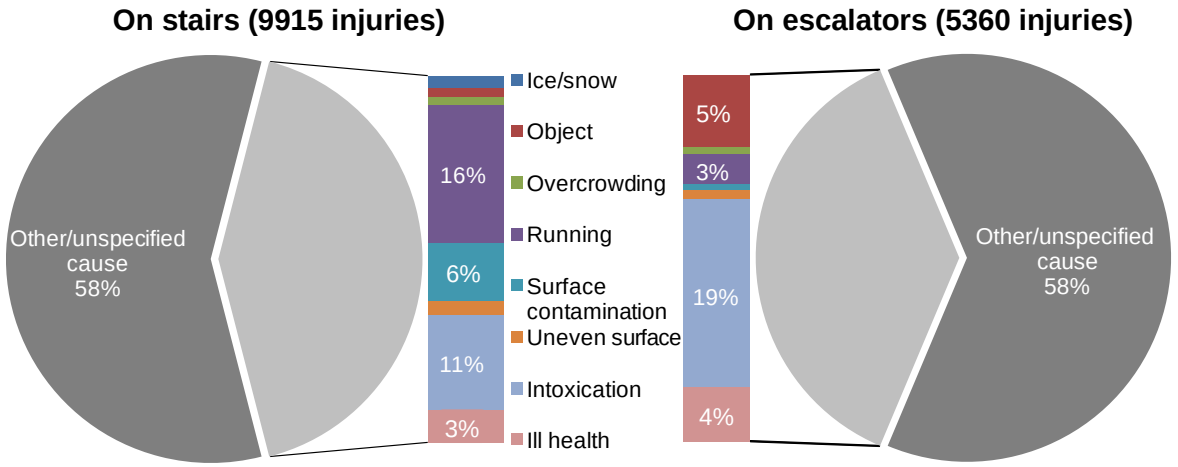
[26] The age of the passenger will be recorded in SMIS in the case of fatalities. Passenger age is estimated by the member of staff recording the injury at the time of the incident in roughly half of non-fatal injuries. The charts on this page only include injures where an age or an age-range was recorded.

[27] As there is known to be a difference in reporting levels between men and women, only Class 1 minor injuries were analysed. When looking at the age profile, there was little difference between Class 1 minor injuries and all injuries.

Causes of slips, trips and falls on stairs and escalators

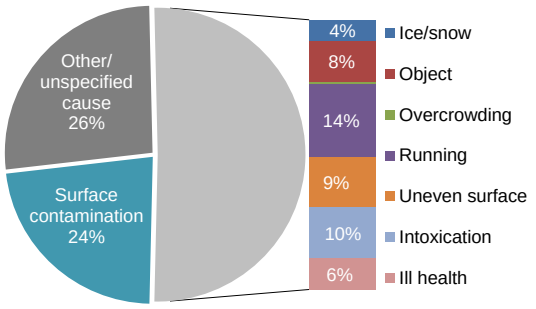
The profile of causes of slips, trips and falls differs depending on where the event has occurred.

Chart 60. Causes of slips, trips and falls on stairs and escalators 2004/05-2013/14



- The cause of the majority of slips, trips and falls on stairs and escalators is not specified. In most of these cases, the passenger has stated that they have 'missed their footing' or 'lost their balance'. This type of injury is especially common amongst the elderly.
- Where the cause of the event has been specified, the profile is different between stairs and escalators. The principal specified causes for accidents on stairs in order of frequency are running, being intoxicated, and the surface of the stairs being contaminated. Contamination includes rain water and drink spillages, for example.
- This contrasts with the principal specified causes of accidents on escalators, where a much smaller proportion of accidents are caused by running and surface contamination (as generally passengers stand on escalators, which are normally sheltered from the weather), and a larger proportion of accidents are caused by intoxication, objects (such as luggage), and ill health.
- At other locations, there is a much smaller proportion of unspecified causes of slips, trips and falls, as shown in Chart 61. Surface contamination (excluding ice and snow) has caused 24% of the accidents at locations other than stairs and escalators. There is a more even spread of other specified causes such as running, intoxication, uneven surfaces, objects, and ill health.

Chart 61. Causes of slips, trips and falls at all other locations 2004/05-2013/14 (14,241 injuries)



5.3.2 Accidents at the platform-train interface

To be a PTI-related injury, the incident must result in the passenger wholly or partially crossing the boundary between the platform and the track, or the platform and the train (if present). The PTI presents a number of potential hazards for station users, which can be exacerbated by their own behaviour, such as rushing, or being under the influence of alcohol or drugs. Passenger risk at the PTI is now the focus of a dedicated industry stakeholder group, the PTI strategy group, which is chaired by Network Rail. In addition, a PTI risk assessment tool is being developed, which will enable station operators to evaluate the features of stations and station platforms to identify areas of higher risk, together with the means of management and mitigation.

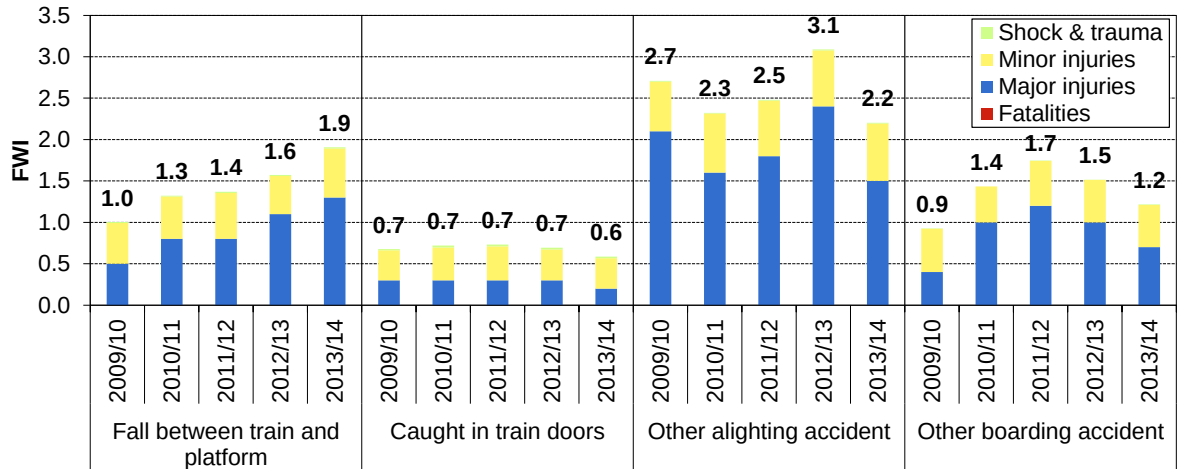
Table 8. Passenger FWI at the platform-train interface

Year	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
FWI	10.4	6.9	9.5	8.7	8.8	10.5	11.8	10.3	10.7	11.3

Accidents during boarding and alighting stationary trains

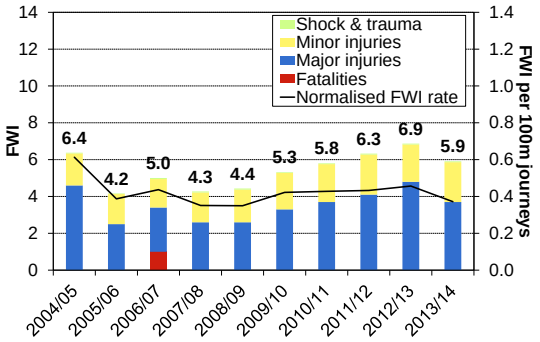
Over the past ten years, there has been an average of 5.4 FWI per year to passengers while boarding or alighting from the train.

Chart 62. Passenger FWI from boarding and alighting accidents



- The level of harm from boarding and alighting decreased by 14% in 2013/14 compared with the previous year (19% on a normalised basis).
- 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*. Overall, alighting accidents account for around twice the amount of harm as boarding accidents, despite accounting for only around half the number of accidents.
- The events within the *other alighting accident* and *other boarding accident* categories are largely falls from the train onto the platform, or trips while getting onto the train.

Chart 63. Boarding and alighting FWI

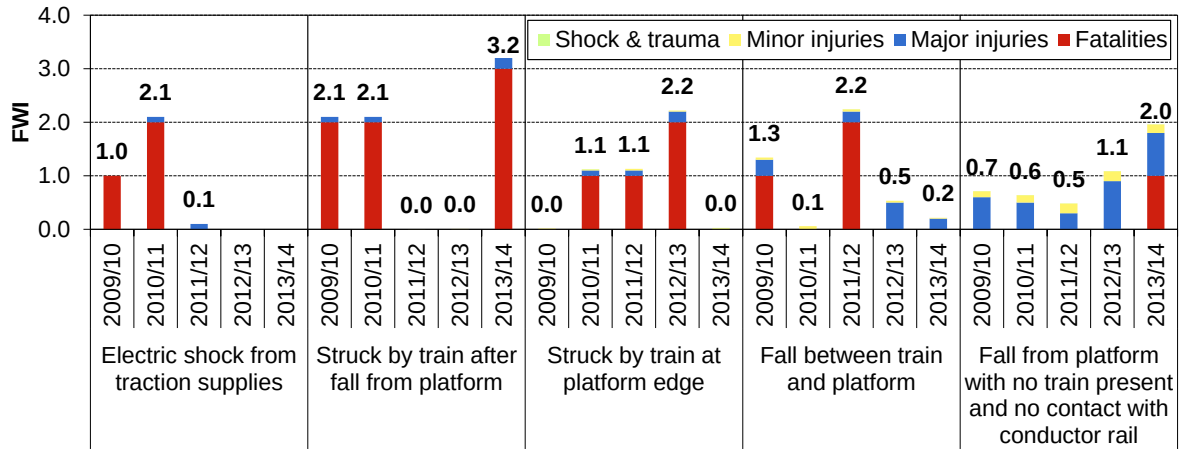


Other accidents at the PTI

Over the past ten years, other accidents at the PTI (those not occurring during boarding or alighting) have accounted for an average of 4.5 FWI per year, which is around 11% of the total average harm to passengers over this period. However, they have accounted for an average of 3.1 fatalities per year, which is nearly 50% of the average number of passenger fatalities seen over the last ten years.

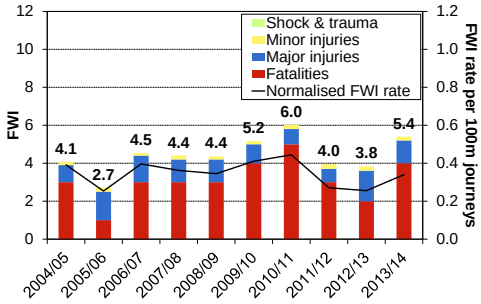
RAIB is investigating two similar incidents involving wheeled transport rolling off a station platform and onto the track. In the first (Southend Central, 28 August 2013), the elderly occupant of a wheelchair suffered a broken hip as a result of the fall. In the second (Whyteleafe, 27 September 2013), a young child in a pushchair sustained minor injuries. No trains were present in either case.

Chart 64. Other passenger accidents at the platform-train interface



- In 2013/14, the level of harm from other platform edge accidents was above the ten-year average; all of the four passenger fatalities this year were due to this type of accident, while the rate of harm (normalised by passenger journeys) was just below the 10 year average (as shown in Chart 65).
- Since 2004/05, there have been 11 injuries due to a passenger falling from the platform and coming into contact with the conductor rail; six 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 or exiting the station occurs.[28] When 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.
- In 2013/14 a passenger fatality at the PTI occurred when the person fell from the platform edge, without them having subsequently either been struck by a train or come into contact with the conductor rail. This is the only fatality due to this kind of accident that has occurred in the period shown.

Chart 65. Other platform-train interface FWI

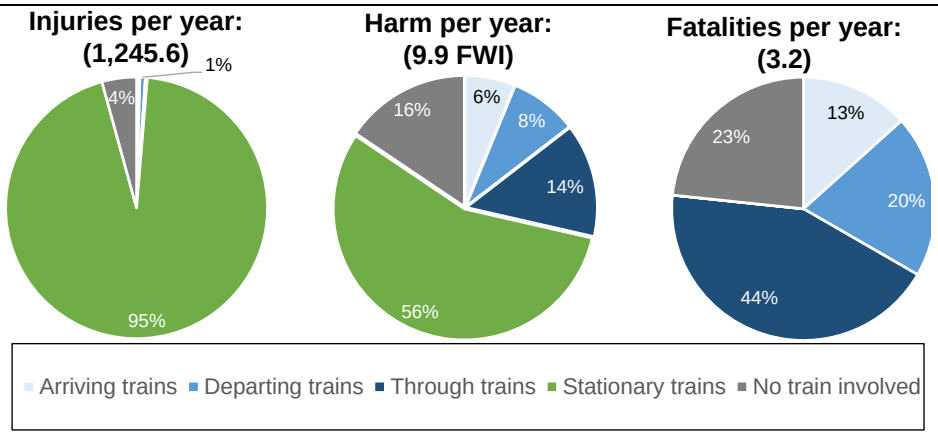


[28] This category includes people standing, walking, running, or otherwise being too close to the platform edge.

Accidents at the PTI involving contact with a train

The severity of a passenger injury at the PTI is heavily influenced by whether or not the accident involves a train and if so, whether the train is stationary or moving. The following analysis is based on all passenger injuries occurring at the PTI in the last 10 years. For those involving trains, the type of train movement is highlighted.

Chart 66. PTI harm 2004/05 to 2013/14[29]



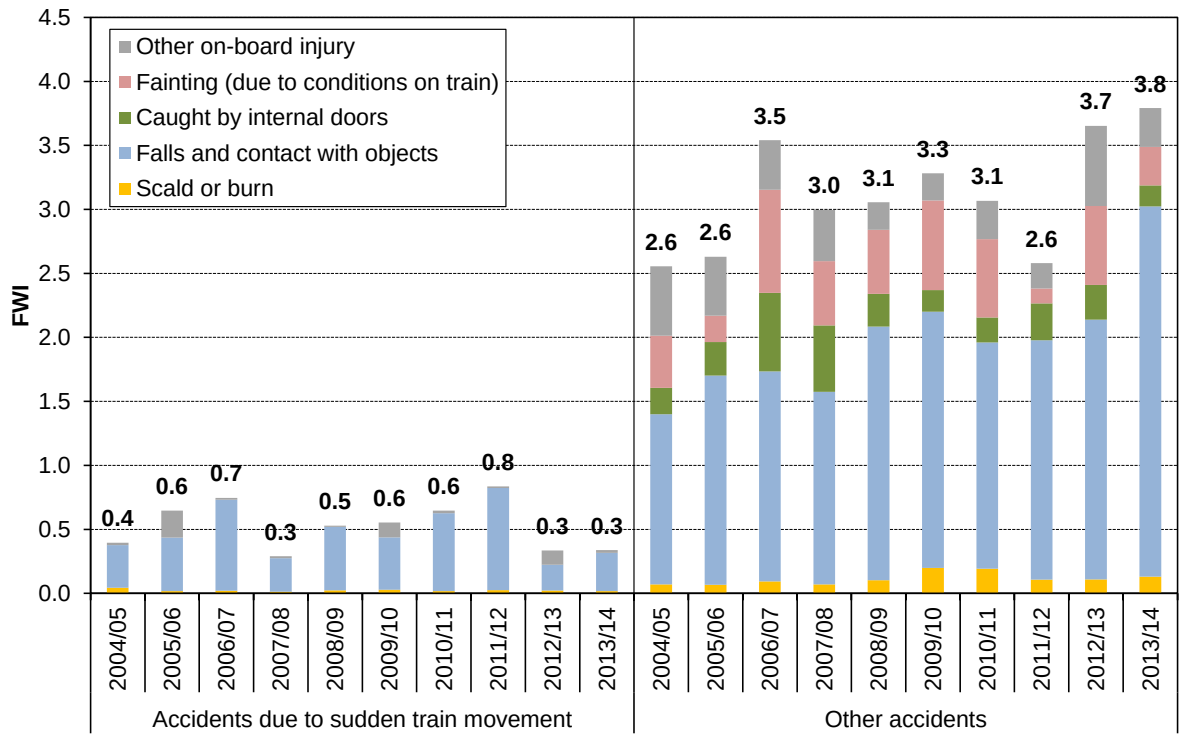
- There have been around 1,250 injuries a year at the PTI, with around 96% involving passengers coming into contact with trains; in 95% of cases the train was stationary, and in around 1% the train was moving. The remaining 4% of PTI injuries occurred when no train was present.
- Accidents involving stationary trains usually occur while boarding or alighting, and include passengers trapped by external doors or falling between the train and platform. Accidents involving moving trains include 'trap and drag ' incidents, passengers falling between the platform and a stationary train that then moves, passengers falling between a moving train and the platform, or passengers being struck by trains as a result of standing too close to the platform edge.
- While they have accounted for just 1% of the events, accidents involving moving trains represented nearly 30% of all PTI passenger FWI harm and over 75% of fatalities of the past ten years.
- Passengers struck by through trains accounted for around 14% of PTI FWI harm and 44% of fatalities.
- Passengers struck by departing trains accounted for 8% of PTI FWI harm and 20% of fatalities. The most recent such fatality occurred at James Street in October 2011; this event was investigated by RAIB (www.raib.gov.uk).
- Passengers struck by arriving trains represent 6% of PTI harm and 13% of fatalities. This includes a fatality at West Drayton in September 2012, also an accident that was investigated by RAIB.
- Fatal accidents at the PTI, not involving trains have generally been due to electrocution, although one fatality, in November 2013, was caused solely by the fall.
- Looking at all PTI injuries, intoxication was implicated in 66% of fatalities (21 out of the 32 in the last ten years). Its prevalence is particularly notable for fatalities involving through trains, where it was implicated in 85% of cases.

[29] Between 2004/05 and 2013/14 there were 71 PTI accidents where the type of train movement was not known. These accounted for 3.27 FWI (two fatalities) and have been apportioned to each train movement category according to the proportion of injuries where the type of train movement is known.

5.3.3 Passenger harm from accidents on board trains

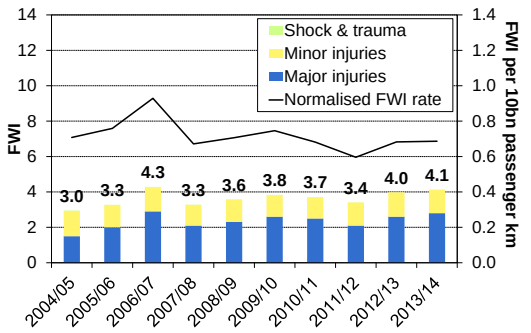
The category of on-board injuries does not include train accidents, falls from trains, or assaults, which are considered under separate categories. On-board injuries have accounted for an average of 3.6 FWI per year over the last ten years, none of which have been fatalities. This represents around 9% of the harm to passengers over this period.

Chart 67. Trends in on-board passenger FWI (excludes train accidents and assaults)



- There is no obvious trend in the overall harm from on-board accidents. On average over the past ten years, *falls* and *contact with objects* within the train have accounted for 64% (77% in 2013/14) of passenger harm on board trains (excluding injuries from train accidents, falls from trains and assault).
- When normalised by passenger kilometres, the rate shows a slightly downward trend, but is variable, due to the low level of FWI.
- Injuries attributable to sudden movements of the train due to lurching or braking have accounted for around 15% of on-board harm since 2004/05. In 2013/14, the proportion was around 8%. 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.

Chart 68. On-board injury FWI

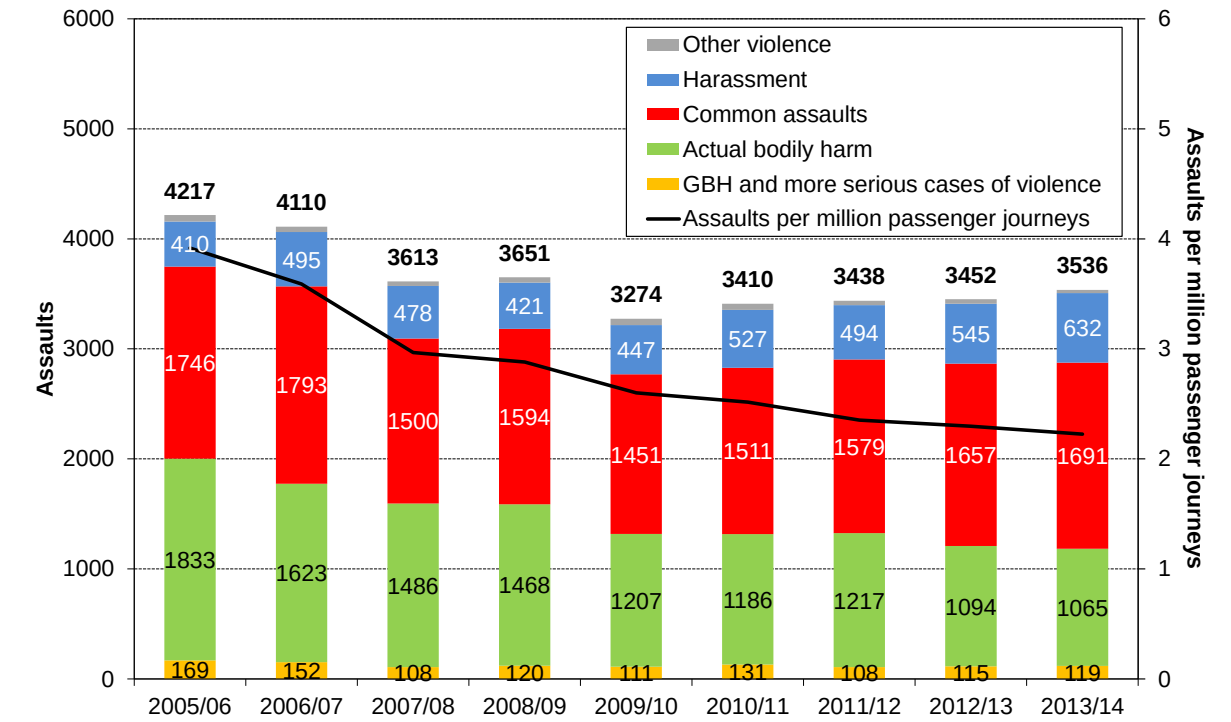


- Fainting accounts for a relatively large proportion of on-board FWI as loss of consciousness (which includes fainting) is categorised as a major injury.

5.4 Passenger personal security[30]

Assaults occur on the railway, as they can in any public environment. The modelled risk from assault, as estimated by SRMv8, is 9.6 FWI per year, of which 0.6 FWI relates to fatalities. This is 16% of the modelled passenger FWI risk, and 7% of the modelled passenger fatality risk. While SMIS is a good source of information on workforce assaults, the BTP CRIME database is the primary source for non-workforce assaults. It is not possible in CRIME to completely identify passengers from non-travelling members of the public, nor is it possible to categorise reliably the seriousness of the non-fatal injuries in terms of FWI.

Chart 69. Assaults and harassment to passengers and public



Source: BTP CRIME data

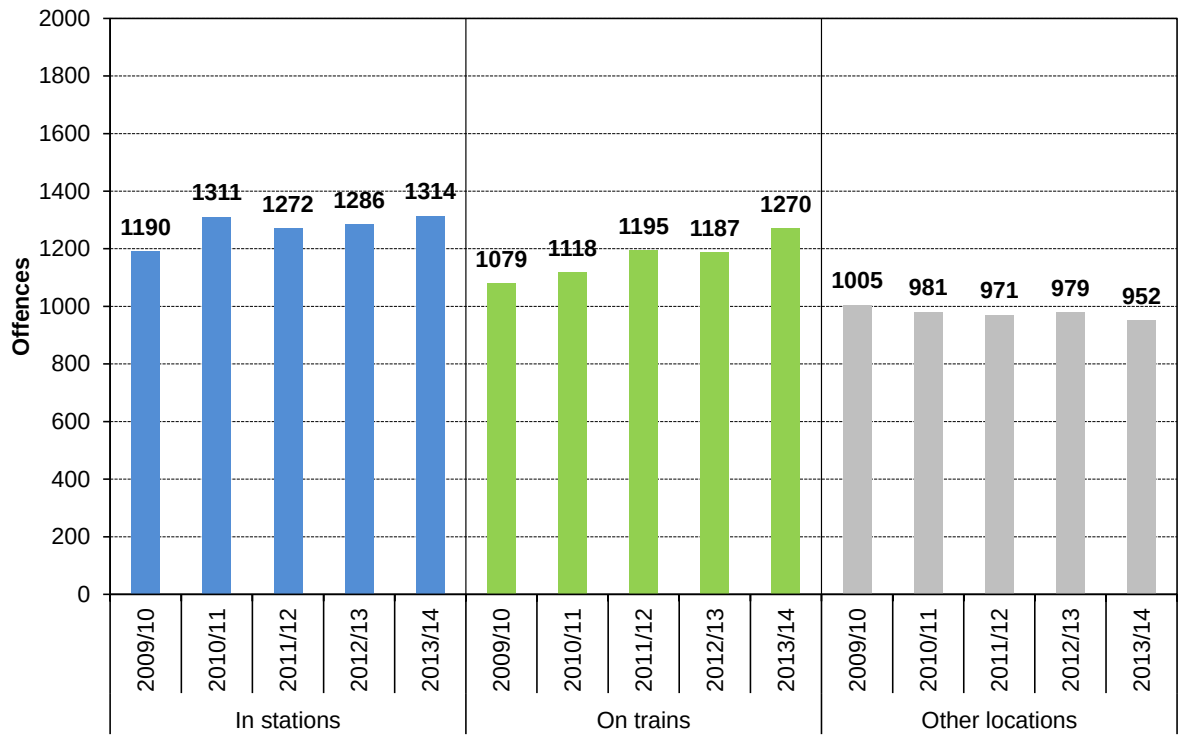
- The number of passenger and public assaults in 2013/14 was slightly higher than that recorded in 2012/13, with an increase of 2.4% recorded over the year.
- Since 2005/06, the rate of recorded assault and harassment per passenger journey has decreased steadily; this is in line with other types of crimes recorded by BTP over the period[31] (and also with general societal trends in violent crime against the person[32]). Possible contributing factors to this fall include improvements in targeted policing and detection technology.
- The rate of assaults per million passenger journeys in 2013/14 is 3% lower than in the previous year, and the lowest level recorded over the period. The likelihood of being the victim of assault or harassment during the average journey is now around 1 in 450,000.

[30] Because of the way BTP records person type, the analysis in this section also includes assaults to non-travelling members of the public.
[31] BTP produces an annual statistical bulletin, which is available at http://www.btp.police.uk/about_us/your_right_to_information/publications.aspx
[32] ONS publish regular updates on societal crime statistics, at: http://www.ons.gov.uk/ons/rel/crime-stats/crime-statistics/index.html

5.4.1 Passenger and public assaults by location

Within the CRIME database, BTP records 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, toilets and car parks (which are otherwise outside ASPR reporting scope).

Chart 70. Passenger and public assaults by location (including harassment)



Source: BTP CRIME data

- Over the period shown, the largest proportion of assaults has been recorded as occurring in stations. Compared with 2012/13, there was a 2% increase in the number of assaults in stations.
- The second most common location recorded is on trains. Compared with 2012/13, there was a 7% increase in the number of assaults at this location.
- 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. The number of assaults at these locations has generally decreased slightly over the past five years.

5.4.2 Passenger perceptions of personal security

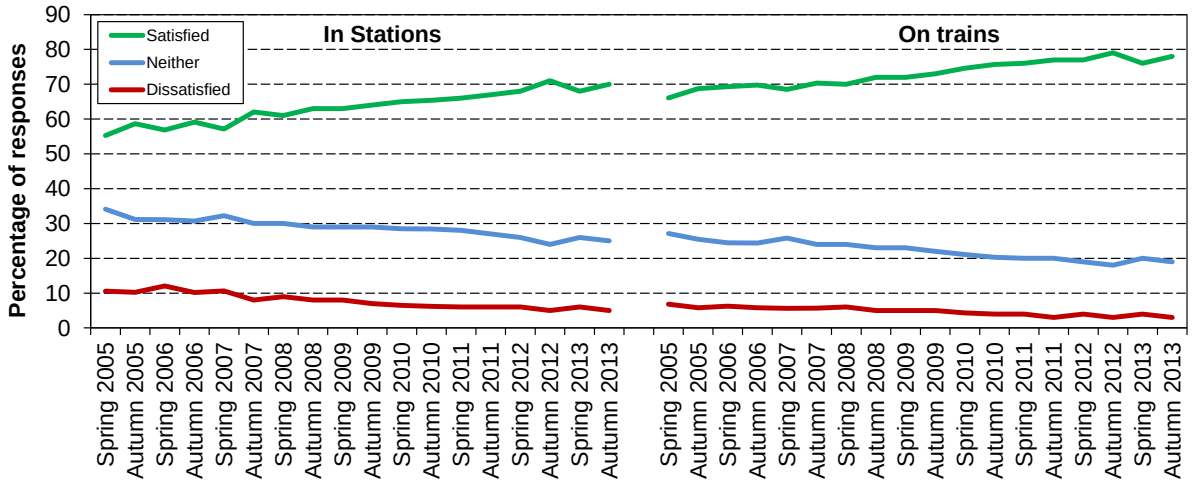
BTP data indicates that the probability of falling victim to assault is relatively low, at around 1 in 450,000 per journey. Media coverage of events can affect public perceptions of personal security, and feeling vulnerable to such offences may still deter people from travelling by train. Passenger Focus, 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. Passengers are asked a range of questions relating specifically to the journey they are making at the time they are surveyed. 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 2013)

	In the station			On the train		
	Satisfied	Neither	Dissatisfied	Satisfied	Neither	Dissatisfied
Long distance	75%	23%	2%	85%	13%	2%
London and South East	69%	26%	5%	76%	20%	4%
Regional	72%	22%	6%	80%	17%	3%
National Total	70%	25%	5%	78%	19%	3%

- Passengers appear to be more satisfied with their level of personal security on trains than in stations. Overall, 70% of passengers perceive their personal security at the station to be satisfactory, and 78% perceive their safety on the train to be satisfactory. Passengers' perceptions of their personal security both in stations and on trains are best on long distance routes.

Chart 71. 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 are likely to include the various improvements made and initiatives instigated by operating companies, such as 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.

Passengers

In the autumn 2013 NPS, a few 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?*', 11% of respondents answered 'yes'. The same question posed in the autumn 2012 NPS also resulted in 11% of respondents answering 'yes'. As a follow-up to this question, those who answered 'yes' were asked the reason(s) for their concern, with respondents being able to provide more than one reason. The five most common stated reasons, for passengers who had experienced such anxiety, are listed in Table 10:

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

	At the station	On the train
1	Anti-social behaviour by others (61%)	Anti-social behaviour by others (73%)
2	Lack of station staff (41%)	Lack of on-train staff (43%)
3	Lack of police officers (26%)	Lack of police officers (23%)
4	Lack of other passengers (16%)	Lack of other passengers (16%)
5	Poor on-station lighting (15%)	Lack of information (10%)

Note: Percentages shown apply only to the 11% of passengers who expressed having had cause to worry and do not total to 100% as respondents were permitted to choose multiple reasons.
Source: National Passenger Survey

- Witnessing anti-social behaviour continues to be the highest cause of worry about personal security to passengers when making a train journey. More than seven out of ten who felt cause for worry on a train listed this as the reason. Lack of other persons (whether staff or passengers) also features high on the list of worries.
- The reasons that people gave for worrying were very similar to those elicited from the 2012 survey, although anxiety due to witnessing anti-social behaviour increased by 3%, both for on trains and in stations.

Passengers were also asked if they knew BTP existed prior to responding to the questionnaire, with 79% saying they did. When passengers were asked how good a job BTP were doing at the local station, the following responses were received:

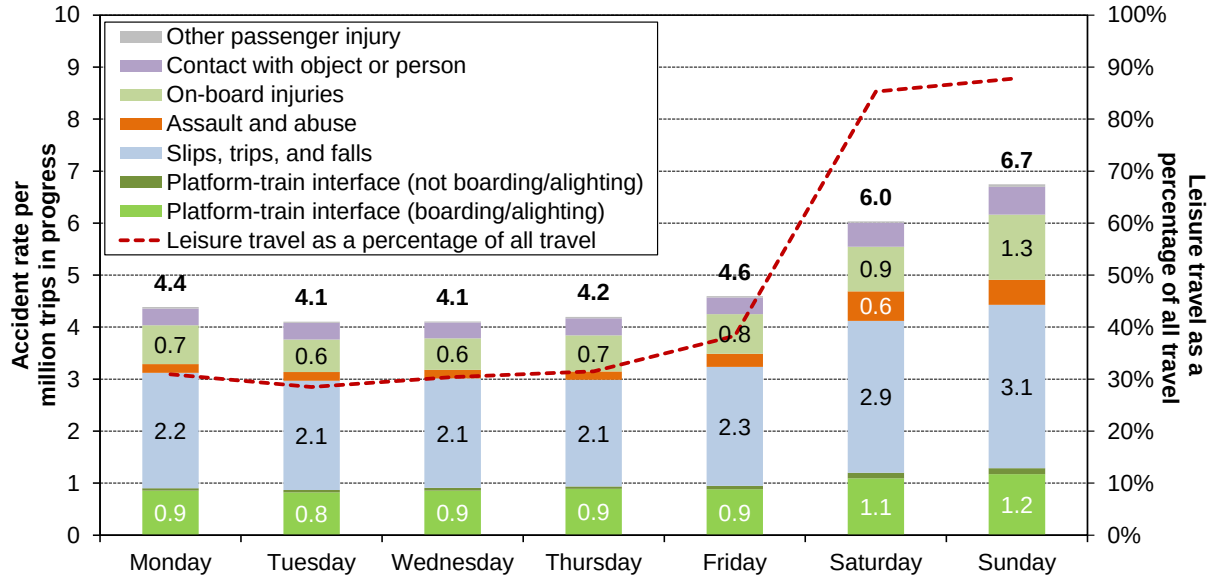
- 12% said 'Excellent'
- 52% said 'Good'
- 27% said 'Fair'
- 5% said 'Poor'
- 3% said 'Very poor'

5.5 Further analysis of passenger safety

5.5.1 Passenger safety and day of week

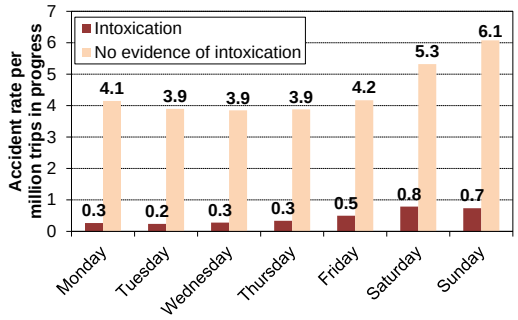
Reported passenger accident rates vary according to the day of the week. Passenger accidents of all levels of consequence are included in the analysis.

Chart 72. Passenger accident profiles by day of week 2004/05 to 2013/14



- The rate of accidents, normalised by trips in progress,[33] increases from Tuesday through to Friday, with the highest rates on Saturdays and Sundays.
- The trend in accidents follows the trend in the proportion of travel for the purposes of leisure, with higher proportions of leisure travel between Fridays and Mondays. This correlation is explored further in Section 5.5.3.
- All accident types share this trend, but *assault and abuse*, and accidents at the *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 73. Intoxication involvement in accidents by day of week 2004/05 to 2013/14



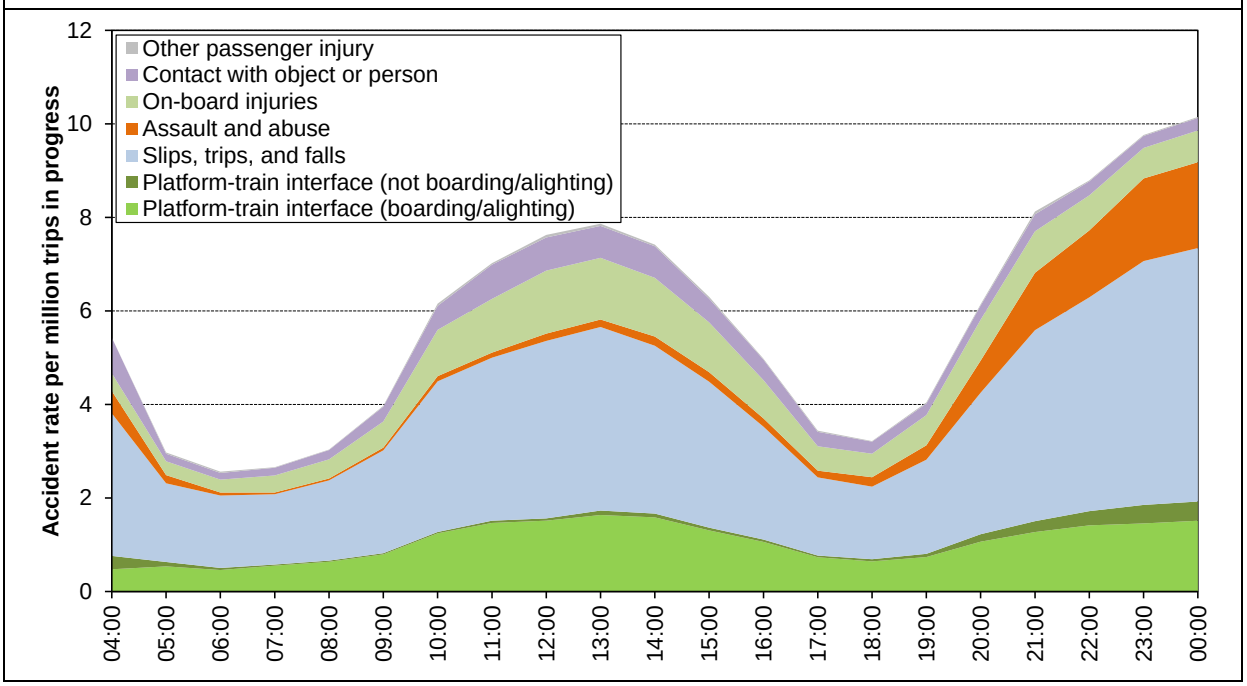
- The rate of accidents with evidence of intoxication (see Chart 73) also increases during the week, more than doubling between Monday and the weekend. This may account for some of the increase in accident rates, especially assaults. However, this analysis is based on SMIS data, which is more limited than BTP data in relation to assaults on passengers. The rate of accidents with no recorded evidence of intoxication shows a similar trend (although with a higher rate on Mondays), so it is likely that other factors are involved. Also, it is likely that intoxication is not always recorded when it has been a factor.

[33] 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.

5.5.2 Passenger safety and time of day

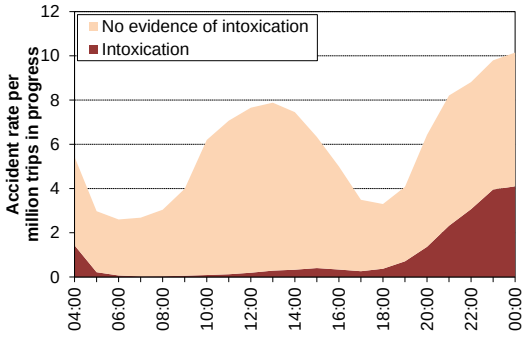
Reported passenger accident rates and profiles also vary according to the time of day. Again, passenger accidents of all levels of consequence are included in the analysis.

Chart 74. Passenger accident profiles by time of day 2004/05 to 2013/14



- The rate of accidents, normalised by trips in progress,[34] 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 may use the railway less frequently and may be at higher risk because they are less familiar with the hazards of rail travel. Additionally, it may be that people travelling off-peak are – on average – under less time pressure and therefore 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 types 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 75. Intoxication involvement in accidents by time of day 2004/05 to 2013/14

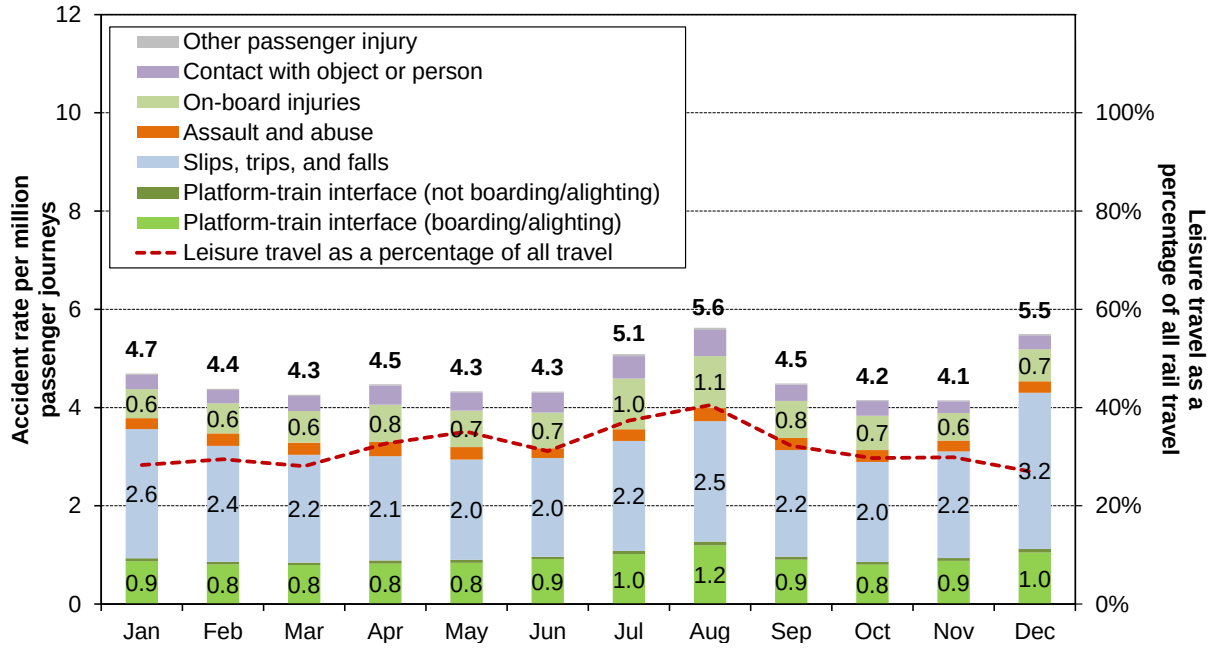


- Chart 75 illustrates that intoxication has a notable effect on the evening accident peak but not on the daytime accident peak.

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

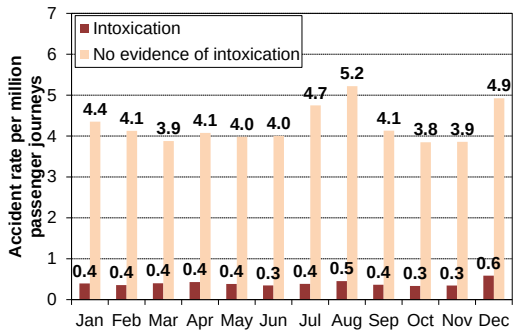
5.5.3 Passenger safety and month of year

Chart 76. Passenger accident profiles by month of year 2004/05 to 2013/14



- The highest accident rates[35] can be seen during the summer months of July and August, and 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 August. The rate of *boarding/alighting accidents* increases during the spring and is highest in July and August, and again 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 both with and without evidence of intoxication increase in summer and winter months.

Chart 77. Intoxication involvement in accidents by month of year 2004/05 to 2013/14



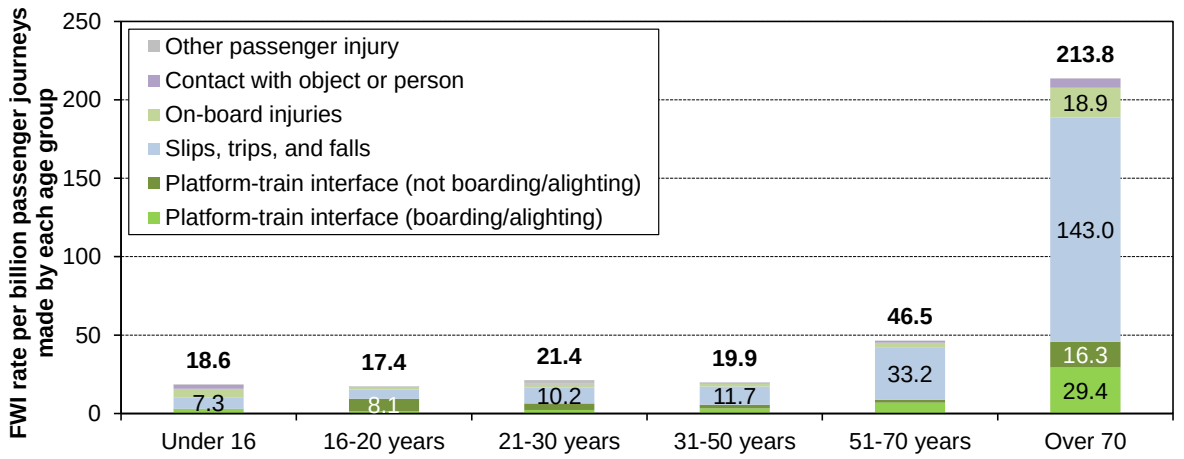
- To an extent, the trend in accidents follows the trend in proportion of travel for the purposes of leisure, particularly the increases in July and August. Passengers who travel at these times may be less frequent users of the railway and therefore less experienced with its associated risks, as well as being more likely to be carrying luggage. They may also be more likely to report an accident for the reasons stated in Section 5.5.2.
- It is likely there are other factors that can affect the accident rate to varying degrees. A factor in the increase in *slips, trips and falls* seen in the winter months is the weather (see ASPR 2010/11 for more details).

[35] Number of accidents normalised by passenger journeys, estimated using data from the DfT National Travel Survey.

5.5.4 Passenger safety and age

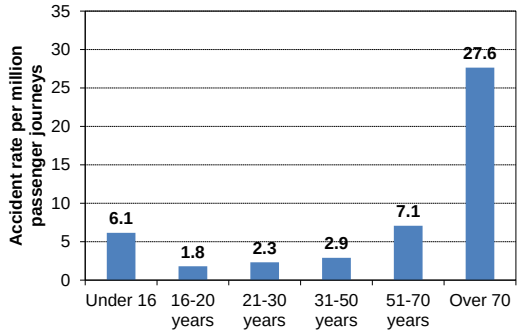
Passenger risk profiles vary by age group, with older people being the most vulnerable. The ageing population and consequent issues related to reduced mobility present a challenge to the railway. The industry is already taking steps to address this, for example by improving the station environment and providing step-free access. The analysis in this section excludes injuries in train accidents, as their occurrence is not related to the age of train occupants (although injury severity might be), as well as injuries due to assault, as passenger assaults are not well recorded in SMIS.

Chart 78. Passenger harm by age group 2004/05 to 2013/14



- The age group containing the oldest passengers have the highest rate of harm per journey.
- The proportion of harm from slips, trips and falls increases with age for adult passengers. They account for just over one-third of FWI in the 16-20 age group, but more than two-thirds in the over 70 age group.
- Just over 45% of the FWI rate in passengers aged between 16 and 20 is due to *platform-train interface (not boarding/ alighting)* accidents. For the *21-30 years* group they account for around 20%, and for other age groups they account for less than 12% 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 relative difference between the FWI rate (in Chart 78) and the accident rate (in Chart 79) seen for those under 16 years old.

Chart 79. Passenger accident rate by age group 2004/05 to 2013/14

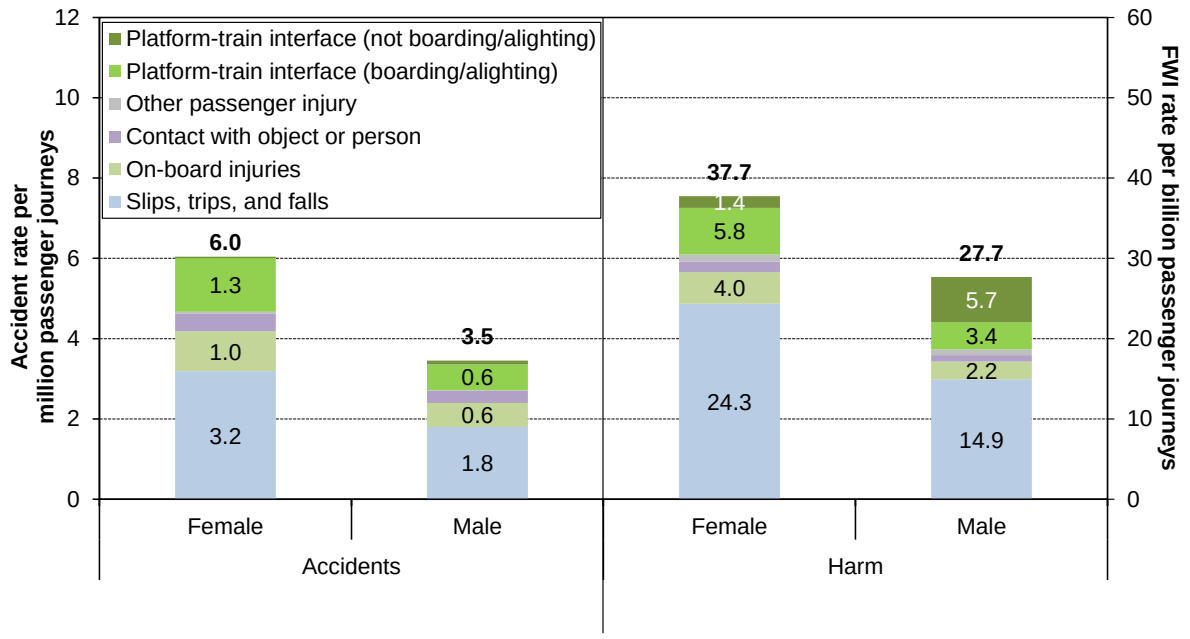


Data source: SMIS data from 2004/05 to 2013/14 where the victim's age was recorded. Between 2004/05 and 2013/14, there were 181.5 FWI (46% of the total passenger harm) where the age of the victim was not recorded. These have been apportioned to each age group according to the proportion of injuries where the age is known. The data has been normalised using data from the DfT *National Travel Survey* and population estimates from ONS.

5.5.5 Passenger safety and gender

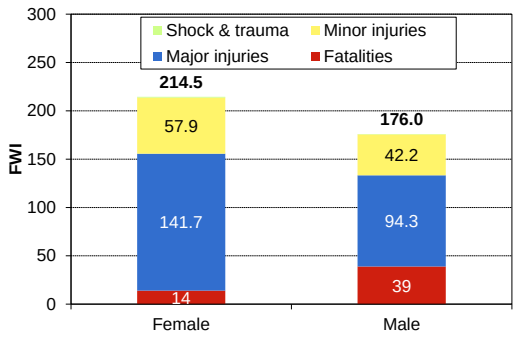
In recent years, men have made around 53% of rail journeys, and women around 47%. There are some notable differences in the accident profiles for each gender. For reasons stated in the previous section, the analysis does not include data on train accidents or assaults.

Chart 80. Passenger accident and FWI rate by gender 2004/05 to 2013/14



- The reported accident rate for females is 75% higher than that of males when normalised by the number of journeys made by each gender. The rate of harm to females is 36% higher than the rate for males.
- This difference is seen in most accident types apart from *platform-train interface (not boarding/alighting)* accidents which make up 1% of the overall accident rate in females compared with 3% in males, and substantially higher proportions of FWI.
- 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 26 male fatalities and five 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 81.

Chart 81. Passenger harm by gender 2004/05 to 2013/14 (not normalised)



Data source: Incident data from SMIS. Normalised using data from National Travel Survey, DfT and population estimates from ONS. Between 2004/05 and 2013/14, there were 56.7 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.

5.6 Learning from operational experience: passengers

The Learning from Operational Experience Annual Report 2013/14 covers passenger safety in Chapter 8: *Lessons learned 2013/14 – passengers*.

The chapter focuses on risk at the platform train interface. In particular, the report discusses:

- The outcome of the RAIB investigation into a passenger fall between the train and platform at London Charing Cross, on 24 November 2012 (published July 2013), where the train subsequently moved off and the person received life-changing injuries. RAIB proposed that as part of the its existing work on the PTI, the industry consider what pre- and post- event improvements could be made, as well as looking at clearance standards and platform gap fillers.

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: *Members of the public.*

Passengers	2009/10	2010/11	2011/12	2012/13	2013/14
Fatalities	**5**	**7**	**5**	**4**	**4**
Train accidents	0	0	0	0	0
Slips, trips, and falls	1	1	2	1	0
Platform-train interface	4	5	3	2	4
Assault and abuse	0	1	0	1	0
On-board injuries	0	0	0	0	0
Contact with object or person	0	0	0	0	0
Struck by train on station crossing	0	0	0	0	0
Other type of passenger injury	0	0	0	0	0
Major injuries	**234**	**251**	**259**	**312**	**270**
Train accidents	3	6	1	0	1
Slips, trips, and falls	145	158	172	203	181
Platform-train interface	43	45	48	64	49
Assault and abuse	9	10	11	10	5
On-board injuries	26	25	21	26	28
Contact with object or person	7	5	6	6	6
Struck by train on station crossing	0	0	0	1	0
Other type of passenger injury	1	2	0	2	0
Minor injuries	**5308**	**5600**	**5954**	**6382**	**6307**
Class 1	1209	1250	1375	1403	1382
Class 2	4099	4350	4579	4979	4925
Incidents of shock	**207**	**226**	**262**	**238**	**235**
Class 1	2	5	5	3	7
Class 2	205	221	257	235	228
Fatalities and weighted injuries	**38.76**	**42.95**	**42.64**	**47.44**	**43.10**
Train accidents	0.39	0.71	0.16	0.05	0.22
Slips, trips, and falls	21.23	22.71	25.75	28.58	25.05
Platform-train interface	10.48	11.82	10.28	10.71	11.31
Assault and abuse	1.34	2.49	1.58	2.38	0.95
On-board injuries	3.84	3.71	3.42	3.99	4.13
Contact with object or person	1.35	1.24	1.40	1.36	1.36
Struck by train on station crossing	0.00	0.01	0.00	0.10	0.00
Other type of passenger injury	0.12	0.26	0.05	0.27	0.07
Passenger kms (billions)	**51.42**	**54.48**	**57.31**	**58.41**	**60.14**
Passenger journeys (millions)	**1259**	**1356**	**1462**	**1503**	**1590**

BTP Passenger & public assaults	2009/10	2010/11	2011/12	2012/13	2013/14
Total	**3274**	**3410**	**3438**	**3452**	**3536**
Actual bodily harm	1207	1186	1217	1094	1065
Common assault	1451	1511	1579	1657	1691
GBH and more serious cases of violence	111	131	108	115	119
Other violence	58	55	40	41	29
Racially aggravated harassment	447	527	494	545	632

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6 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 types of accident that affect the wide variety of railway roles, from infrastructure workers to station staff.

In April 2010, the ORR highlighted some concerns regarding the number of lost-time minor injuries that were being reported by Network Rail and its contractors when compared to the total number of major injuries reported. 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. RSSB was tasked with establishing the level of under-reporting. The review found that during the period 2005/06 to 2009/10 around 500 to 600 Class 1 injuries, predominantly to infrastructure workers, are likely to have gone unreported. In the appropriate workforce charts in this chapter, the effect of taking into account the missing injuries over that period has been shown as an overlaid line.

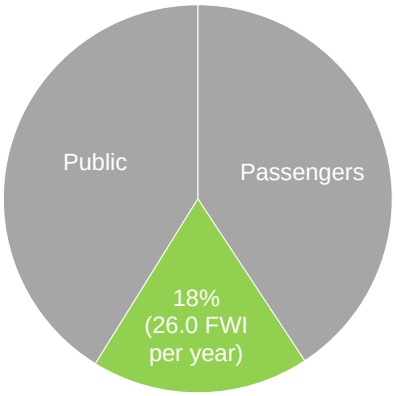
A detailed breakdown of statistics related to workforce fatalities and injuries is presented in the key safety facts table at the end of this chapter.

2013/14 Headlines

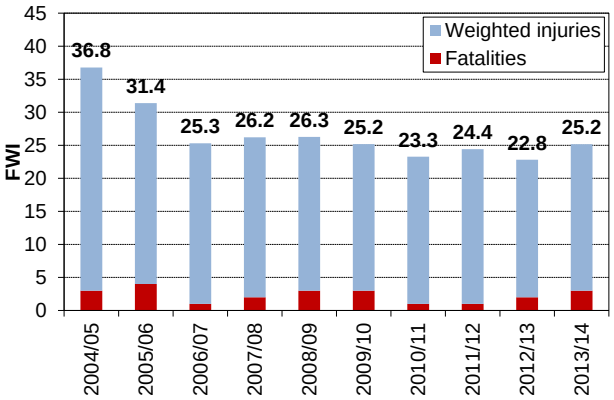
- There were no workforce fatalities in train accidents. There were three workforce fatalities from other causes: two infrastructure workers died as a result of a road traffic accident while on duty, while another was struck by a train and fatally injured.
- In total in 2013/14, there were: three fatalities, 126 major injuries, 4,913 minor injuries and 1,001 cases of shock/trauma reported. This equates to 25.2 FWI, which is an increase of 10% compared with 22.8 FWI occurring in 2012/13.
- When normalised by workforce hours, the rate of harm to the workforce increased by 8% in 2013/14, compared with 2012/13.
- An increase in harm was seen by all worker types except other on-board train crew and train drivers, who saw decreases of 0.9 FWI and 0.6 FWI respectively. The remaining workforce groups saw a collective increase of 3.8 FWI in 2013/14, of which 2.4 FWI was an increase in harm to infrastructure workers.

Workforce safety at a glance

Workforce risk in context (SRMv8)



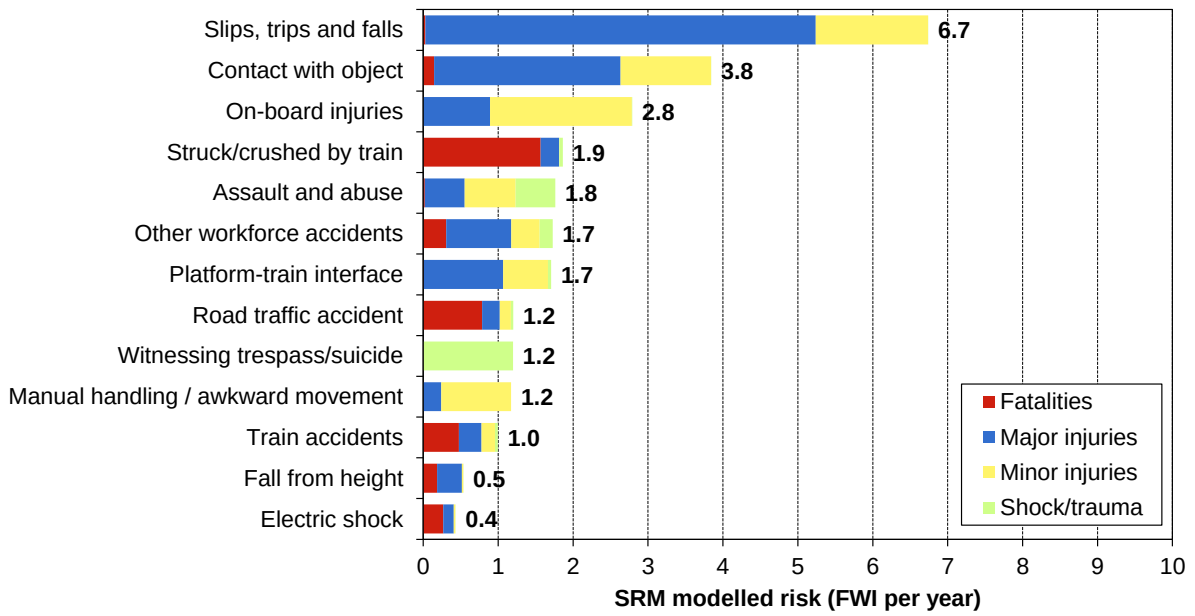
Trend in workforce harm



6.1 Workforce risk profile by accident type

The breakdown of workforce risk in Chart 82 is taken from SRMv8, and therefore represents the modelled estimate of the underlying risk to the workforce. In the remainder of this chapter, the charts are based on the levels of harm reported into SMIS, which, in any given year, may differ from SRM modelled values. One reason for this is statistical variation; another is that the SRM includes an estimate of the risk from events that may not have occurred during the year, such as train accidents involving workforce injuries. Descriptions of the types of event that are included in each accident type grouping are shown in Appendix 8.

Chart 82. Workforce risk by accident type: 26.0 FWI per year



Source: SRMv8

- Slips, trips, and falls pose the greatest risk to the workforce as a whole. Around 26% of the total FWI risk is from this source, although the contribution to the fatality risk is relatively low, at around 1%.
- The greatest source of fatality risk is being struck by a train, which accounts for 7% of the overall workforce risk profile, but 41% of the fatality risk profile. Injuries from this cause have a high likelihood of being fatal.
- Train accidents account for 4% of the FWI risk profile and 13% of the fatality risk profile.
- The greatest causes of workforce shock or trauma are assault and abuse, and witnessing suicide and trespass fatalities. Cases of shock or trauma from assault and abuse occur more frequently but are assigned a lower weighting than those associated with fatalities (see the next section for an explanation).

6.2 Workforce fatalities and injuries in 2013/14

Accident and injury data is collected in SMIS on all events occurring at stations or elsewhere on NRMI. Fatalities and injuries to the workforce occurring as a result of road traffic accidents while driving between sites to carry out work in association with the maintenance or working of the operational railway are included. Workforce fatalities that occur during working time in yards, depots and sidings are also included, non-fatal injuries in this locations are currently not within scope, but will become so in future years (see Appendix 4 for details). A more complete outline of the scope can be found in Appendix 3.

Workforce minor injuries and shock/trauma events are further broken down into Class 1 and Class 2 events. Minor injuries that result in the injured party being incapacitated for normal duties for more than three calendar days, not including the day of the injury, are termed Class 1. All other minor injuries are termed Class 2. Shock/trauma resulting from being involved in a train accident, or witnessing personal accident with a high likelihood of being fatal (such as being struck by train), is termed Class 1. All other occasions of shock/trauma are termed Class 2.

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

Fatalities

There were three workforce fatalities within scope during the year; all infrastructure workers.[36]

Table 11. Workforce fatalities in 2013/14

Date	Location	Accident type	Territory	Description of incident
19/06/2013	A1, near Newark	Road traffic accident	London North East	Two infrastructure workers were fatally injured in a car accident whilst travelling between sites while on duty. The two members of staff had been welding on site at Langley Junction in Lincolnshire, and whilst returning to their depot the car was reported to have collided with the rear of a lorry that was parked in a layby of the A1
22/01/2014	Newark Northgate	Struck/crushed by train	London North East	An infrastructure worker who was acting as lookout for a small gang engaged in the inspection of points to the south of Newark North Gate station, was struck by a passenger train approaching the station. The injured person was taken to hospital by air ambulance, but died of his injuries on 31 January.

Major injuries

- There were 126 major injuries in 2013/14, of which 79 (63%) were to infrastructure workers.

Minor injuries

- There were 4,913 recorded minor injuries, 560 (11%) of which were Class 1. These affected the full range of railway employees and had a wide variety of causes.

Shock and trauma

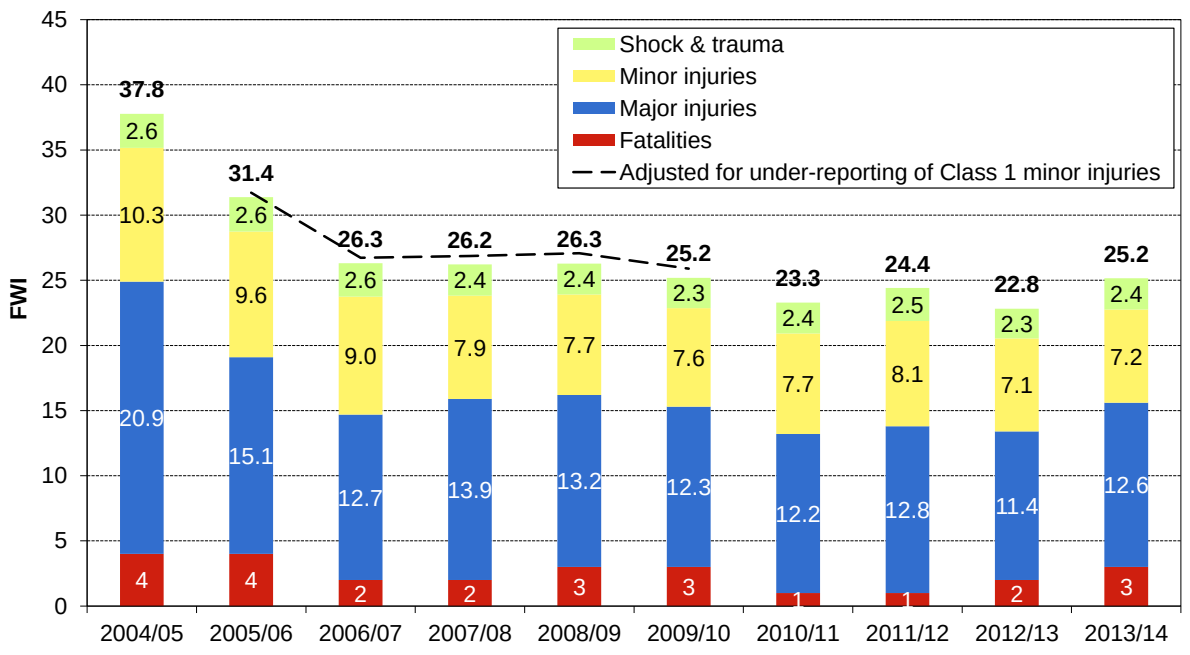
- There were 1,001 reports of shock or trauma; of these, 351 (35%) were Class 1.

[36] A fourth workforce fatality occurred on 26 February 2014, but is currently classed as a suspected suicide, and is therefore recorded in the public risk chapter.

6.3 Trends in workforce harm by injury degree

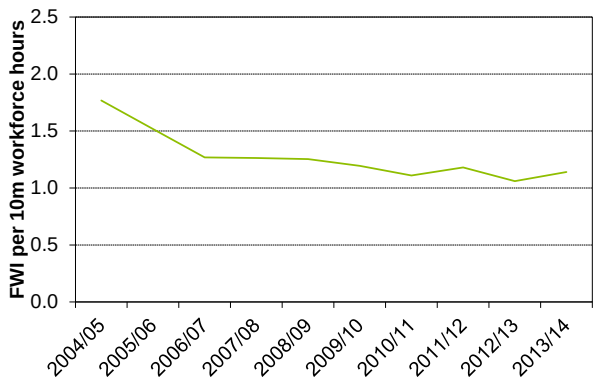
Over the past decade, the average level of harm to members of the workforce has been 26.7 FWI per year, of which 2.3 FWI has been due to fatalities.

Chart 83. Workforce FWI by injury degree[37]



- The level of workforce harm for 2013/14 showed an increase of 10% compared with the previous year. When normalised, the rate of workforce harm also increased by 8%.
- At three, the number of fatalities increased from 2012/13 by one. There was also an increase in the harm from major injuries and shock and trauma, but a slight reduction in the harm from minor injuries.
- Two of the years shown in the chart contain multi-fatality accidents. In 2004/05, two infrastructure workers at Hednesford were killed in an accident involving a road-rail vehicle. In 2013/14, two infrastructure workers were fatally injured in a road traffic accident while on duty.

Chart 84. Normalised FWI rate

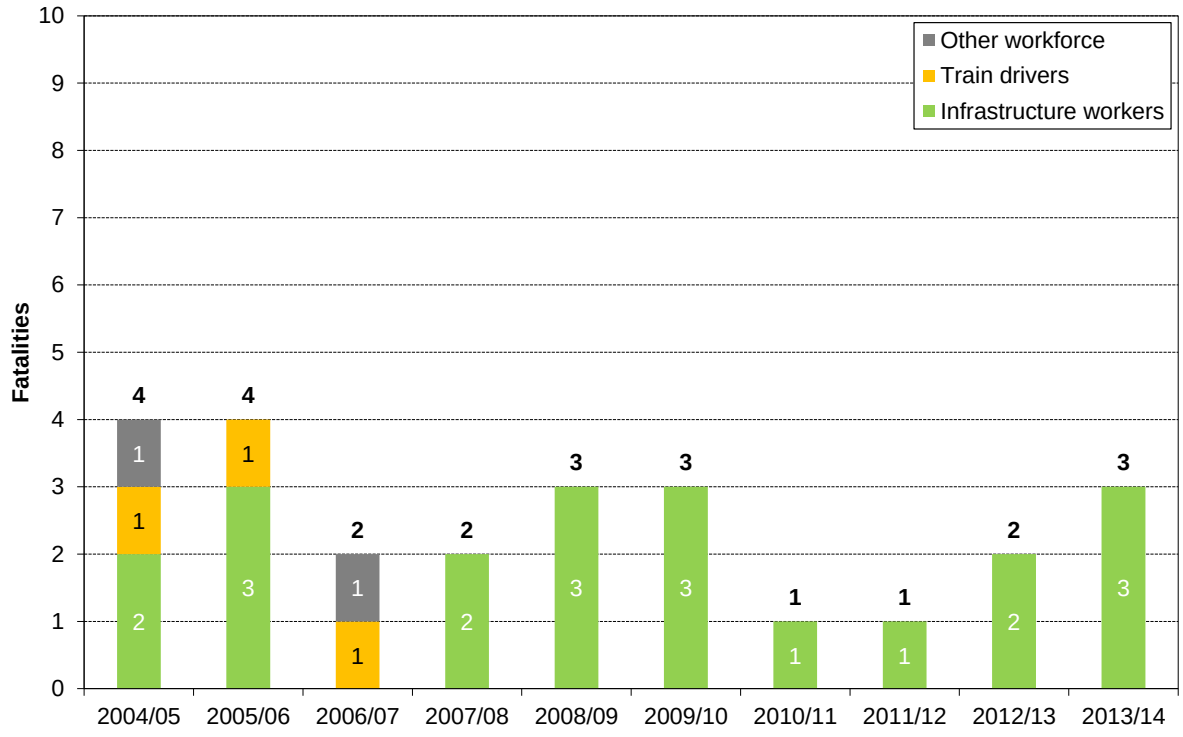


[37] In April 2010, the ORR highlighted some concerns regarding the number of lost-time minor injuries that were being reported by Network Rail and its contractors when compared to the total number of major injuries reported. Network Rail carried out a review of its data, and concluded that some misclassification of lost-time injuries had indeed taken place, and thus under-reporting had occurred. RSSB was tasked with establishing the level of under-reporting. The review found that during the period 2005/06 to 2009/10 around 500 to 600 Class 1 injuries, predominantly to infrastructure workers, are likely to have gone unreported. In the appropriate workforce charts in this chapter, the effect of taking into account the missing injuries over that period has been shown as an overlaid line.

6.3.1 Workforce fatalities

The broad category of 'infrastructure worker' encompasses those whose work involves inspecting, maintaining and renewing the track, signalling and telecommunications equipment, and other railway infrastructure, such as earthworks and bridges. 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 85. Workforce fatalities by type of worker



- Since 2004/05 there has been a total of 25 fatalities; 20 have occurred to infrastructure workers. The fatalities included in the *other workforce* category in Chart 85 were both shunters. Both of these members of the workforce were fatally injured after being caught between two rail vehicles while coupling trains in yards.
- There were three fatalities in 2013/14:
  - On 19 June, two infrastructure workers were fatally injured in a car accident whilst travelling between sites while on duty. The two members of staff had been welding on site at Langley Junction in Lincolnshire, and whilst returning to their depot the car was reported to have collided with the rear of a lorry that was parked in a layby of the A1.
  - On 22 January, an infrastructure worker who was acting as lookout for a small gang engaged in the inspection of points to the south of Newark North Gate station, was struck by a passenger train approaching the station. The injured person was taken to hospital by air ambulance, but died of his injuries on 31 January. RAIB launched an investigation into the incident.

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 on his or her train. Shunters can also work in trackside locations, often in yards and sidings.

Table 12. Workforce fatalities by location and activity 2004/05 to 2013/14

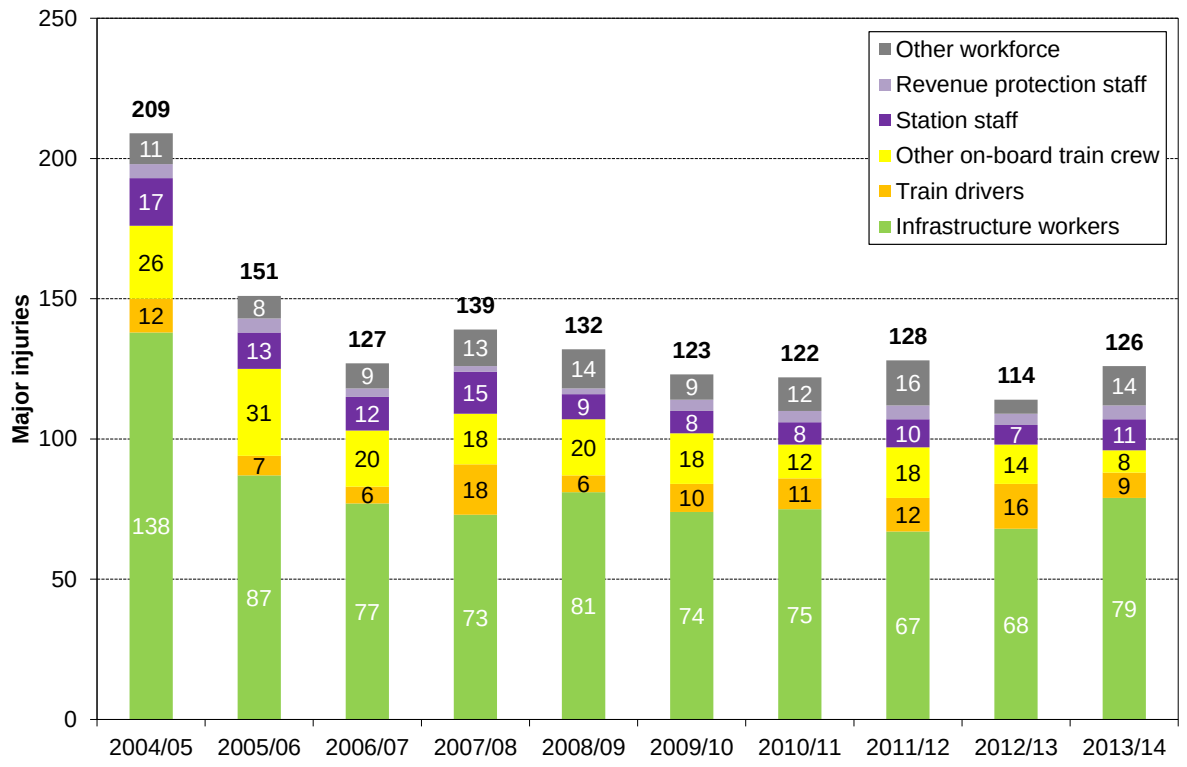
		Location type							
		Running line	Yard/Depot/Siding	On trains	On railway infrastructure - not trackside	Travelling to/from work (on duty)	Travelling between sites	Public /private property (non railway owned)	**Total**
Infrastructure worker	Banksman							1	**1**
	Civil structure maintenance				3				**3**
	CoSS	3							**3**
	Electrification maintenance	1							**1**
	Hand Signaller	2							**2**
	Lookout	1							**1**
	Machine controller	1							**1**
	Track maintenance	4				1	2		**7**
	Track renewal/upgrade					1			**1**
	Train drivers	2		1					**3**
Other worker	Shunters		2						**2**
	Total	**14**	**2**	**1**	**3**	**2**	**2**	**1**	**25**

- Most fatalities have occurred on or about the running line. This is a consequence of the number of employees working in this environment and the hazards to which they are exposed. Since 2004/05, there have been 14 fatalities in this category; 12 were infrastructure workers, four of whom were engaged in 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.
- Since 2004/05, there have been two fatalities in yards, depots and sidings. Although the reporting of non-fatal injuries in these locations is not mandatory in SMIS, since April 2010 there has been a voluntary initiative to report such injuries. Appendix 4 provides more details on this project.

6.3.2 Workforce major injuries

Workforce major injuries are were 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.[38]

Chart 86. Workforce major injuries by type of worker



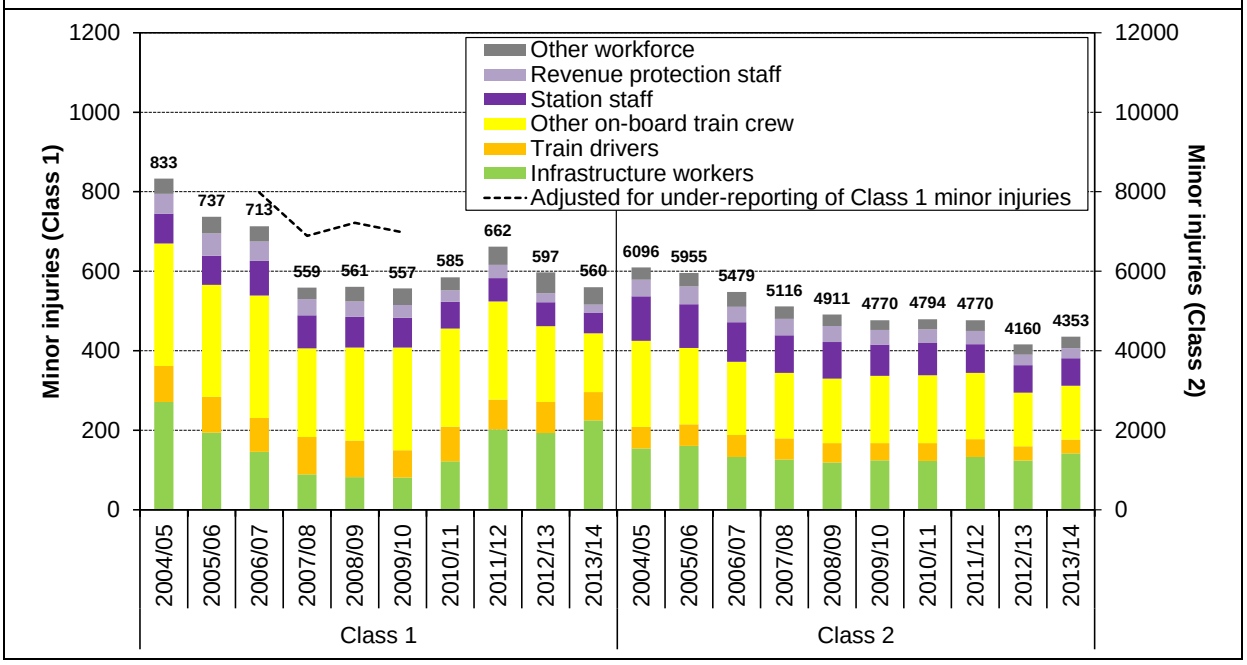
- At 126, the number of workforce major injuries in 2013/14 increased by 12 compared with 2012/13, but remains 8% below the average level of harm over the period shown.
- Since 2004/05, 60% of all major injuries have occurred to infrastructure workers. This proportion has stayed fairly constant over the period shown in the chart.
- *Other on-board train crew* have the next highest proportion of major injuries, accounting for 13% of all major injuries over the period shown. The annual totals for this group are quite low, but they have seen a general downward trend over the past ten years.

[38] These regulations were first published in 1985, and have been amended and updated several times. The latest version of RIDDOR, published 2013, the term 'major injury' was dropped; the regulation now uses the term 'specified injuries' to refer to a slightly different scope of injuries than those that were classed as major. For consistency in industry safety performance analysis, the term major injury has been maintained, along with the associated definition from RIDDOR 1995.

6.3.3 Workforce minor injuries[39]

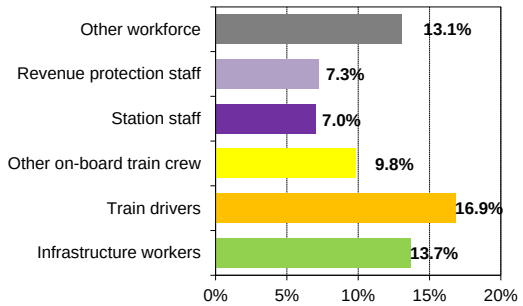
Workforce minor injuries are categorised as Class 1 if they are not major injuries but result in the staff member being unable to return to normal duties for more than three calendar days.

Chart 87. Trends in workforce minor injuries by worker type



- The number of Class 1 injuries has seen a reduction since 2011/12, due mainly to a fall in the number of other on-board train crew injuries. The number of Class 2 injuries increased by 5% in 2013/14, but remains the second lowest level in the analysis period.
- The number of both Class 1 and Class 2 minor injuries for infrastructure workers has increased since last year, by 17% and 14% respectively. As a result of this, infrastructure workers represent the largest proportion of minor injuries for 2013/14.
- Chart 88 shows the proportions of minor injuries which are Class 1 for different workforce types for 2013/14. Different working environments are likely to affect the type and severity of injuries that occur, and different reporting tendencies may also exist.

Chart 88. Proportion of minor injuries that are Class 1, 2013/14



[39] The SRMv8 modelled risk arising from workforce minor injuries is 7.6 FWI per year, which is 29% of the total modelled workforce risk.

6.3.4 Workforce injuries: body part profiles

The following table shows areas of the body that are likely to be affected by different accident types.

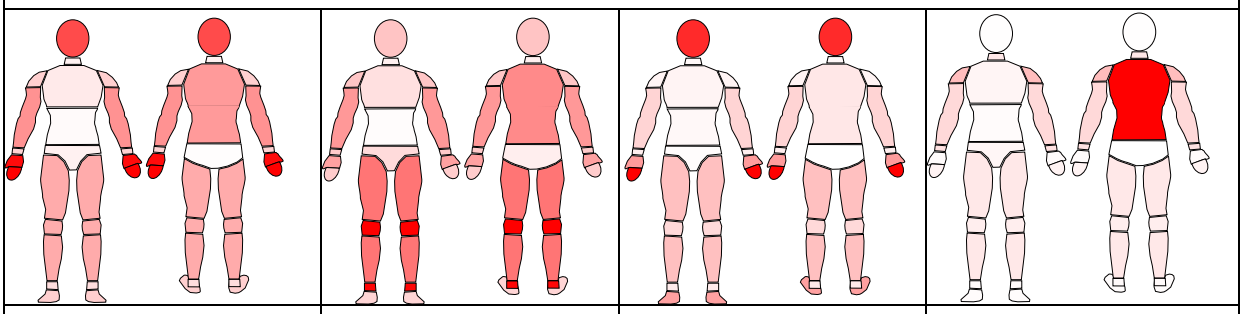
Table 13. Workforce injuries by body part in 2013/14[40]

	Head	Arm	Hand	Torso	Leg	Foot	Other	Total
Collisions and derailments (including OTP)	9	8	2	6	5	0	1	**31**
Struck/crushed by train	1	1	0	1	0	0	1	**4**
Electric shock	2	6	9	2	0	0	25	**44**
Falls from height	2	8	0	1	3	2	0	**16**
Platform-train interface	28	46	66	42	135	41	11	**369**
Slips, trips and falls	72	154	190	180	378	280	24	**1278**
Machinery/tool operation	35	8	105	6	15	11	4	**184**
Contact with objects	283	71	477	61	131	147	48	**1218**
Manual handling / awkward movement	27	114	51	302	44	10	10	**558**
Assault and abuse	206	74	56	87	45	11	34	**513**
On-board injuries	198	159	552	146	170	83	64	**1372**
Other accidents	58	31	50	8	20	8	39	**214**
Road traffic accident	77	25	9	35	14	2	6	**168**
Total	**998**	**705**	**1567**	**877**	**960**	**595**	**267**	**5969**

These injuries can be mapped onto the outline of a person, where the darker the shaded area the greater the number of injuries that have occurred.

- On-board incidents represent the largest number of injuries. Hands are the most commonly injured body part, accounting for 40% of all on-board injuries, almost half of which occur to fingers.
- Slips, trips and falls predominantly result in injuries to the leg and foot, which combined, account for half of all injuries from slips, trips and falls. The most commonly injured body parts are knees and ankles, both of which account for 19% each of the total.
- Contact with object accidents predominately consist of injuries to hands, which make up 39% of these types of injury, with 27% of the total being due to injuries to fingers. A further 23% of these injuries occur to the head, one third of which are due to foreign objects entering the eye.
- Manual handling and awkward movement injuries most commonly occur to the back, which account for 50% of the injuries from this accident type.

Figure 2. Workforce injured body parts in 2013/14



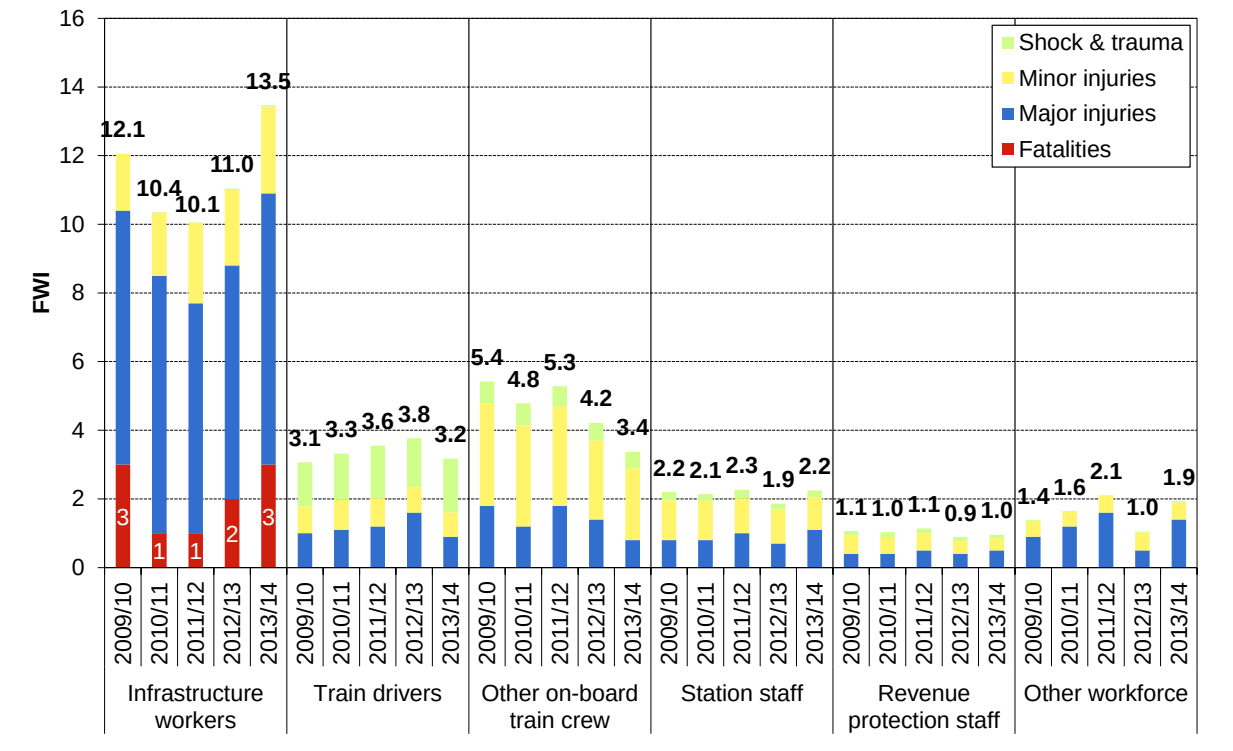
On-board injuries | Slips, trips and falls | Contact with objects | Manual handling

[40] Table shows a count of the number of injuries in 2013/14 and does not reflect harm to members of workforce.

6.4 Trends in workforce harm by type of worker

Different types of work on the railway expose personnel to different levels of risk. This is partly due to the nature of the roles, but also due to the different environments where the work takes place.

Chart 89. Workforce fatalities and weighted injuries by type of worker



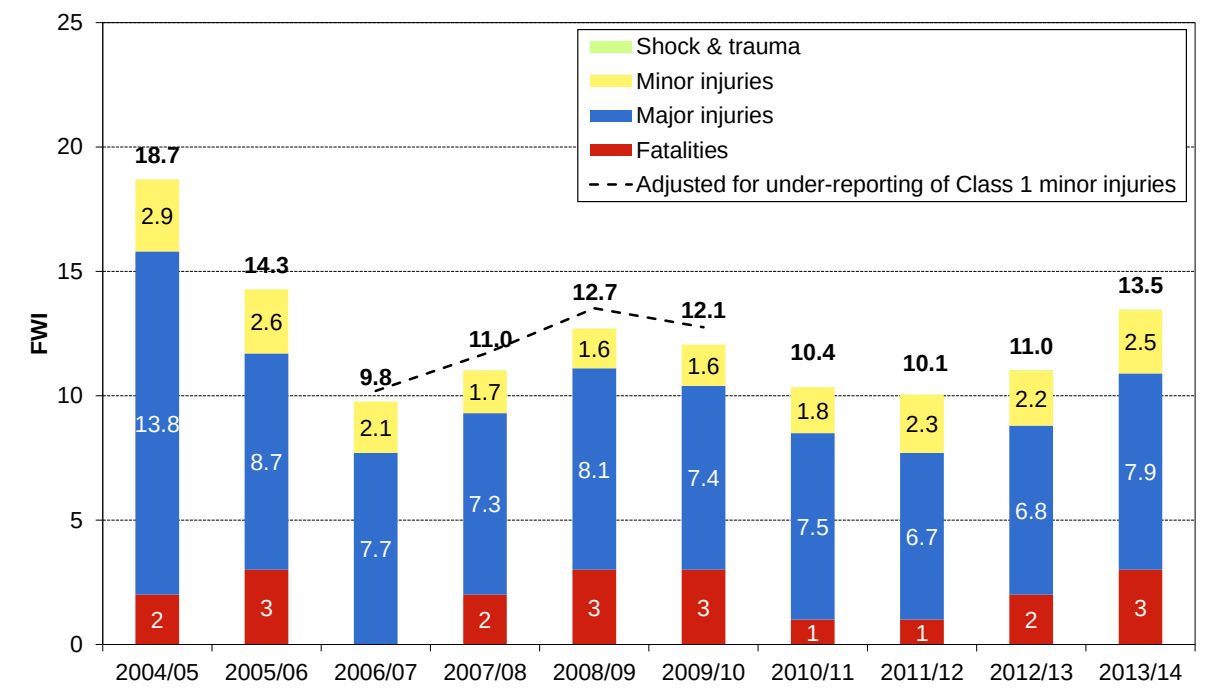
- *Infrastructure workers* suffer the greatest proportion of harm, with 47% of the total workforce harm over the period shown. The total level is affected by the number of fatalities, but is dominated by major injuries.
- *Train drivers* and *other on-board train crew* have the next greatest proportion of harm, with 33% of the total workforce harm over the period shown, when combined. In previous years the level of harm to train drivers has shown an increasing trend, however this year it has decreased by 16% from last year. This is mainly driven by a fall in the number of major injuries.
- *Other on-board train crew* harm fluctuated over the years, being influenced by major injuries. However, there has been a gradual reduction in harm from minor injuries. Minor injuries make up a much larger proportion of harm to these sectors of the workforce than others. *Other on-board train crew* saw a reduction in major and minor injuries, and shock and trauma in 2013/14.
- Over the period shown, *station staff* has accounted for 9% of the total workforce harm.
- *Revenue protection staff* and *other staff*[41] have recorded the lowest levels of harm over the period, at 4% and 7% respectively. However, their injury profiles are different, with other staff having a greater apparent tendency for more serious injury. *Other staff* do now always work on NRMI, so some injuries will not be included in the reporting scope.
- 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.

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

6.4.1 Rail infrastructure workers

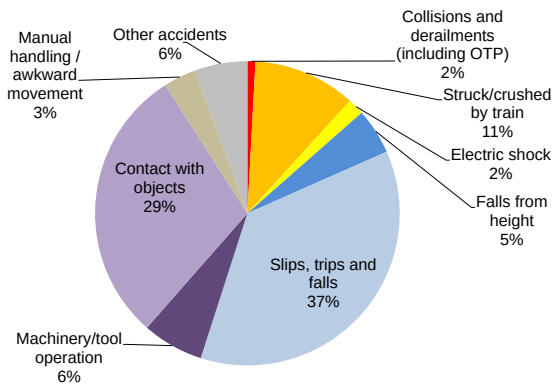
The term 'infrastructure worker' encompasses those whose work involves inspecting, maintaining and renewing the track, signalling and telecommunications equipment, and other railway infrastructure, such as earthworks and bridges. Since 2004/05, the average level of infrastructure worker harm has been 12.3 FWI per year.

Chart 90. Trend in infrastructure worker FWI



- Infrastructure worker harm peaked in 2004/05 at 18.7 FWI. In any given year, the total level of harm is influenced strongly by the number of fatalities. The level of harm in 2013/14 was an increase compared with the level for 2012/13. This is because of the additional fatality, and an increase of 16% in harm from weighted injuries.
- As shown in Chart 91, the category responsible for the largest proportion of infrastructure worker harm is *slips, trips and falls,* accounting for 37% of harm over the period shown. 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 107 and 109.
- *Electric shock*, *train accidents*, and *being struck by a train* are relatively rare events, but are more likely to result in fatality than most other types of accident.

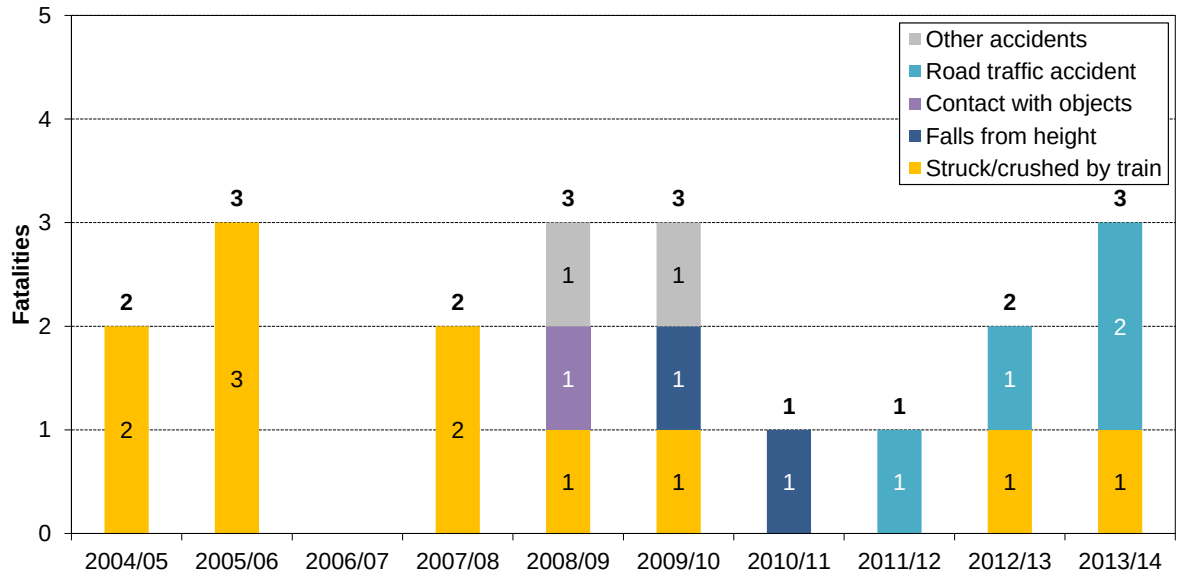
Chart 91. Infrastructure worker FWI by accident type 2004/05 to 2013/14



Infrastructure worker fatalities

Since 2004/05, around one-sixth 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[42].

Chart 92. Infrastructure worker fatalities by accident type



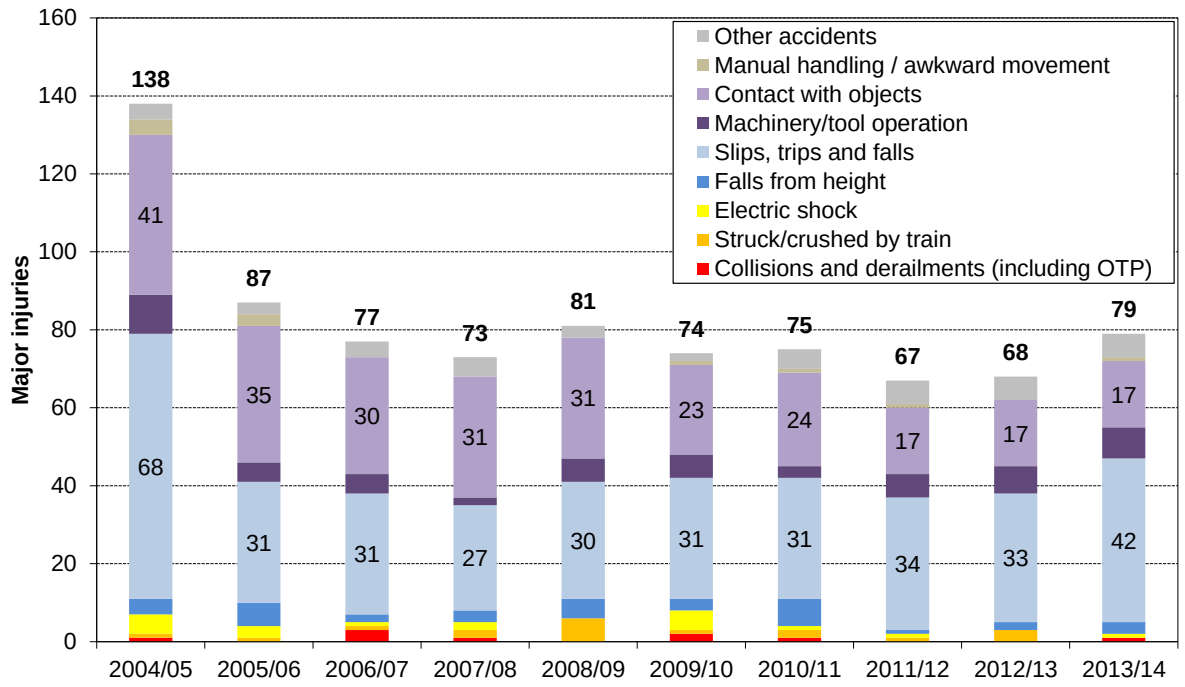
- The most common cause of fatality for infrastructure workers is being struck or crushed by trains[43]; over the period shown, 11 of the 20 infrastructure worker fatalities have been due to this cause.
- In 2013/14, there were three infrastructure worker fatalities; two workers died as a result of a road traffic accident while on duty, another was struck by a train whilst on the line at a station.
- Over recent years there has been an industry-wide initiative to improve the recording of road traffic accidents. As the recording of these incidents improves, there is likely to be an increase in the number seen. Four of the fatalities shown in the chart are classed as road traffic accidents. In both 2011/12 and 2012/13 infrastructure workers were fatally injured as a result of road traffic accidents while travelling on duty. In 2013/14 a road traffic accident resulted in two infrastructure workers being killed while travelling back to their depot.
- Two of the fatalities shown in the chart are classed as falls from height. In both 2009/10 and 2010/11, there were fatalities involving infrastructure workers engaged in bridge maintenance. There is more analysis of falls from height on page 108.
- The remaining category of *other accidents* covers two events. 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, and in 2009/10, an infrastructure worker was overcome by fumes from the chemicals he was using.

[42] There has been one electrocution in the last ten years, when in 2006 a train driver came into contact with the third rail while investigating a smoking wagon at Deal.
[43] Under RIDDOR, rail vehicles such as on-track plant and engineers machines are also classed as trains.

Infrastructure worker major injuries

Since 2004/05, 66% of infrastructure worker harm has been due to major injuries.

Chart 93. Infrastructure worker major injuries by accident type

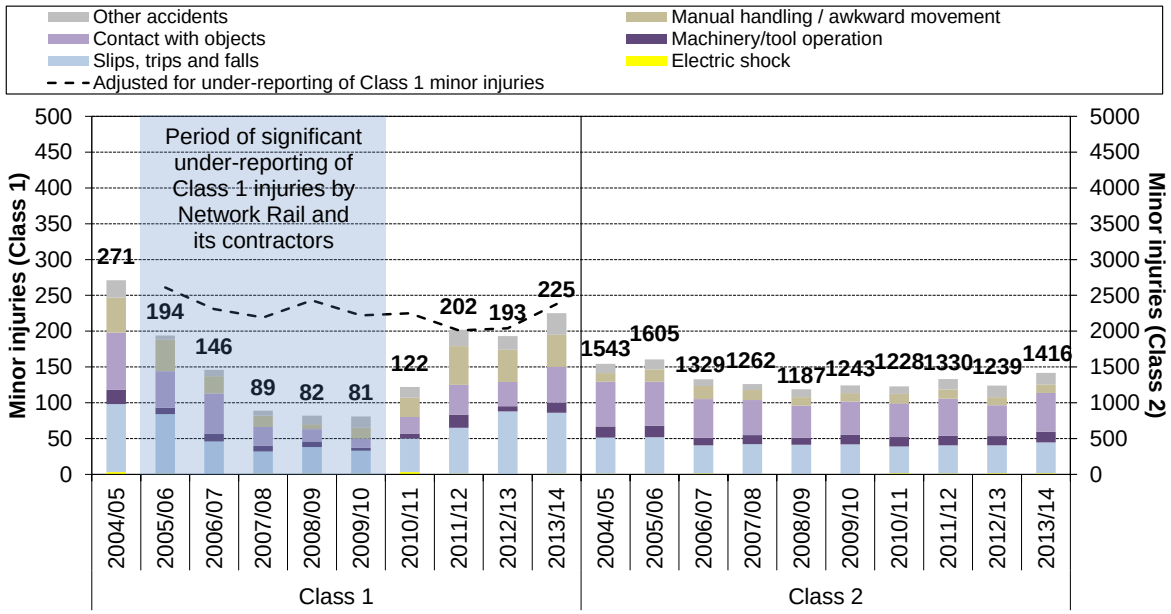


- The number of major injuries to infrastructure workers in 2013/14 was 16% higher than the previous year, becoming the highest number observed in the past 5 years.
- The large peak in 2004/05 occurred around the time that Network Rail brought track maintenance in house. It is possible that when working 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 around two thirds during this period. However, the increase was short-lived.
- Since 2004/05, 44% of infrastructure worker major injuries have been due to *slips, trips and falls*, and a further 32% have been due to *contact with objects*. Previously the number of major injuries due to *slips, trips and falls* had remained fairly stable, however an increase of nine injuries in 2013/14 has made this accident category the biggest driver in the overall increase in infrastructure worker major injuries. The number of major injuries due to *contact with object* has shown a decreasing trend and has now been static for three years (see page 109).
- The most common 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 2004/05, 17% of infrastructure worker harm has been due to minor injuries.

Chart 94. Infrastructure worker minor injuries by accident type

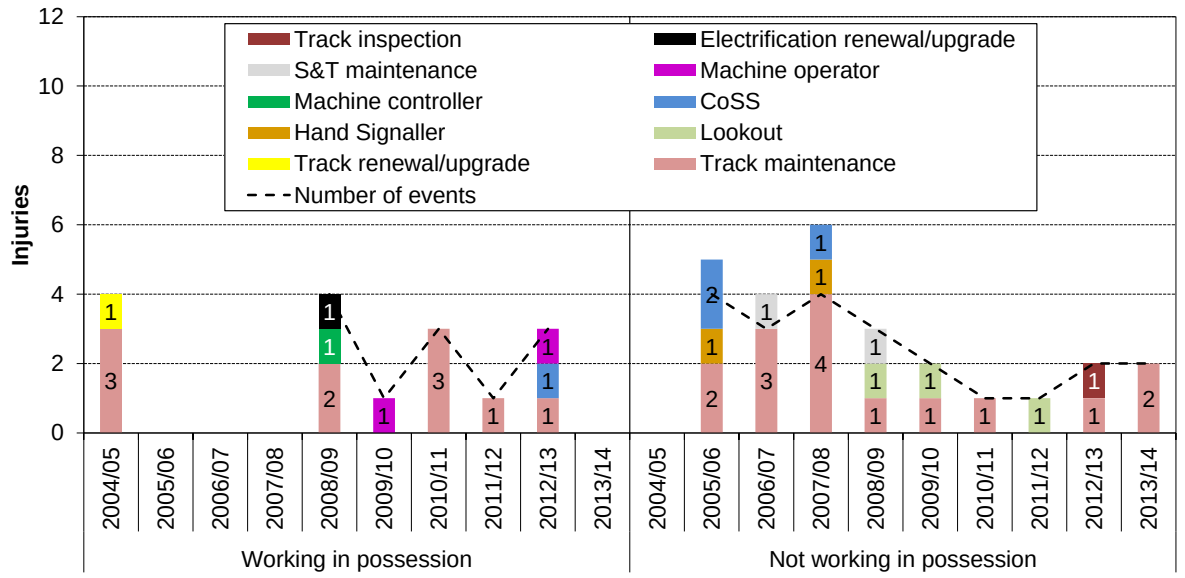


- There was a large reduction in the number of Class 1 minor injuries reported between 2004/05 and 2007/08. Although some of this reduction was due to improved levels of safety (as shown in the fall in major injuries), the review of lost-time injury reporting by Network Rail and its contractors found that there had been significant under-reporting and misclassification of such injuries over the period 2005/06 to 2009/10.
- Following the review, there is evidence that the reporting rate improved, returning to expected levels by 2011/12. The black dotted line on Chart 94 shows the expected number of Class 1 minor injuries each year, based on an assumed reporting ratio of three Class 1 minor injuries to each major injury. The line has been extended past the period where significant under-reporting is identified to have occurred, to illustrate how current levels have now returned to be more in line with those expected, given the number of recorded major injuries.
- Recorded numbers of Class 2 minor injuries peaked in 2005/06. Since then, a lower level of injuries has been seen. *Contact with objects* has been the most common cause over the past ten years, accounting for 38% of Class 2 minor injuries. *Slips, trips and falls* was the second largest group, accounting for 32%.

Infrastructure worker risk from being struck by train (including on track plant)

Chart 92 showed that the majority of infrastructure worker fatalities are the result of being struck by a train. Chart 95 looks at all events (ie both fatal and non-fatal) involving this type of accident. Since 2004/05, there have been 37 events in which infrastructure workers were struck by trains, resulting in 42 injuries.

Chart 95. Infrastructure workers struck by trains 2004/05 to 2013/14

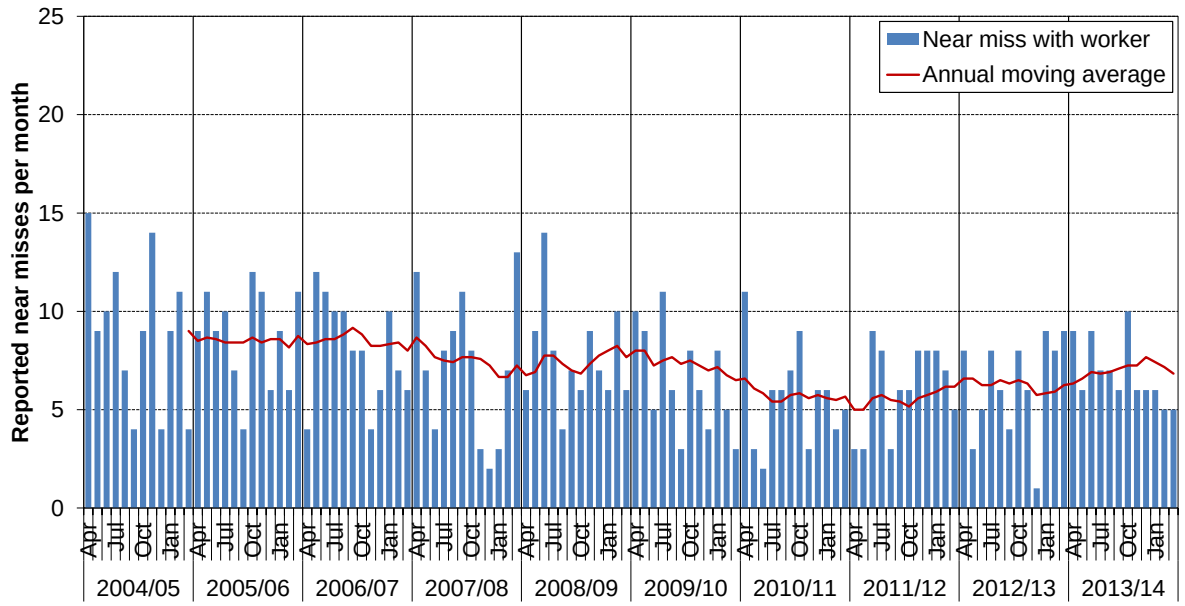


- The 37 events over the past ten years have resulted in 42 injuries. Of these, 11 were fatal, 18 were major, 9 were minor, and 4 were shock or trauma. The total FWI since 2004/05 has been 12.8 FWI.
- The events are split between those occurring to people working in a possession (15) and outside a possession (22). The 15 events in possessions resulted in 16 injuries, and the 22 events outside possessions resulted in 26 injuries.
- There were two incidents in 2013/14, both occurring outside of a possession, and both of which were investigated by RAIB. The first of these was the fatal incident in January 2013, mentioned earlier in this chapter. The other resulted in a minor injury to the person involved, and was published in a RAIB bulletin.

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 risk. In addition, near misses can be a cause of shock and trauma to train drivers.

Chart 96. Near misses with the workforce



- The annual moving average of recorded near misses between 2010/11 and 2013/14 gradually increased, but remains below levels seen before 2009/10. The increase follows a generally reducing trend seen between 2004/05 and 2010/11. The number of recorded near misses in 2013/14 (82), is 76% of the number recorded in 2004/05 (108).
- In the past ten years there have been 865 recorded workforce near misses, but only three recorded instances of infrastructure workers suffering from shock/trauma due to a near miss. It is possible that train drivers are more likely to perceive an event as a near miss, and that there are reporting differences between train drivers and infrastructure workers.
- Chart 96 shows that the number varies month by month, but not in any stable seasonal pattern.
- Table 14 shows that most near misses are reported during the day-time period, from 08:00 to 17:00, with the peak times being between 10:00 and 12:00. The factors involved are likely to be visibility, the times that certain types of track work are taking place, and the timetabling of trains.

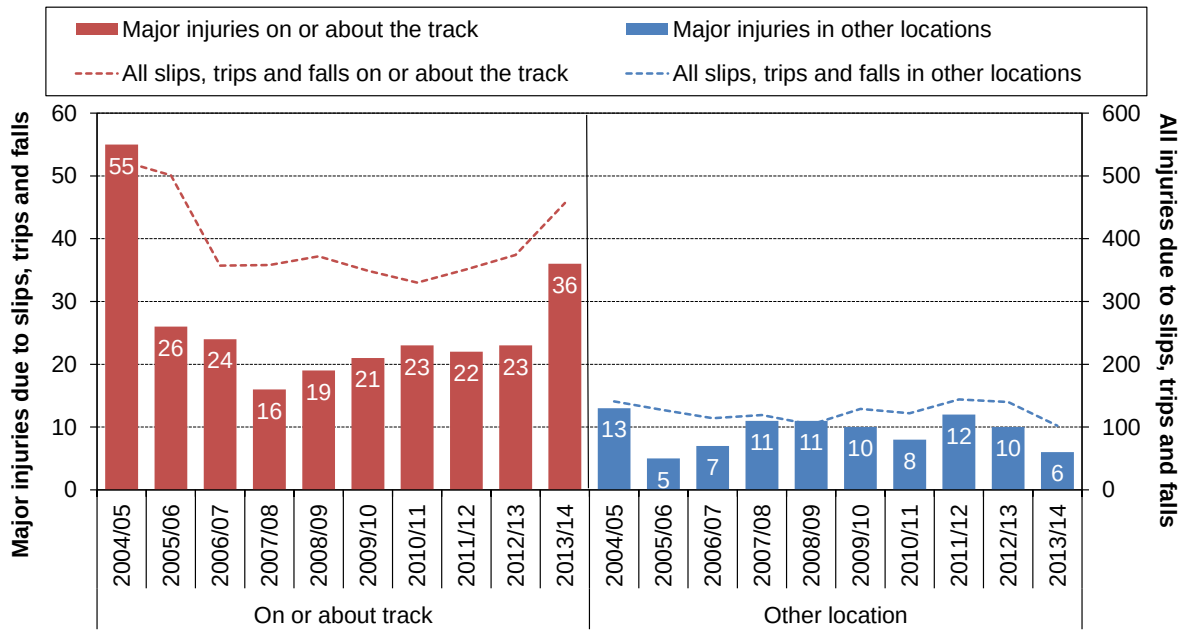
Table 14. Workforce near misses, 2004/05 to 2013/14

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
0	5	3	1	2	8	1	4	3	3	3	3	3	39
1	2	0	4	4	2	2	5	2	2	2	2	1	28
2	2	1	0	2	1	2	4	2	0	2	0	3	19
3	0	1	0	3	0	0	3	0	0	1	0	1	9
4	0	1	0	0	3	0	0	1	2	0	2	0	9
5	0	0	3	0	0	1	2	1	0	2	0	0	9
6	2	1	2	0	0	0	4	0	1	0	0	0	10
7	0	1	0	2	0	0	2	2	1	2	1	1	12
8	1	0	0	3	2	7	5	0	1	0	4	4	27
9	11	11	8	11	5	7	7	14	9	10	11	4	108
10	9	14	10	15	14	13	16	7	13	18	13	10	152
11	8	10	9	15	13	9	16	14	6	11	8	6	125
12	8	9	9	13	5	10	5	2	3	9	10	5	88
13	4	5	4	5	9	5	5	5	4	6	6	3	61
14	3	1	7	5	4	4	1	6	4	8	3	4	50
15	3	1	4	0	3	5	3	2	1	2	3	0	27
16	2	2	1	2	0	3	1	0	2	0	0	2	15
17	2	3	1	1	1	2	1	1	1	1	0	0	14
18	1	1	1	0	0	0	0	0	0	0	1	1	5
19	1	1	0	0	0	0	1	1	0	2	0	1	7
20	4	1	1	1	1	0	0	0	1	0	1	0	10
21	1	1	0	2	0	2	1	1	1	1	0	0	10
22	1	0	0	0	1	1	2	0	1	1	1	1	9
23	4	2	2	1	0	4	0	1	4	3	1	0	22
Total	74	70	67	87	72	78	88	65	60	84	70	50	865

Infrastructure worker slips, trips and falls: injuries by location

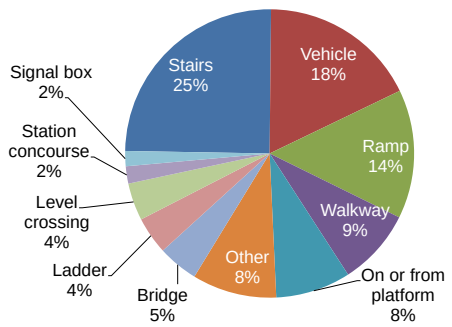
Within SMIS, infrastructure worker slips, trips and falls are classed by location. The category of *slips, trips and falls* does not include falls from heights greater than two metres, which are analysed separately, on page 108. Injuries from slips, trips and falls have accounted for 35% of harm to infrastructure workers since 2004/05.

Chart 97. Infrastructure worker major injuries due to slip, trips and falls



- In 2013/14 there were 42 major injuries arising from slips, trips and falls in all locations. This is the second highest level seen since 2004/05.
- At 559, the total recorded number of slips, trips and falls occurring to infrastructure workers was an increase of 9% on the number for 2012/13. The number of incidents occurring on or about the track has increased since 2010/11, yet remains 16% lower than the level seen in 2004/05.
- Thirty of the slips, trips and falls on or about the track in 2013/14 resulted in fractures. Ankles and feet made up 11 fractures, while wrists and hands accounted for five fractures. Other body parts to suffer fractures were chest, legs and arms.
- Since 2004/05, 26% of slips, trips and falls, that resulted in an injury have been recorded as occurring in locations other than on or about the track. However, this is likely to be an underestimate since the category *on or about track* is often used as a default category, where information about the event is limited or unclear. Chart 98 shows the location types recorded, where the event was not categorised as on or about track.

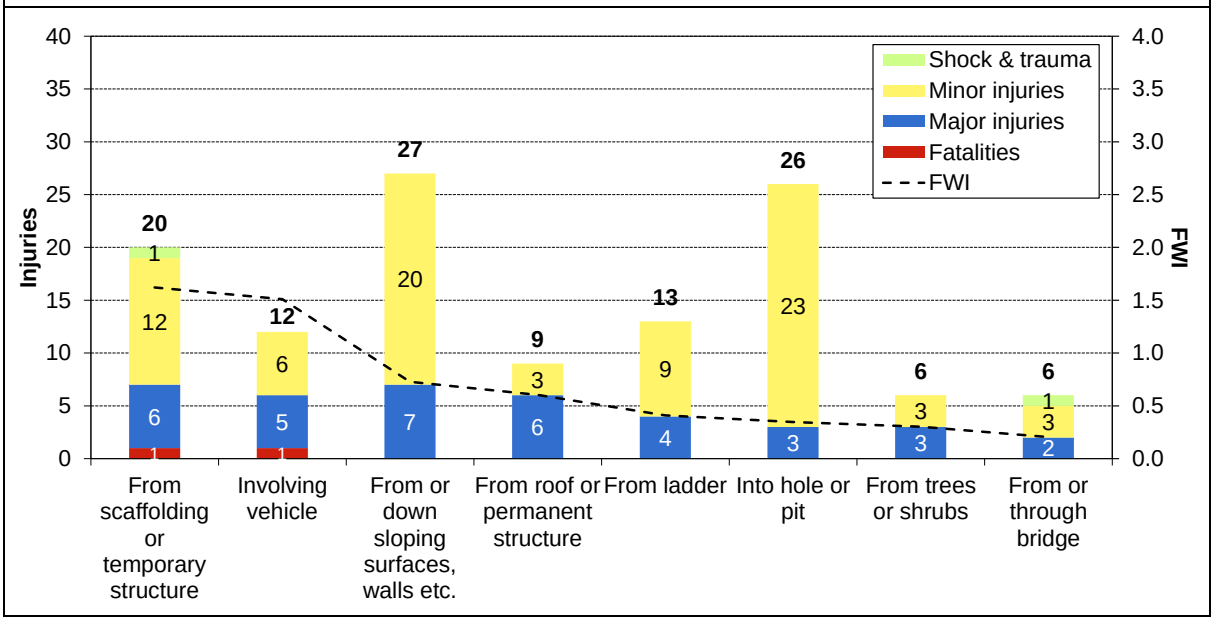
Chart 98. Slips, trips and falls at other locations since 2004/05



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

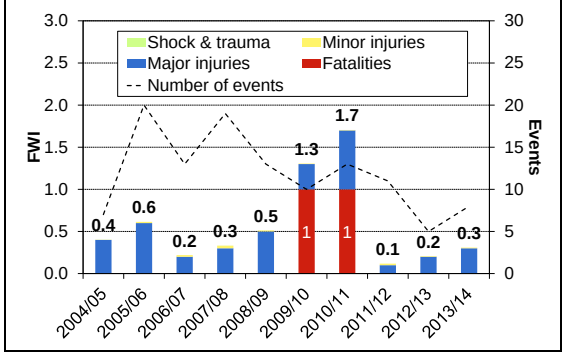
Since 2004/05, there have been 119 injuries to infrastructure workers classed as falls from heights greater than two metres.

Chart 99. Incidents involving falls from height (>2m) since 2004/05



- Of the 119 falls from height since 2004/05, two have been fatal. The last such event occurred in April 2010, when a contractor working for Network Rail was fatally injured after the cherry picker, which he was using while engaged on strengthening work at Stewarton viaduct, toppled over, causing him to fall around 70ft.
- The incident type causing most the largest amount of harm to infrastructure workers is falls *from scaffolding or temporary structure,* accounting for 28% of the total FWI.
- The most frequent types of event have been falls *from or down sloping surfaces, walls, etc*, (23%), and falls *into hole or pit* (22%).
- Over the past ten 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, as seen in Chart 100, was the highest of the period shown.

Chart 100. Infrastructure worker FWI from falls from height

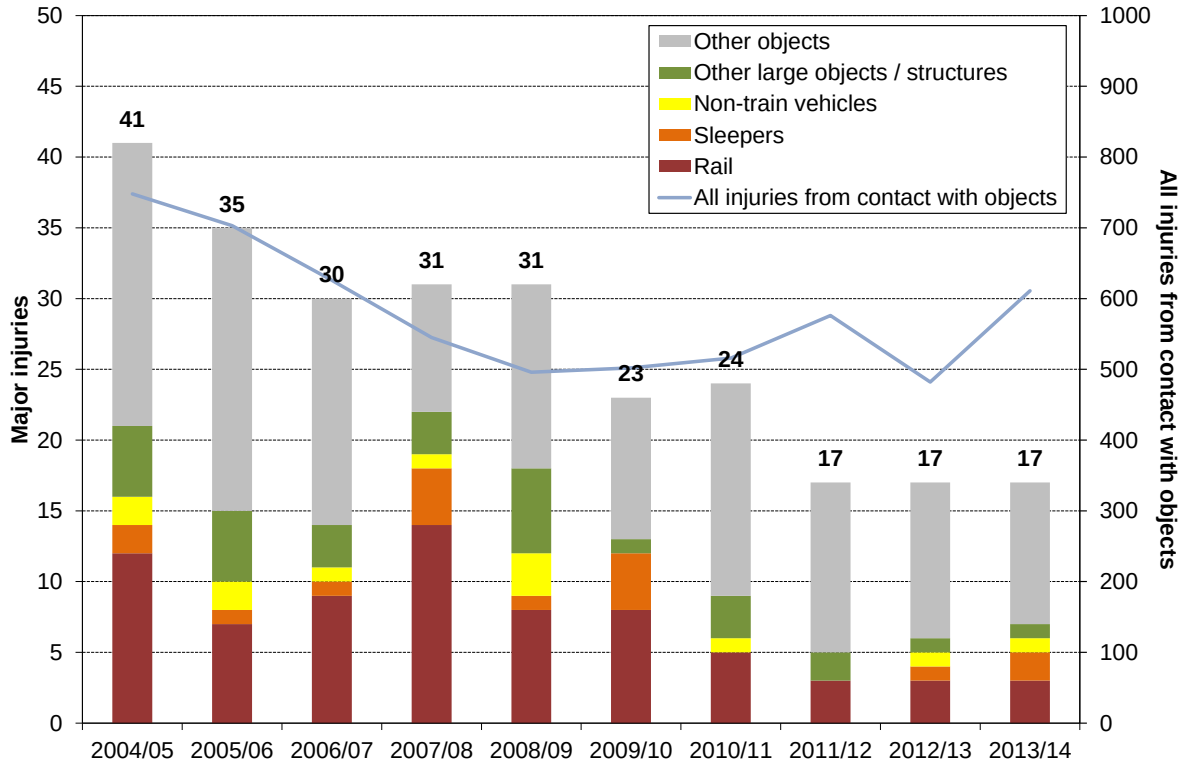


- Of the three major injuries in 2013/14, two occurred to infrastructure workers who fell from scaffolding, one breaking an arm after falling to the platform in Bradford-on-Avon station, the other breaking a leg after falling from scaffolding over the platform at Salisbury Station and onto the four foot.
- The third major injury in 2013/14 occurred when an infrastructure worker who had been examining a structure in Charing Cross station stepped onto an area of tin roofing, which gave way, resulting in the injured person falling between 12 and 15 feet to the floor and dislocating a shoulder.

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

The category *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 101. Infrastructure worker major injuries due to contact with object



- Contact with object injuries have accounted for 29% of the total FWI occurring to infrastructure workers since 2004/05. This category of accidents is the next largest source of infrastructure worker FWI after slips, trips and falls.
- While the number of major injuries in 2013/14 maintained the lowest level over the period shown in the chart, the total number of contact with object injuries increased by 27% in 2013/14, to the highest level seen since 2006/07.
- The reduction in major injuries in the last six years has been driven by a fall in injuries arising from contact with rail, sleepers and other large objects.
- The types of event occurring under the contact with object category are varied in nature. Examples of events occurring during 2013/14 include:
  - An infrastructure worker was hit in the head by van doors which were opened fully by high winds, knocking him to the floor unconscious.
  - Whilst removing an old ticket station and shelter at Tonypandy station, an infrastructure worker walked into the exclusion zone just as a lintel was being lifted. The lintel slipped and fell onto the person, resulting in multiple injuries including a fractured spine.

Close Call

The close call system comprises 26 Level 1 categories, which are mandatory to select for each record. Each has a number of (non-mandatory) Level 2 sub-categories. During 2013/14, 51,060 close call reports were submitted. Of all these records, 29,723 (58%) were not assigned a Level 2 category. There is more information on the close call system in chapter 10.

Table 15 presents information on the top 10 Level 1 categories that were selected; these categories accounted for just over 80% of the total number of close calls in 2013/14.

The category of *Site welfare / site housekeeping* accounted for 31% of close calls recorded in 2013/14. Within these records, *Slip/trip hazards on site* was the most common sub-category assigned.

Table 15. Top 10 Close Call Level 1 categories in 2013/14

Top ten Level 1 categories	Close calls in 2013/14
Site welfare, site housekeeping	15,645
Other	12,115
Public protection/traffic management	4,362
Safe systems of work planning	2,422
Personal protective equipment	1,937
Moving plant & machinery	1,249
Tools and equipment	1,193
Electrical safety	1,140
Third party interface	1,131
Work at height	1,095

Road traffic accidents

The Level 1 category *road vehicles* received 849 close calls over 2013/14. The nature of the reporting system means records can be recorded for close calls involving workforce and non-workforce road vehicles. Table 16 shows the primary reason for these close calls. The most common reason for reporting was because of a person at fault, followed by a fault with the vehicle.

The majority of *person at fault* reasons related to parking (164), with most citing a contravention of reverse parking rules on site. Other common reasons, which resulted from driver behaviours, included speeding (75), performing unsupervised manoeuvres (53), general erratic/reckless driving (50), collisions with vehicles or objects (41), and using a mobile phone while driving (37).

Table 16. Road vehicle close calls in 2013/14

Primary reason	Total
Person at fault	523
Vehicle at fault	144
Site management issue	81
Environmental factor	67
Unrelated to road vehicle safety	34
Total	**849**

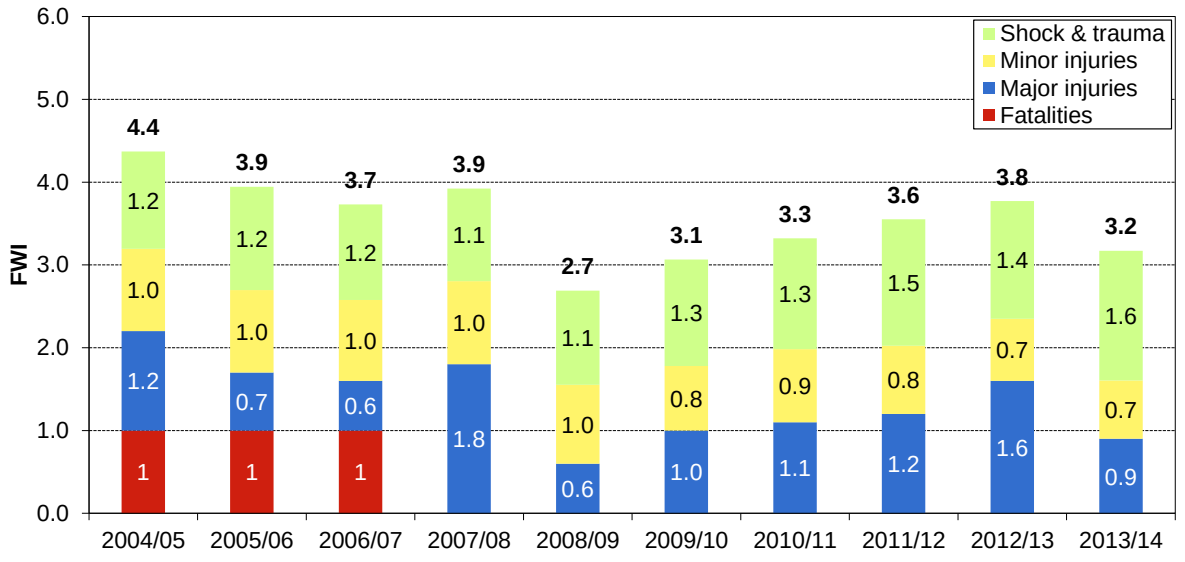
Common reasons for reporting a vehicle at fault included; items falling from vehicles on public highways, damaged tyres/wheels and faulty lights.

Site management issues included: insufficient or missing fences and barriers between vehicles and the workforce/public, insufficient or missing road signs and road markings, and insufficient briefings to staff about the worksite layout.

6.4.2 Train drivers

Around 13,100[44] people are employed as train drivers. Since 2004/05, the average annual level of harm per year for train drivers has been 3.6 FWI, and the average number of fatalities has been 0.3 per year.

Chart 102. Trend in train driver FWI



- There was a reduction in harm to train drivers in 2013/14 compared to the previous year. However, a relatively small number of major injuries has a strong influence on the FWI total, so it is not possible to attach any statistical significance to the decrease.
- Chart 103 shows that over the period as a whole, the largest contributor to train driver FWI has been 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. Since 2004/05, there have been three train driver fatalities, shown in Table 17.

Chart 103. Train driver FWI 2004/05 to 2013/14

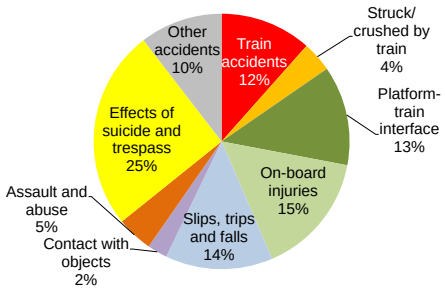


Table 17. Train driver fatalities since 2004/05

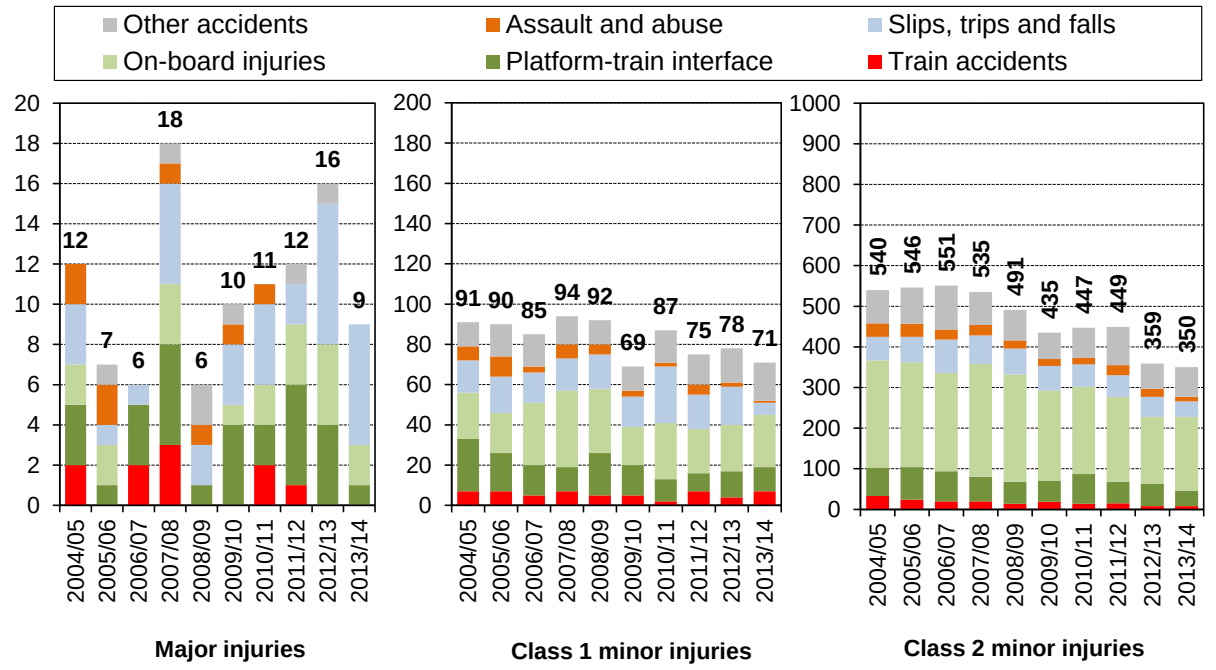
2004/05 Train accident	A train driver and five passengers were killed as a result of a train collision with a car parked on a level crossing at Ufton. The car driver, who was also killed, had deliberately parked on the crossing to commit suicide.
2005/06 Struck by train	A driver walking along the track 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.

[44] Source: HLOS survey 2014. The HLOS survey is an annual survey whereby workforce hours are collated by RSSB, for the purpose of assessing progress against the HLOS targets.

Train driver injuries

Since 2004/05, 30% of train driver FWI has been due to major injuries, and 25% has been due to minor injuries.

Chart 104. Train driver injuries by injury degree and type

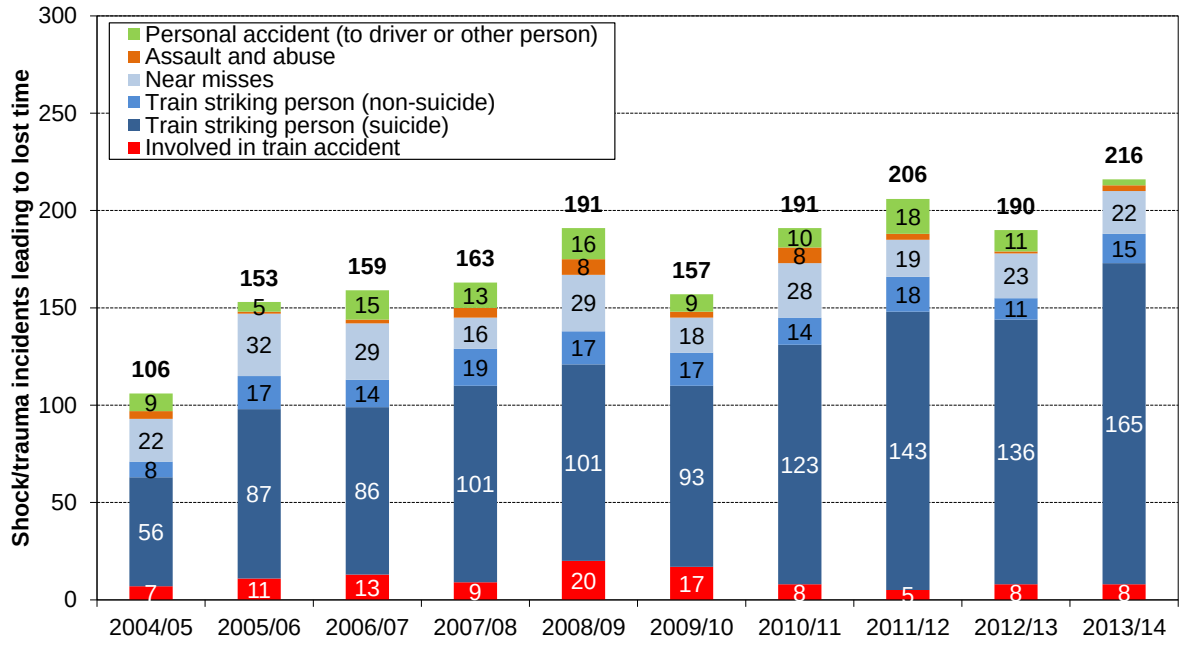


- Although the numbers are small, the number of major injuries in 2013/14 reduced by seven from the previous year. The largest force behind the decrease has been in both the *platform-train interface* and the *on-board injury* categories, which have decreased by three and two respectively.
- The number of both Class 1 and Class 2 minor injuries have stayed relatively consistent in 2013/14 when compared to the previous year. From 2012/13, Class 1 minor injuries saw a 9% reduction. Class 2 minor injuries saw a 3% reduction, to the lowest level observed in the analysis period.
- On-board injuries have accounted for 31% of Class 1 minor injuries, and 49% of Class 2 minor injuries over the period shown. These accidents include instances of drivers striking or being struck by objects on the train, and slips, trips and falls occurring within the train. Reductions have been seen in on-board injuries involving train defects and being caught by internal doors.

Train driver shock and trauma

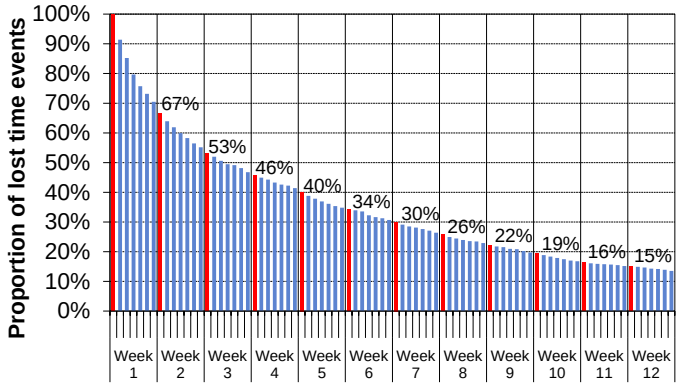
Relative to other worker types, train drivers experience a higher level of incidents resulting in shock or trauma. Since 2004/05, shock and trauma have accounted for 37% of train driver FWI. Fatalities and injuries to people struck by trains are the main causes.

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. In 2013/14 there was an increase of 14% from the previous year, which put the total 25% above the average of 173.2 incidents per year over the period shown. It should be noted that because of its nature, this type of event is more prone to delayed reporting and so the number in 2013/14 might increase further.
- The most common cause of recorded shock/trauma to drivers is the train striking a person, and there has been an increasing trend over the past ten years. More than 80% of time, the incident is a suicide or suspected suicide.
- The percentage increase in incidents leading to lost time due to striking a person is greater than the increase of persons struck by train over the same period (see Chart 130). It is possible that changes in the quantity and quality of support available to those affected has improved reporting rates.
- Of those cases involving lost time, over 60% have resulted in the driver being absent from work for more than one week. Over one third involved more than five weeks off, and 16% involved more than ten weeks absence.

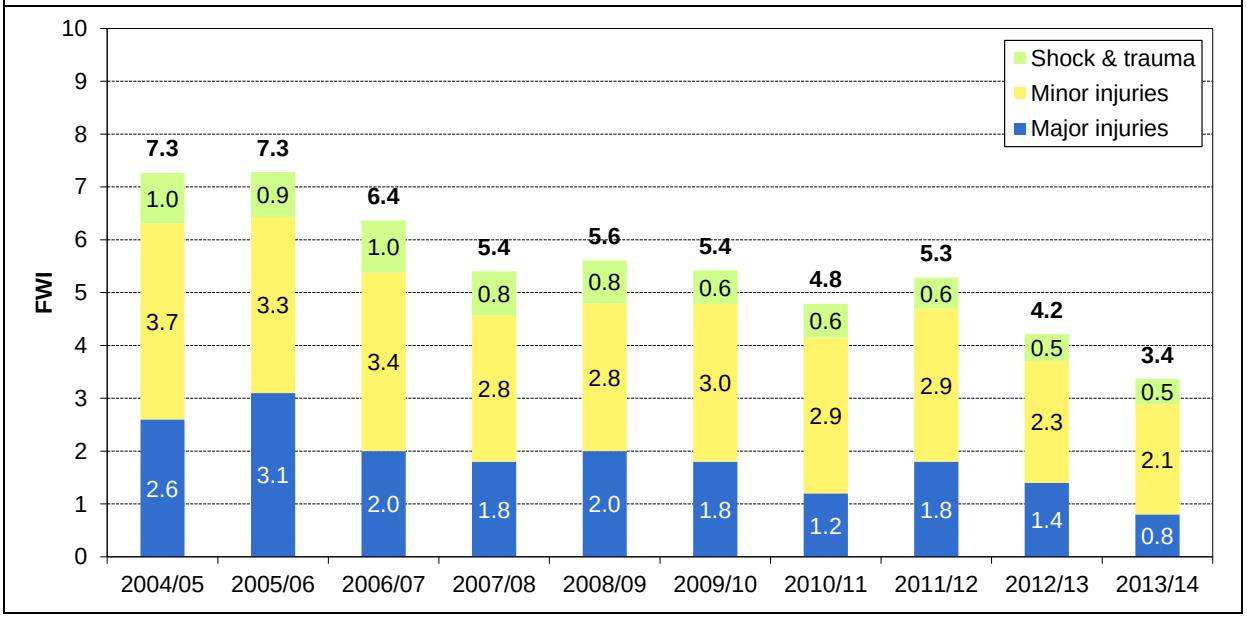
Chart 106. Lost-time durations since 2004/05



6.4.3 Other on-board train crew

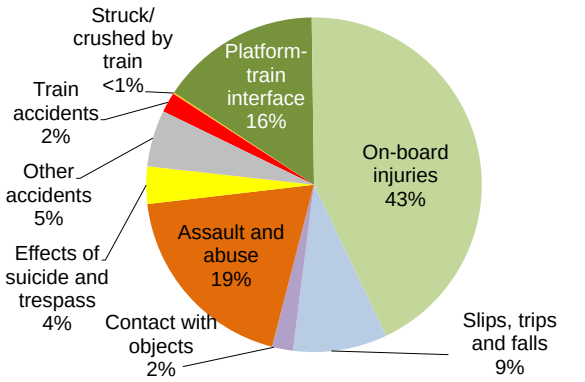
Around 12,000[45] people are employed as non-driving train crew. The majority (around 60%) work as guards or conductors, with train hosts or catering staff comprising most of the remainder. Since 2004/05, the average level of harm to other on-board train crew has been 5.5 FWI per year. There have been no fatalities during the analysis period.

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



- The level of harm to other on-board train crew reduced by 1.2 FWI in 2013/14, bringing the total to a ten-year low. Major injuries, minor injuries and shock & trauma injuries are all at their lowest levels over the period shown.
- Chart 108 shows that the largest contributor to FWI is *on-board injuries*, which have accounted for 43% since 2004/05. The next largest contributor is *assault and abuse*, which has accounted for 19% 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 train crew fatalities 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 2004/05

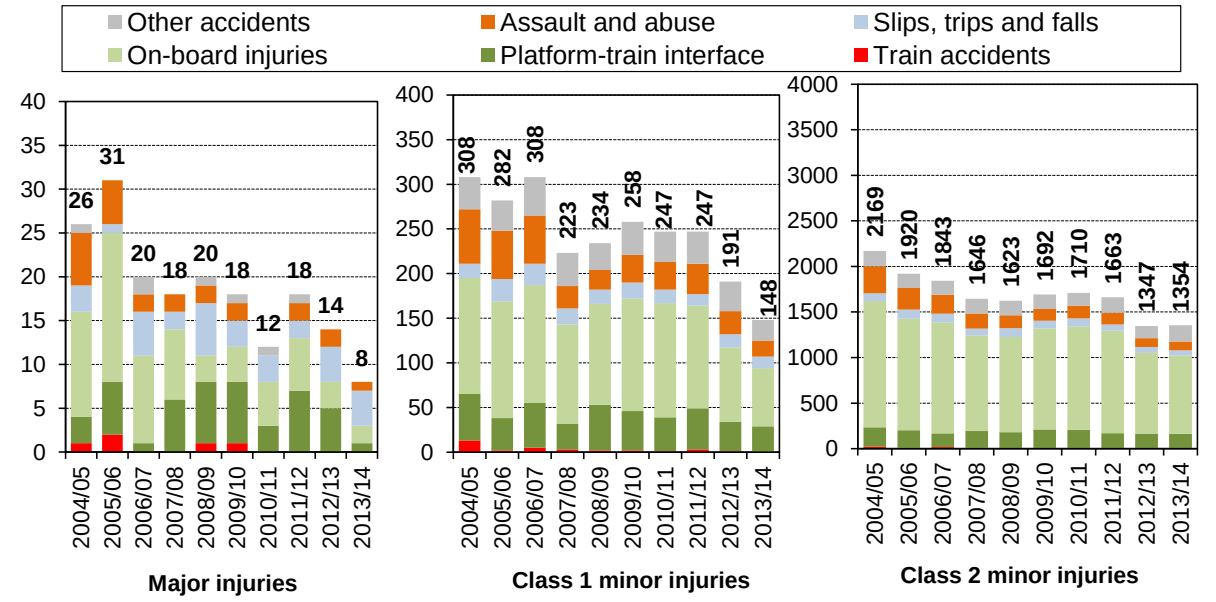


[45] Source: HLOS survey 2013.

Other on-board train crew injuries

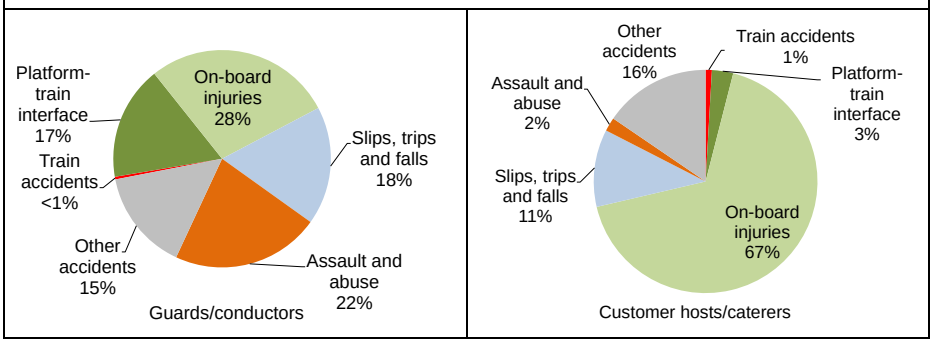
Since 2004/05, 34% of the total FWI occurring to other on-board train crew has been due to major injuries, and 53% has been minor injuries

Chart 109. Other on-board train crew injuries by injury degree and type



- The number of major injuries occurring to other on-board train crew has followed a generally reducing trend over the past ten years. *Assaults and abuse* and *platform-train interface* incidents have seen the largest reductions since 2012/13, decreasing by 50% and 80% respectively.
- There have been no on-board train crew major injuries from train accidents since 2009/10, when a train guard was overcome by fumes resulting from an electrical fire on the underframe of a train.
- The number of Class 1 minor injuries has reduced by 23% in 2013/14, and now sits at its lowest level over the past ten years. The number of Class 2 minor injuries has remained relatively consistent when compared with the previous year.
- Reductions in on-board injuries, such as those from trains lurching, internal doors and train defects, have had the largest impact on the totals. On-board injuries have accounted for 46% of Class 1 minor injuries, and 65% of Class 2 minor injuries over the period.

Chart 110. Other on-board train crew FWI by role and accident type, 2013/14



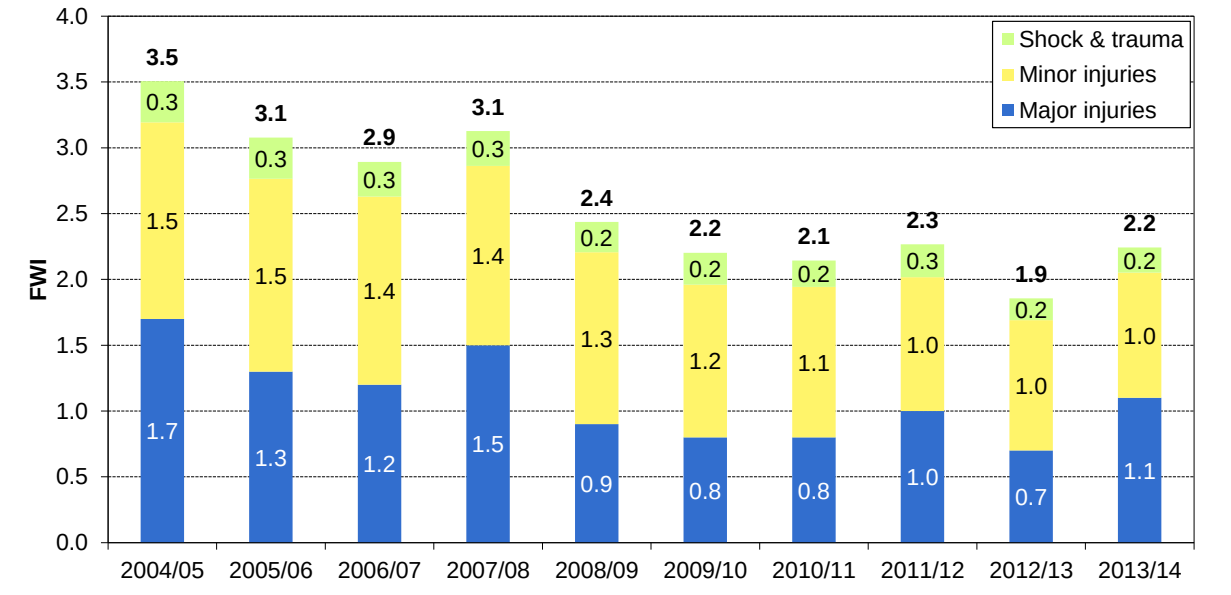
- Different members of train crew undertake different tasks, which expose them to different hazards. Chart 110 shows that guards and conductors, who tend to be responsible for duties such as train dispatch and ticket examination, are more prone to injuries from assault and during boarding/alighting. Customer hosts and caterers are more prone to on-board injuries.

Station staff

There are around 13,000[46] members of staff working in railway stations. A wide range of activities is carried out by these staff, such as train despatch on the platforms, and customer management.

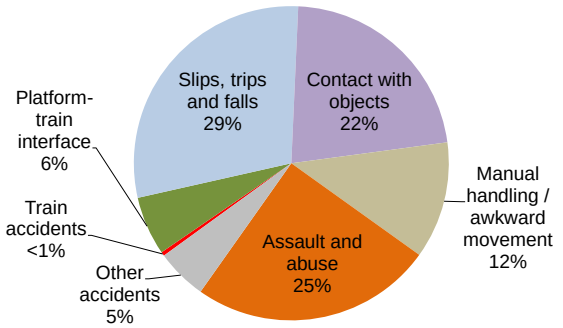
Since 2004/05, the average level of harm per year to station staff has been 2.6 FWI; there have been no fatalities over the past ten years.

Chart 111. Station staff FWI



- The level of FWI to station staff increased in 2013/14 from the previous year, but it remains lower than the level seen before 2008/09
- The annual totals are influenced by major injuries. The numbers of these are low, so a small annual change can have a large impact in the total. The increase in harm in 2013/14 is largely down to the increase in major injuries.
- Over the period as a whole, the three largest contributors to station staff FWI have been *slips, trips and falls*, *assault and abuse* and *contact with objects*.
- There have been no fatalities involving station staff during the period shown in the chart. The last such incident occurred at Purley station in July 2002, when a member of station staff was fatally injured attempting to put out a train fire. Another member of station staff and a train driver suffered shock and trauma injuries in this incident.

Chart 112. Station staff FWI by type 2004/05 to 2013/14

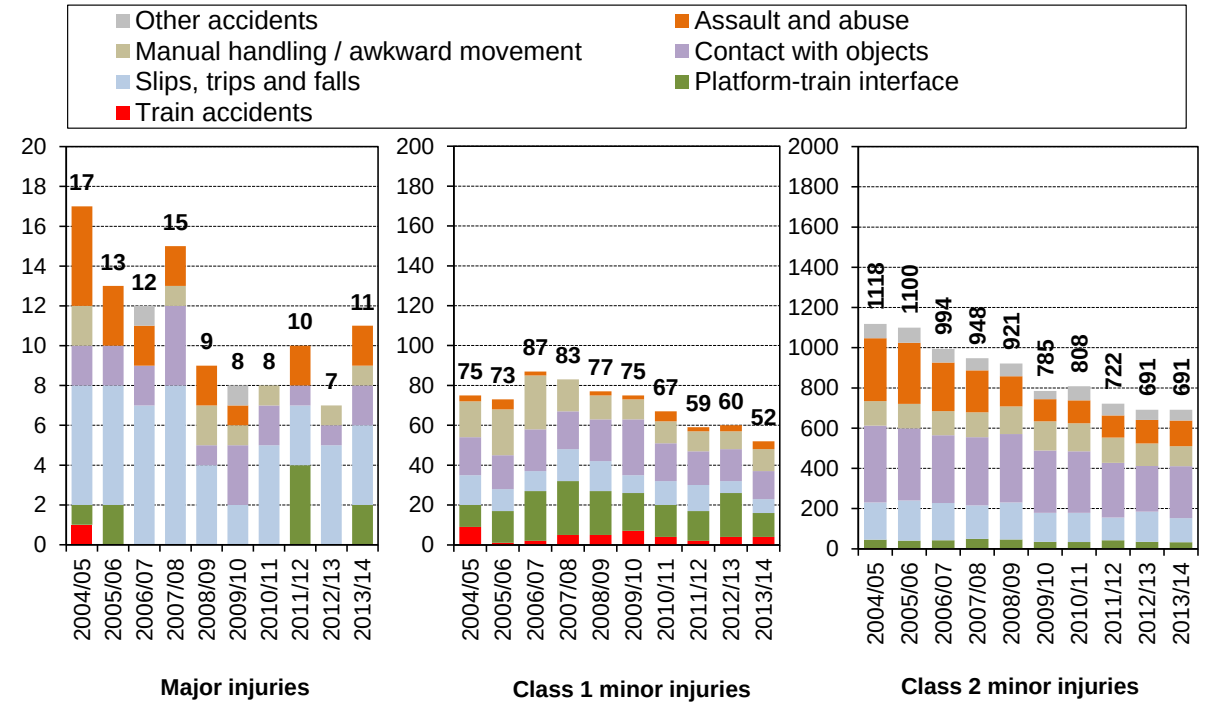


[46] Source: HLOS survey 2013.

Station staff major and minor injuries

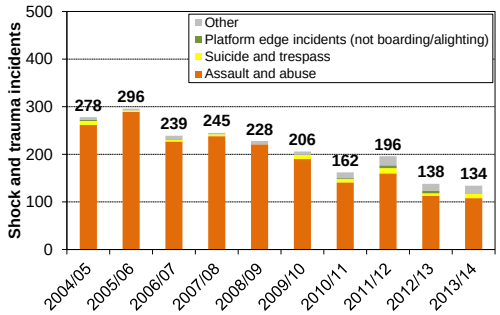
Since 2004/05, 43% of harm to station staff has been major injuries, and 48% has been minor injuries.

Chart 113. Station staff injuries by injury degree and type



- The number of major injuries in 2013/14 increased by 4 from the previous year, resulting in the highest number of major injuries observed since 2007/08. Numbers are small, so it is difficult to discern trends, but the second half of the decade shows consistently lower figures than the first half.
- There are fluctuations in the charts above, but a general reduction can also be seen across the reporting period for both classes of minor injury. Both Class 1 and Class 2 minor injuries are now at the lowest levels seen over the past ten years. The biggest contributors to the reduction, over the period as a whole, are falls in the categories of *contact with objects* and *assault and abuse*.
- *Shock and trauma* have caused 9% of the total station staff FWI since 2004/05. The number of these incidents has dropped over the years, and now stands at 48% of the level seen in 2004/05. The greatest cause of shock and trauma to station staff has been *assault and abuse*, which has accounted for 92% of cases over the period as a whole.

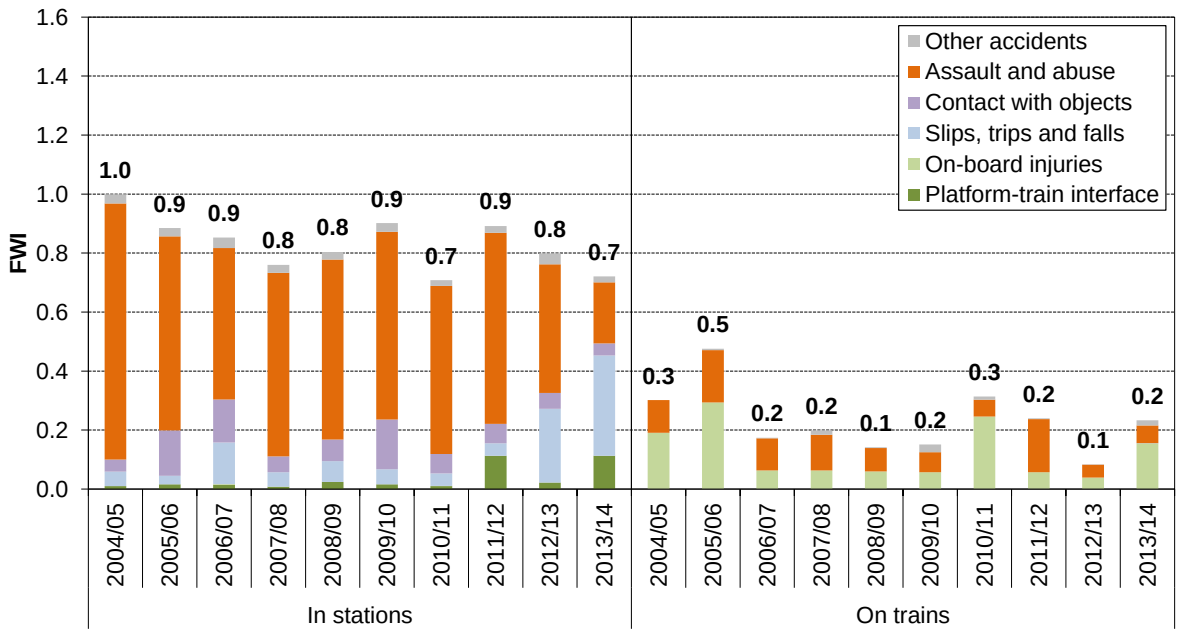
Chart 114. Station staff shock/trauma since 2004/05



6.4.4 Revenue protection staff

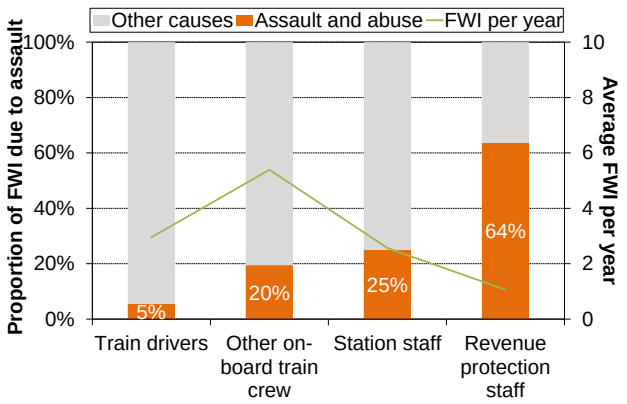
There are an estimated 3,000[47] revenue protection staff working in the rail industry, who work both in stations and on trains.[48] Since 2004/05, the average annual level of harm to revenue protection staff has been 1.1 FWI. There have been no fatalities in this reporting period.

Chart 115. Revenue protection staff injuries by cause and site type



- Since 2004/05, 78% of the total harm to revenue protection staff has occurred in stations.
- Of the harm that has occurred in stations, 69% has been due to assault or abuse. Of the harm that has occurred on trains, 43% has been due to assault or abuse.
- In stations, *contact with object* injuries and *slips, trips and falls* respectively account for 10% and 13% of harm. 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 64% of total FWI. This compares with proportions of 25% for station staff, 20% for on-board train crew, and 5% for train drivers. More analysis of workforce personal security issues is presented in Section 6.5.

Chart 116. Assault proportions since 2004/05



[47] Source: HLOS survey 2013.
[48] It is not always clear in SMIS records if an incident has occurred to a member of revenue protection staff specifically, rather than a member of station staff or other train crew. Therefore some revenue protection staff may be included in the previous analyses for these two occupations.

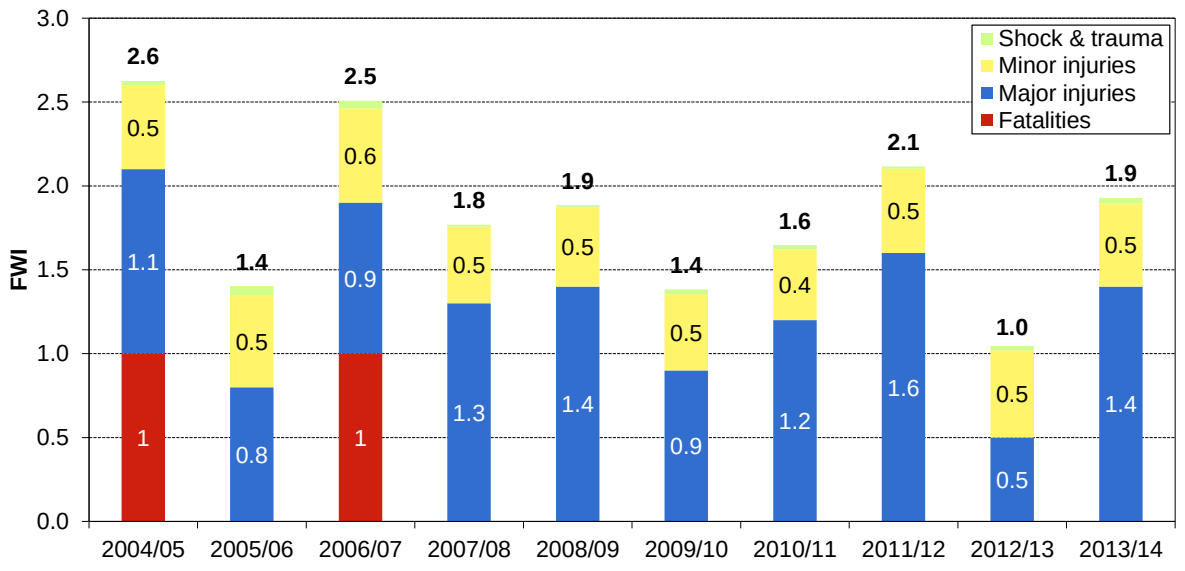
6.4.5 Other workforce groups

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.

Some of the locations where injuries occur to other workforce groups are outside the scope of the ASPR, unless such injuries are fatal.[49] These locations, such as yards, depots and sidings, are not subject to mandatory SMIS-reporting. However, a number of 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. More information on the yards, depots and sidings project is shown in Appendix 4.

Since 2004/05, the average level of harm for this combined group has been 1.8 FWI, and the average number of fatalities has been 0.2 per year.

Chart 117. Trend in FWI for other workforce groups



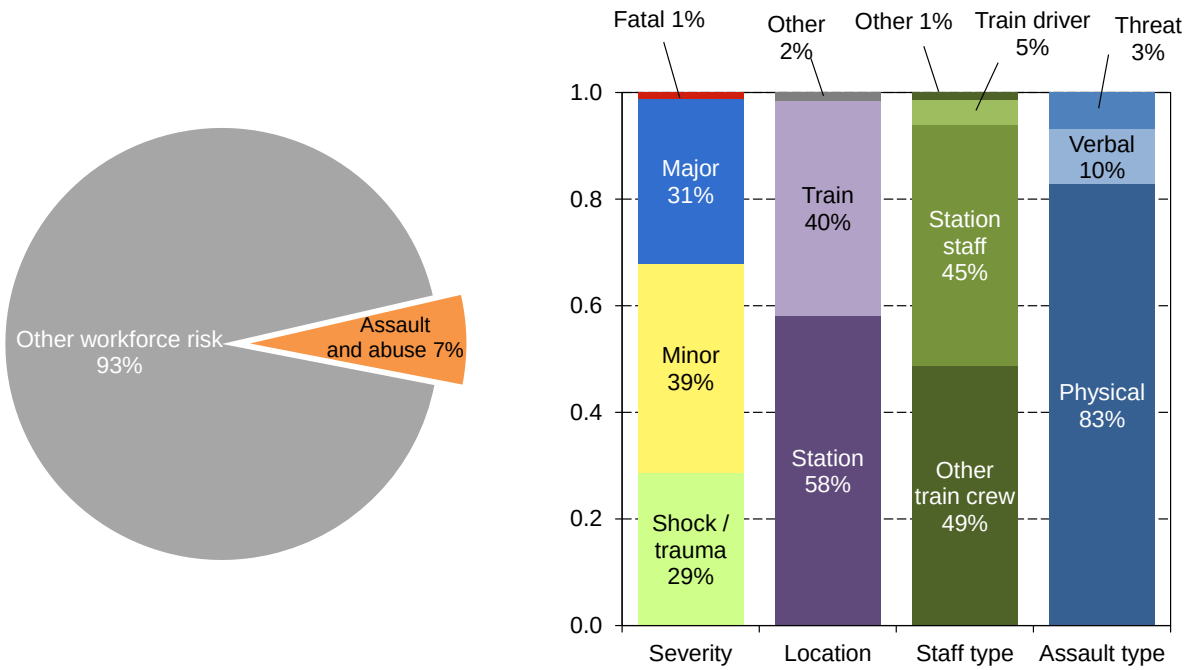
- Harm to other workforce groups increased in 2013/14 from the previous year, but numbers are too small to discern genuine trends.
- The two fatalities over the past ten years were both shunters, who were crushed between rail vehicles while shunting in yards.
- The major injuries in 2013/14 consisted of five slips, trips and falls, three road traffic accidents, three contact with objects, one manual handling, one assault and one fall from height.

[49] Other locations, such as stations and track sections closed for long-term construction or renewal work, are out of scope of the ASPR for all levels of injury, including fatal injuries.

6.5 Workforce personal security[50]

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, workforce assaults[51] occur on a daily basis. Attacks can take the form of verbal abuse and threats, or actual physical assault.

Chart 118. Workforce assault risk (1.7 FWI per year) in the context of all workforce risk



Source: SRMv8. In the SRM coding methodology, revenue protection risk is included in the station staff or other train crew categories, depending on where the event occurred; this is reflected in the chart.

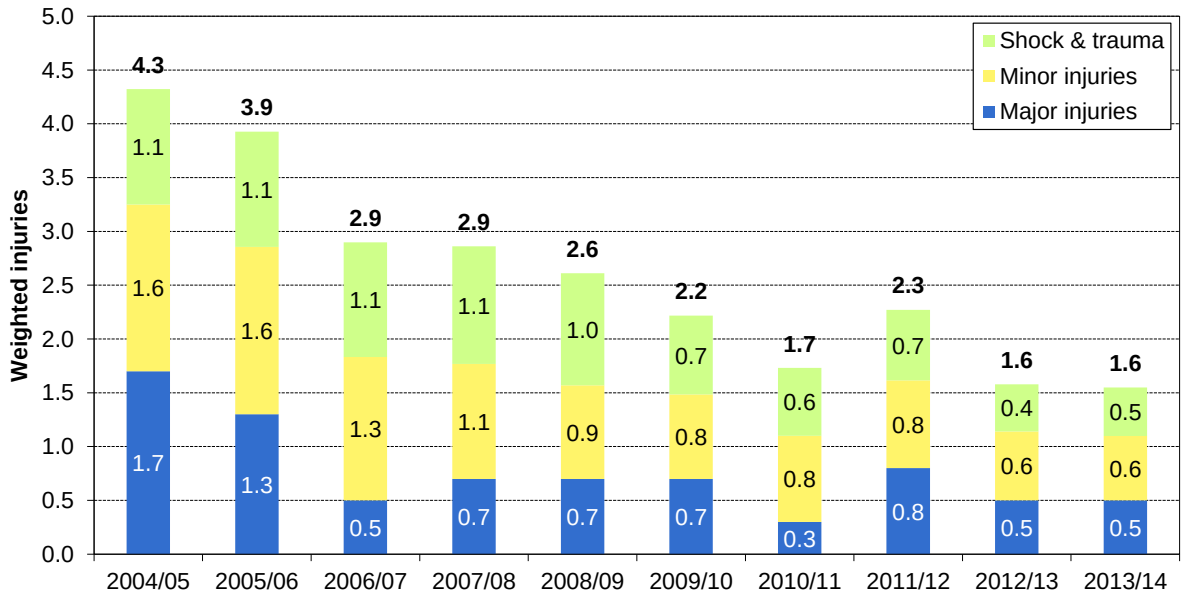
- The SRM estimates that 7% of all workforce risk is due to assaults. This equates to 1.7 FWI per year. The FWI risk is fairly evenly split between the risk from major injuries, minor injuries and shock/trauma; fatality risk from workforce assault is relatively low.
- Around 83% of workforce assault 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 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 are at a much higher risk from assault than train drivers or infrastructure workers.
- During 2013/14, there were five major injuries, 430 minor injuries, and 452 cases of shock/trauma as a result of assault, giving an overall FWI of 1.6. Of the five major injuries, two occurred to station staff, one to a member of on-board train crew, one to an infrastructure worker and one to a security officer.

[50] Estimates of the risk related to workforce personal security, and analysis of the trends in the occurrence of injury, are based on data from SMIS, which contains information on the number of incidents and the resulting injuries. This is in contrast to passenger/public personal security, which is based on data from BTP, this being a better source of information on passenger and public assault.
[51] Throughout this section, the term 'workforce assaults' is used to cover physical assaults, verbal abuse and threats.

6.5.1 Trend in harm from workforce assaults

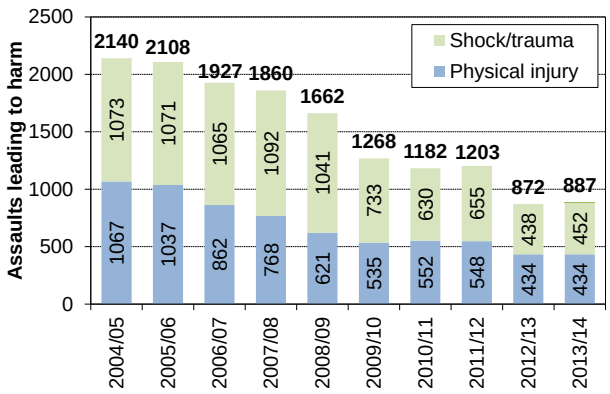
Since 2004/05, the average level of harm from workforce assault has been 2.6 FWI. There have been no workforce fatalities related to assault over the period shown in the chart.

Chart 119. Harm from workforce assaults



- The overall level of harm suffered by members of the workforce from assaults reduced slightly in 2013/14, compared with 2012/13, and now stands at the lowest level seen in the ten-year period.
- Chart 120 shows that over the past ten years, the recorded number of assaults leading to physical injury has shown a generally reducing trend.
- A similar trend has been seen in the recorded number of assaults leading to shock/trauma.
- The total number of recorded assaults leading to harm in 2013/14 was 2% higher than in 2012/13, but is 41% of the level for 2004/05.

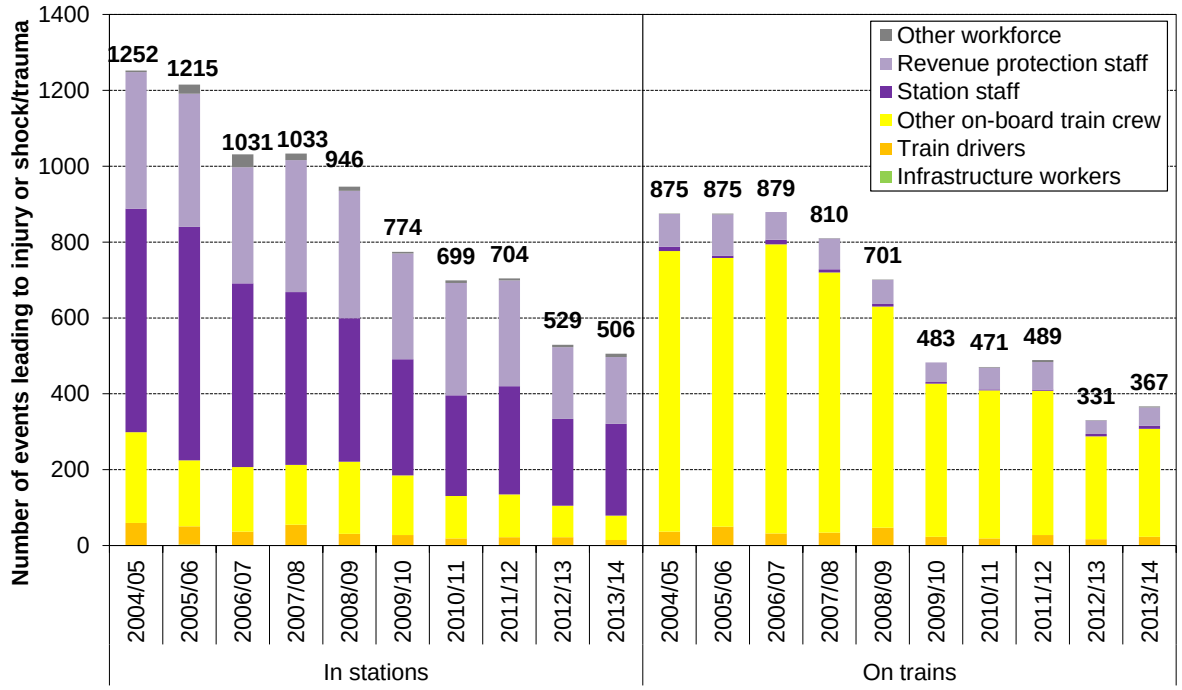
Chart 120. Assaults leading to harm



Trends in the location of workforce assaults that lead to harm

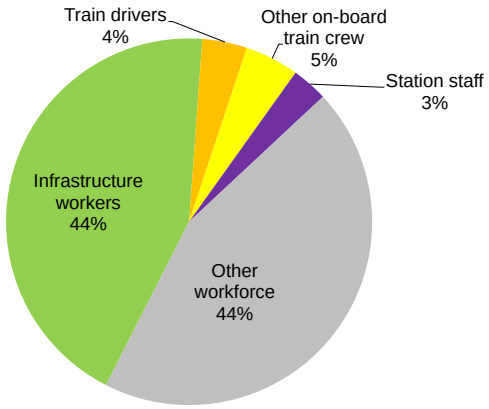
Most assaults leading to harm take place in stations. This may be because there are more station staff than customer-facing train crew, and more people congregate in stations than on board trains. It may also be related to revenue protection activity, and other passenger management issues (the industry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

Chart 121. Trends in workforce assaults in stations and on trains



- In 2013/14, the number of assaults leading to harm has continued a general downward trend in stations, but increased by 11% on trains compared to the previous year.
- As would be expected, the worker type profiles differ by location, with station staff and revenue protection staff generally predominating in stations, and train crew predominating on trains.
- For nearly all worker types, the number of assaults occurring in stations has reduced notably over the past ten years, by 50% or greater.
- 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.

Chart 122. Assaults in other locations by person type, since 2005/06 (126 in total)



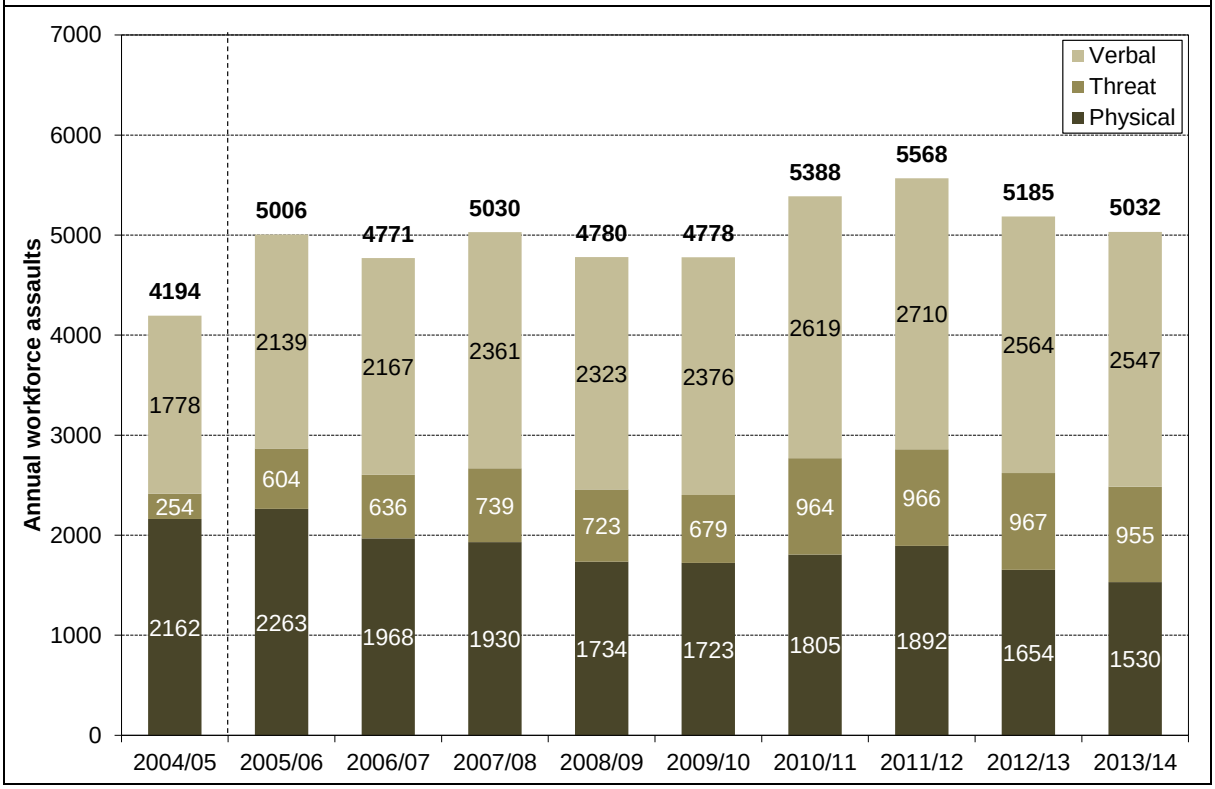
- Chart 121 does not include assaults in locations other than trains and stations. There have been 126 assaults away from trains or stations since 2005/06, when the reporting of threats and verbal abuse became more consistent (see Chart 123). Chart 122 indicates that almost 90% of these involved infrastructure workers and other workforce types.

Trend in all workforce assaults, threats and cases of abuse

Not all workforce assaults lead to harm, even where 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, in a relatively small number of cases, physical injury may arise from a non-physical assault, for example if the threat causes the member of staff to react in such a way that they subsequently injure themselves by falling over or colliding with something.

Over the past ten years, the industry has attempted to improve reporting of all types of attack on the workforce 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 also includes events that do not lead to bodily injury or shock/trauma.

Chart 123. Physical assaults, threats and verbal abuse against members of the workforce

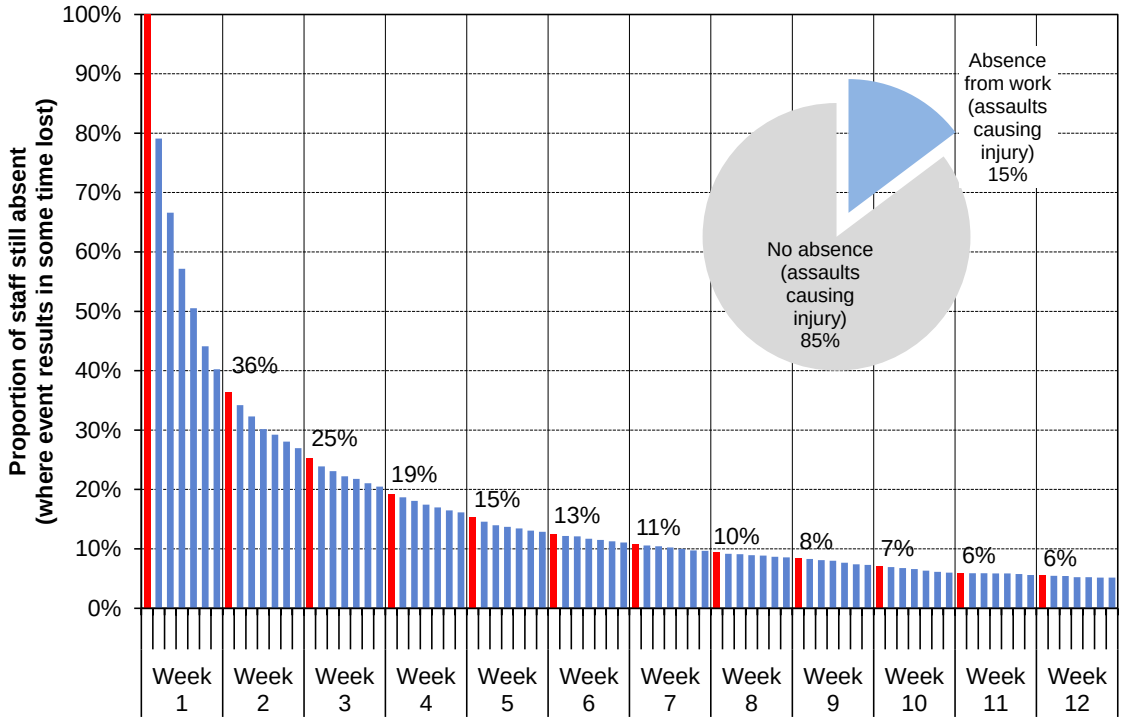


- The total number of recorded attacks showed a decrease in 2013/14 compared with 2012/13. This decrease was reflected in all categories – physical, verbal and threat.
- Up until 2005/06, there were increasing trends in all types of event, but particularly those classed as verbal or threat. This is believed to be due to industry drives to encourage staff to report all events. Since 2005/06, the reporting of all categories is considered to be more consistent.
- Because not all physical assaults lead to harm, the number of physical assaults shown in Chart 123 is higher than the number of assaults causing physical injuries, shown in Chart 120.

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 unable to return to work for months after the event.

Chart 124. Time lost as a result of workforce assaults 2005/06 to 2013/14

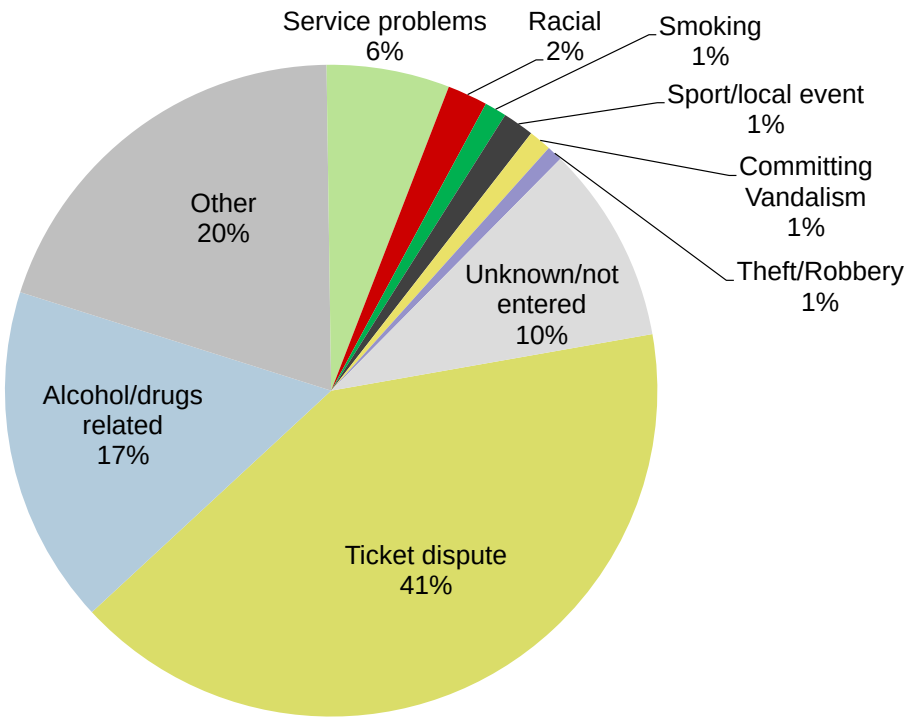


- Of the assaults that lead to injury (major, minor or shock/trauma) 15% result in a loss of time from work of at least one day. Based on 2013/14 data, this is around one event every three days.
- Around 36% of assault-related injuries, that result in time loss, result in the victim being absent from work for more than a week. Based on 2013/14 assault rates, this equates to around one such incident per week.
- In 11% of cases where time is lost after an assault, more than six weeks' absence is recorded. This equates to roughly one such incident per month, based on 2013/14 levels of assault.

Workforce assault by instigating event

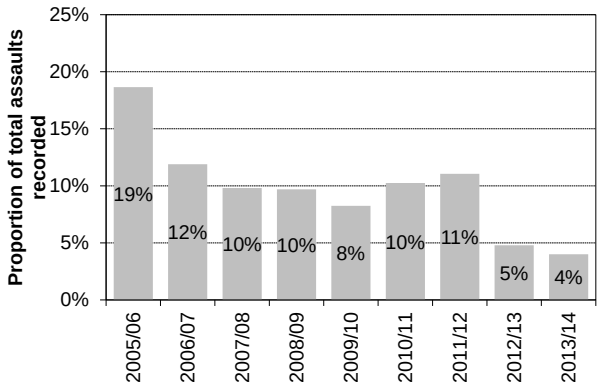
Since 2005/06, SMIS has recorded more detailed data on the types of event that cause or contribute to workforce assaults. The range of different causes highlights the challenge faced by the industry in managing the risk from assault. The following analysis is based on all physical assaults, verbal abuse and threats occurring since 2005/06, when workforce assault recording levels became more consistent. The total number of assaults recorded during this period was approximately 46,000, around 36% of which were physical in nature.

Chart 125. Primary contributory factors to attacks on rail staff since 2005/06



- Since 2005/06, the biggest recorded factor has been ticket dispute, which was identified as the primary contributory factor in 41% of all workforce assaults (45% when limited to those where a cause was specified).
- The next highest factor is alcohol/drugs, which was recorded as the primary cause in 17% 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. In 2013/14, only 4% of assaults had no cause recorded. Over the period as a whole, 10% of assaults have had no cause specified.

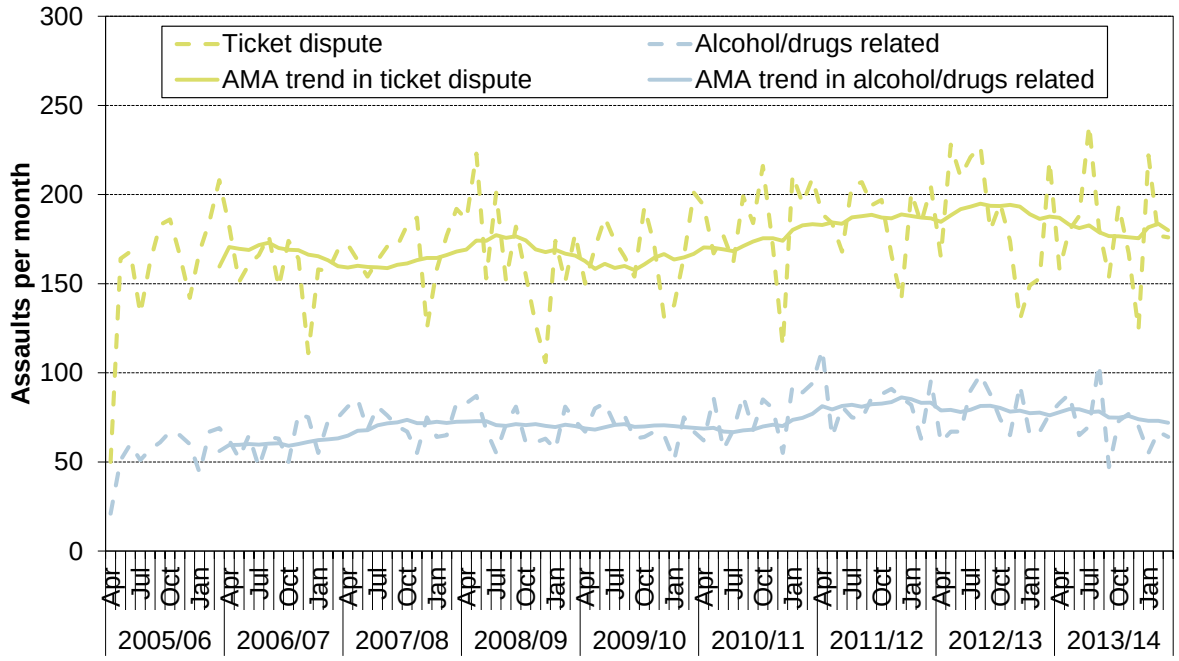
Chart 126. Trend in assaults with cause not specified



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 127. Trends in the top contributory factors to workforce assault



- The annual moving average of assaults involving ticket disputes has shown variation. After a recent rising trend, the annual moving average decreased since December 2012.
- The trend in the annual moving average of assaults involving alcohol or drugs had been very stable over the period 2007/08 to 2010/11. After a brief rise it has since been on a downward trend.

6.6 Workforce injuries in yards, depots and sidings

RSSB is undertaking a project to extend the scope of the SRM and safety performance reporting to incorporate incidents and injuries in YD&S sites.[52] The extension will enable industry to understand better the risk at YD&S sites. Stakeholder participation in the project is voluntary. With industry agreement, the reporting of safety-related events in YD&S into SMIS has been made a non-mandatory requirement in the Standard for safety information reporting (GE/RT 8047).

Information on injuries in YD&S is presented in Appendix 4.

[52] A YD&S site is defined as any location that is connected to, but away from, the mainline railway, where train maintenance, stabling, marshalling and/or servicing (including refuelling) takes place under the management/control of another infrastructure manager.

6.7 Learning from operational experience: workforce

The Learning from Operational Experience Annual Report 2013/14 covers workforce safety in Chapter 9: *Lessons learned 2013/14 – workforce*.

The chapter focuses on risk from road vehicle driving while on duty, and the risk from track work. In particular, the report discusses:

- Industry guidance and research such as T997 *Managing occupational road risk associated with road vehicle driver fatigue.*
- The effects of overspeeding, long worksites and distraction, factors influence the ability to establish safe systems of work, and the infrastructure worker fatality at Saxilby on 4 December 2012 (RAIB report published August 2013)

6.8 Workforce key safety facts

Workforce	2009/10	2010/11	2011/12	2012/13	2013/14
Fatalities	**3**	**1**	**1**	**2**	**3**
Infrastructure worker	3	1	1	2	3
Train driver	0	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	0	0	0	0	0
Major injuries	**123**	**122**	**128**	**114**	**126**
Infrastructure worker	74	75	67	68	79
Train driver	10	11	12	16	9
Other on-board train crew	18	12	18	14	8
Station staff	8	8	10	7	11
Revenue protection	4	4	5	4	5
Other workforce	9	12	16	5	14
Minor injuries	**5327**	**5379**	**5432**	**4757**	**4913**
Class 1	557	585	662	597	560
Class 2	4770	4794	4770	4160	4353
Incidents of shock	**1169**	**1156**	**1239**	**964**	**1001**
Class 1	291	302	323	325	351
Class 2	878	854	916	639	650
Total FWI	**25.19**	**23.28**	**24.41**	**22.81**	**25.16**
Infrastructure worker	12.05	10.36	10.06	11.04	13.48
Train driver	3.07	3.32	3.55	3.77	3.18
Other on-board train crew	5.42	4.79	5.28	4.22	3.37
Station staff	2.20	2.1	2.3	1.9	2.2
Revenue protection	1.07	1.03	1.14	0.88	0.96
Other workforce	1.38	1.65	2.12	1.04	1.94

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7 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.

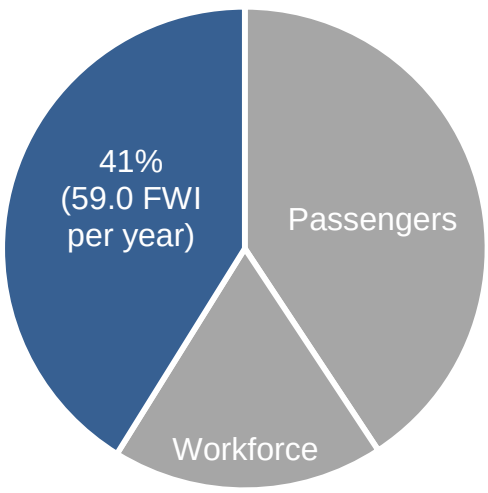
In the majority of cases, the risk to members of the public is the direct result of their own behaviour, either deliberate or accidental, rather than the operation of the railway. While most of the risk caused by public behaviour is borne by the public themselves, some types of behaviour, such as that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

2013/14 Headlines

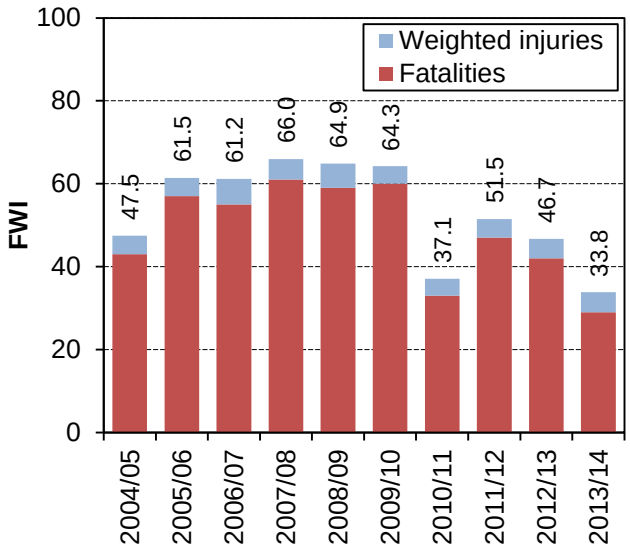
- The total number of fatalities, from all causes, occurring to members of the public was 308 in 2013/14, compared with a total of 288 for 2012/13.
- Excluding suicides and suspected suicides, there were 29 fatalities to members of the public during 2013/14. When non-fatal injuries are taken into account, the total level of public harm was 33.8 FWI, compared with a total of 46.7 FWI (42 fatalities) recorded last year.
- Of the 29 fatalities recorded in 2013/14, 21 occurred to trespassers and eight occurred at level crossings. In 2012/13, there were 32 trespass fatalities, nine level crossing fatalities, and one public fatality not involving trespass or level crossings.
- In addition to the accidental fatalities, there were 279 suicides and suspected suicides. This is higher than the 246 recorded 2012/13.
- Through the enhanced co-operation taking place under the National Suicide Prevention Working Group, BTP have been able to share more information on railway fatalities, going back to 2009/10. For this reason, caution must be taken when comparing the second half of the past ten years with the first five years. The charts in this chapter clearly highlight where this is the case.

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

Public risk in context (SRMv8)



Trends in public harm

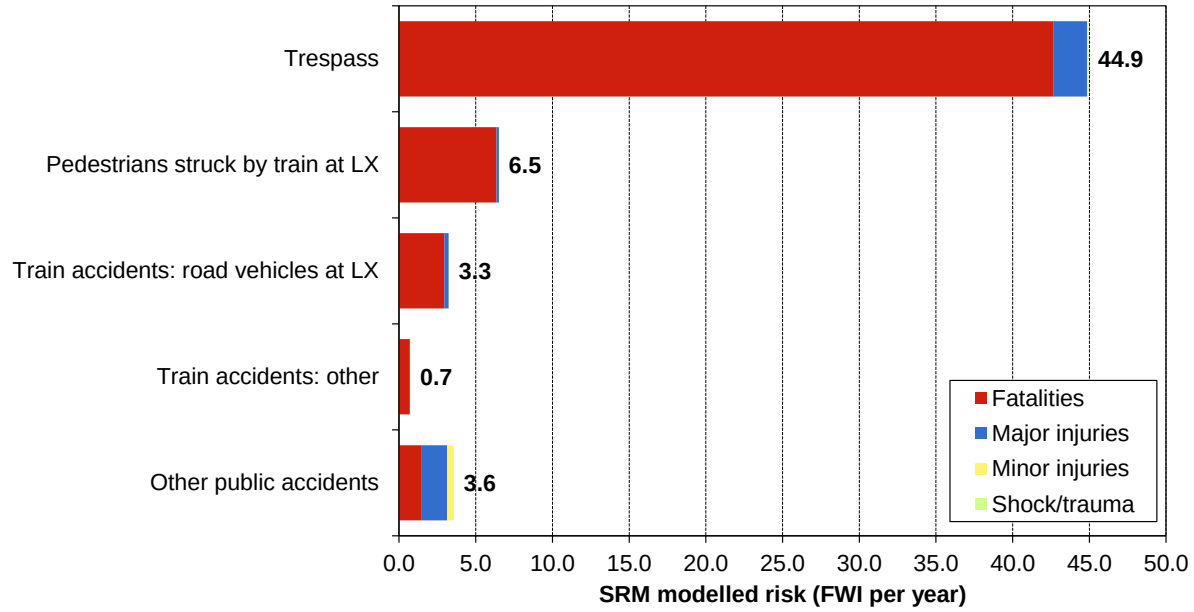


7.1 Public risk profile by accident type

The breakdown of public risk in Chart 128 is taken from SRMv8, and therefore represents the modelled estimate of the underlying risk to members of the public. Suicide and suspected suicide are not included in SRM analysis presented in this section, and are generally excluded from all charts within the chapter, unless explicitly stated.

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 8.

Chart 128. Risk to members of the public by accident type: 59.0 FWI per year



Source: SRMv8. Excludes suicide and suspected suicide.

- Trespass accounts for 76% of risk to members of the public.
- Accidents involving pedestrians struck by trains at level crossings account for a further 11%, with train collisions with road vehicles contributing 5.5%.
- The category *train accidents: other*, which comprises around 1.2% of the total risk to the public, mainly covers the risk from train collisions with road vehicles not at level crossings (ie vehicle incursions). However, it also includes the small 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 derailment.
- The remaining 6% of public risk that does not result from trespass, train accidents, or level crossing usage, mainly results from accidents to people who are in stations, but not for the purposes of travel. It includes the types of events seen in the passenger risk profile: slips, trips and falls, falls from the platform edge, and assault.

7.2 Public fatalities: trespass and suicide

When categorising public fatalities, it is important to try to distinguish between suicides and accidental deaths, because the means of addressing these issues will be different. For the rail industry, determining whether a fatality was accidental or suicide is straightforward where a coroner's inquest has been held, and a verdict reaching either of those two conclusions has been returned. Where the coroner has yet to return a verdict, or returns an open or narrative verdict, some judgement must be applied.

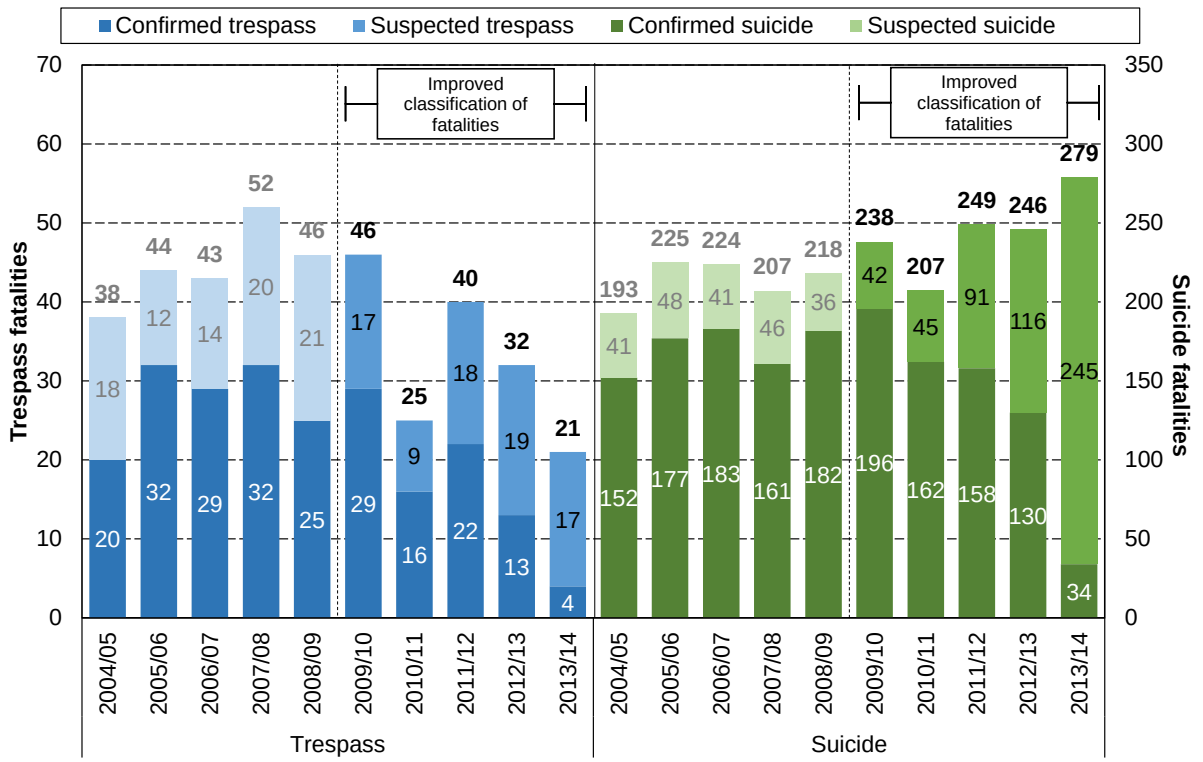
Most coroners' reports take around six months to complete, and some verdicts are not returned until several years after the event. A coroner will then only return a suicide verdict if there is evidence that shows *beyond reasonable doubt* that the deceased intended to take his or her own life. If the cause of death cannot be confirmed to this extent, an open or narrative verdict will be returned. In these cases, and those where the inquest is still awaited, the industry applies rules known as the Ovenstone criteria (see Appendix 6) 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/or BTP. 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 and reclassified on an on-going basis, in the light of new information. Work is currently taking place to review previous years open/narrative events in the light of increased information from BTP, as well as the availability of coroners reports.

Throughout 2013/14, a greater amount of information about fatalities related to trespass and suicide was made available by BTP to the industry, through the enhanced co-operation taking place under the National Suicide Prevention Working Group. The Suicide Prevention and Mental Health team within BTP was established and has worked with Network Rail and RSSB to look at classification of fatalities. As part of this partnership, BTP have been able to share more information on railway fatalities, going back to 2009/10. This has enabled the industry to review a number of cases where the coroners' verdict is not yet returned, or is recorded as open or narrative, and re-assess them against the Ovenstone criteria.

Chart 129 presents the trespass and suicide fatalities for the past ten years. The dark bars represent the number of events with a coroner's confirmed verdict (either suicide or accidental). The light bars represent the number of verdicts that were open or narrative, or have not yet been held. These have been divided based on application of the Ovenstone criteria into those suspected of being suicide and those suspected of being accidental (and thus trespass). An outcome of this increased data sharing is that there is a discontinuity in the public fatalities charts: classifications up to and including 2008/09 have been based on a reduced amount of information. This means that trespass figures for years prior to 2009/10 may be overestimates of the true level, while suicide figures may be underestimates. Caution must therefore be taken in comparing the second half of the past decade with the first five years. The discontinuity is reflected in the chart by the use of paler shades and grey numerals. Later years have greater proportions of unconfirmed categorisations, while coroners' inquests or verdicts are still awaited.

Chart 129. Trends in trespass and suicide

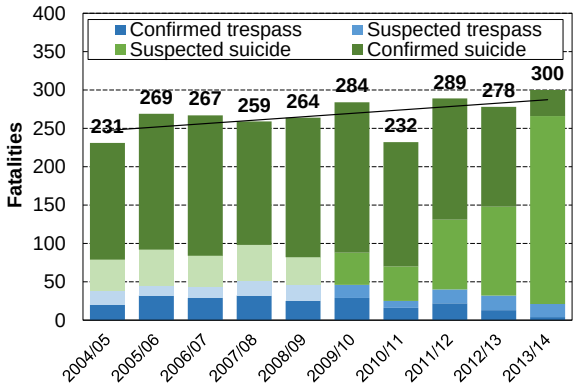


Note: For 2009/10 onwards, the classification of open, narrative and unreturned coroners' verdicts has based on an improved amount of information.

Because of the proportion of cases (ie those that are open, narrative or unreturned) where judgement needs to be applied, it is useful to look at the trends in trespass and suicide fatalities as a whole.

- Chart 130 shows that over the past decade there has been an increasing trend in public fatalities due to trespass or suicide, with 2013/14 being the highest recorded for the period.
- The overall trend is not affected by the improved classification in the case of open, narrative and unreturned verdicts. Therefore, although the bars relating to suspected suicide and suspected trespass are shown in paler colours before 2009/10, the totals for the years are not affected and are shown in black numerals, not grey (as in Chart 129).

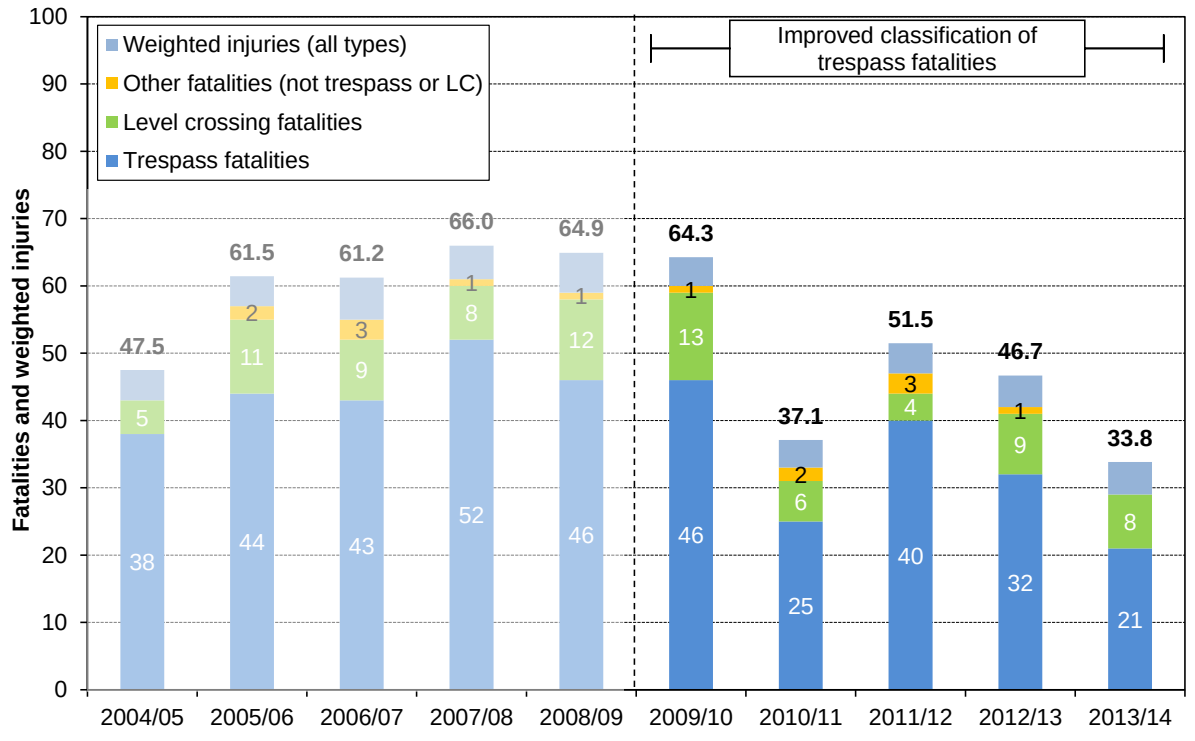
Chart 130. Trends in total public fatalities from trespass and suicide



7.3 Trends in harm to members of the public from causes excluding suicide

From 2009/10 the classification of trespass has been based on an improved data set; the overall levels of harm to members of the public before and after this date are not directly comparable. The average level of harm to members of the public over the period 2009/10 to 2013/14 was 46.7 FWI per year.

Chart 131. Trends in public FWI by accident type



- At 33.8 FWI, the harm to members of the public recorded in 2013/14 was below the five-year average of 46.7 FWI, and a decrease from the 46.7 FWI in 2012/13. Most of the fall in the level of harm was due to the lower number of trespass fatalities, which, at 21, was the lowest total recorded in the past five years.
- The number of level crossing fatalities for 2013/14 was eight; six of these were pedestrian users of level crossings (one of whom was a cyclist) and two were car occupants.
- All public fatalities in 2013/14 were due to either trespass or level crossing accidents.
- 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.

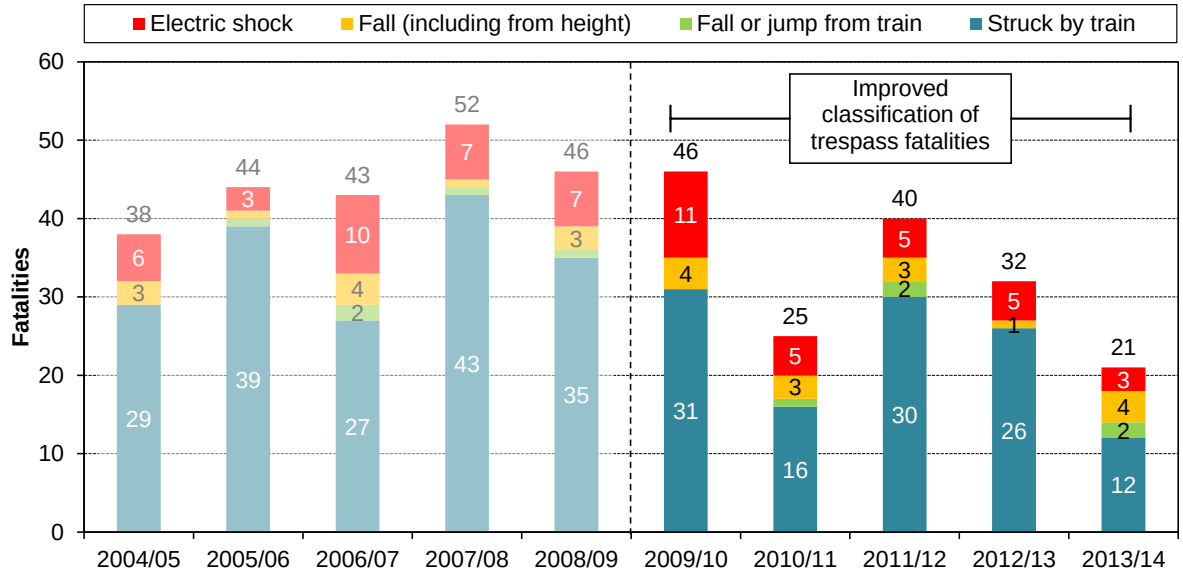
7.4 Trespass

Incidents involving access of prohibited areas of the railway are categorised as trespass if that access was the result of deliberate or risk-taking behaviour. All such events are analysed under risk to members of the public. Such behaviour includes deliberately alighting a train in running (other than as part of a controlled evacuation procedure), and getting down from the platform to the tracks, for example to retrieve an item that has been dropped. An exception to this rule of classing the deliberate access of a prohibited area as trespass is at level crossings. This is because level crossings are areas of the railway that are legitimately accessible by people for most of the time.

Trespasser fatalities by cause

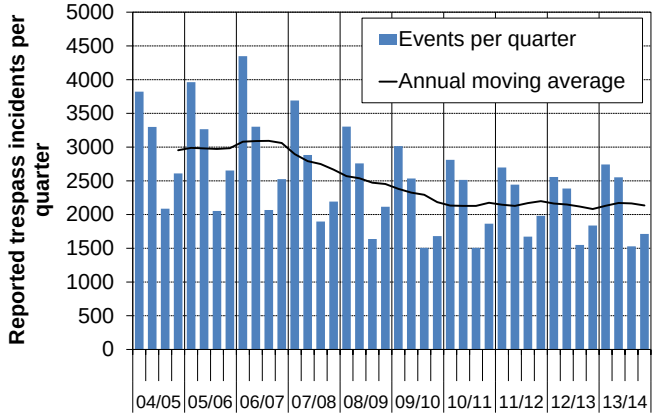
The railway represents a hazardous environment for trespassers; the majority of trespasser harm is from fatalities.

Chart 132. Trespass fatalities by cause



- Being struck by trains has accounted for 70% of all trespasser fatalities over the last five years. Electrocution has accounted for a further 18%.
- Chart 133 indicates that after a period of decreasing levels, the trend in reported trespass has plateaued. The chart also shows a defined seasonal quarterly pattern.

Chart 133. Trends in reported trespass

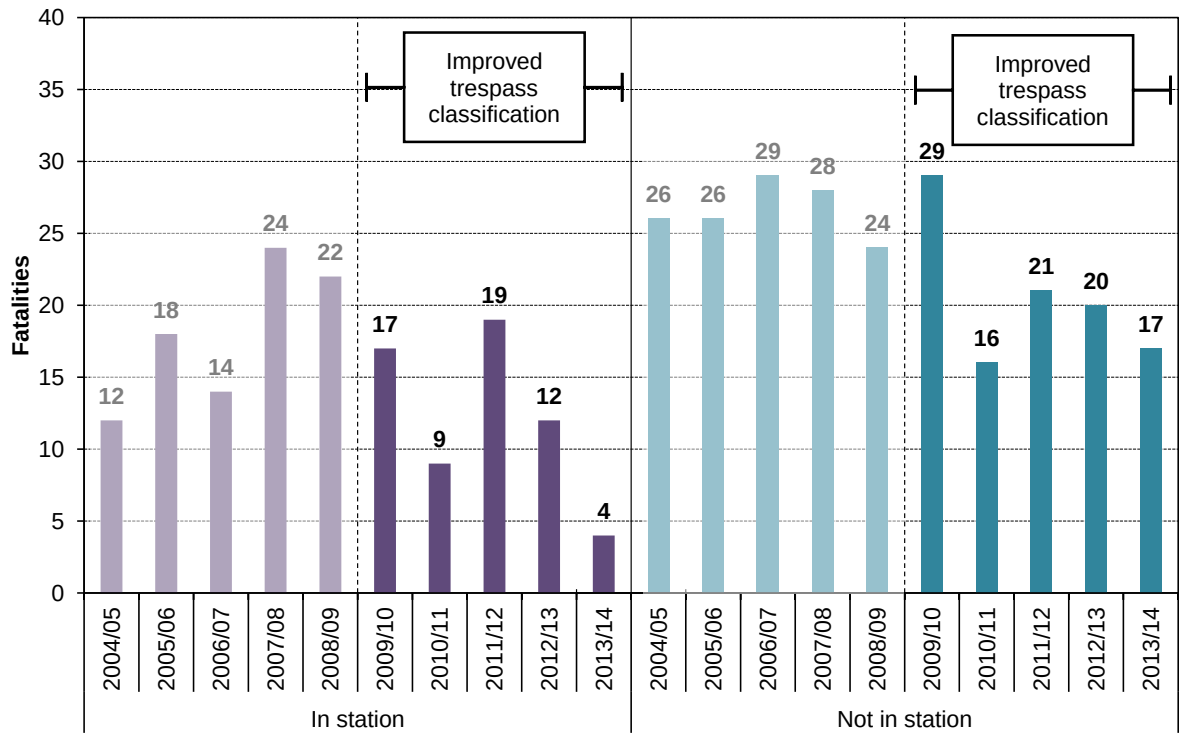


Trespasser fatalities by location

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. In 2013/14, there were two fatalities recorded where passengers deliberately exited a train while it was in running.

In previous years there have been a number of cases involving passengers on stranded and delayed trains, who either forced the doors open or used the emergency release handles to open the doors and alight onto the track. To date, no fatalities have occurred as a result of these events.

Chart 134. Trespass fatalities by location



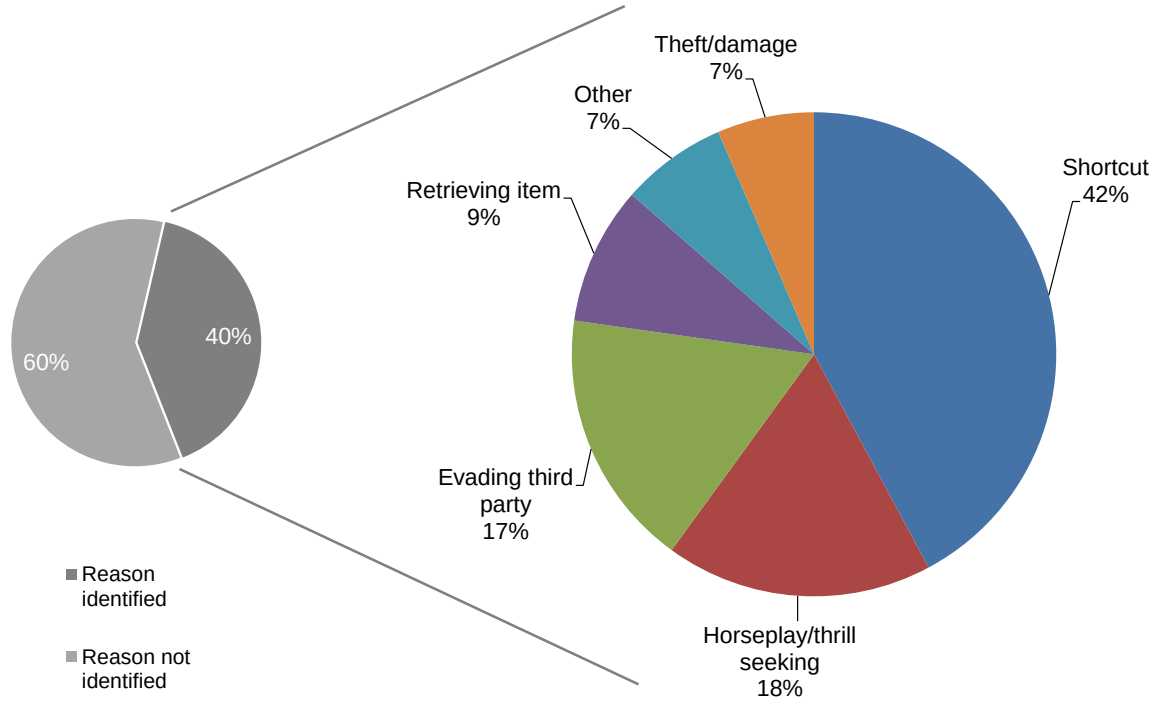
- At four, the number of fatalities in stations is the lowest number recorded in the past five years. The majority of trespass fatalities occur away from stations. Nearly all of these occur to people trespassing on the running line, but the category also includes the small number of people who have died as a result of train-surfing, jumping from trains in running, or falling from height.

7.4.1 Analysis of the motivation behind trespass

People commit trespass for a variety of reasons. For some, it may be convenience – taking a shortcut 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, such as playing 'chicken', there may be a thrill-seeking element to the behaviour.

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

Chart 135. Trespass injuries by motivation, 2004/05 to 2013/14 (804 events in total)



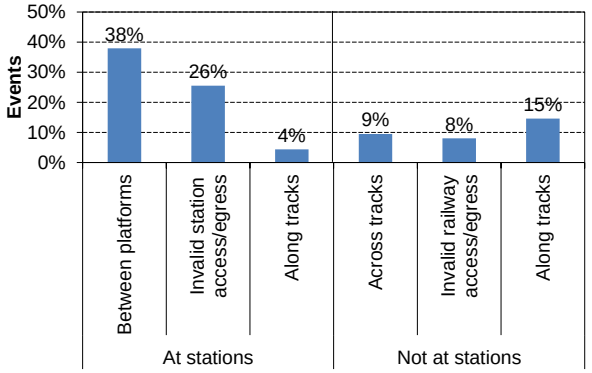
- In more than half of incidents, the reason for the trespass is not known or not identified.
- In those events where the motivation for the trespass is identifiable, the most common reason is for the purpose of taking a shortcut. Other reasons where the trespass is incidental to the main motivation of the person include retrieving an item, evading a third party, or committing criminal theft/damage. For those engaged in horseplay or thrill-seeking behaviour, the trespass itself may be part of the motivation.
- During the past ten years, there have been 479 trespass injuries for which no reason for the trespassing has been identified or recorded; around 75% involved people on the railway line. The majority of the remainder involved people jumping/falling from bridges.

Table 18. Activity where reason is not known

Person on line	74.5%
Jump/fall from bridge	19.4%
Invalid railway access/egress	2.9%
Climbing on railway property	2.7%
Train surfing/jumping from train	0.4%

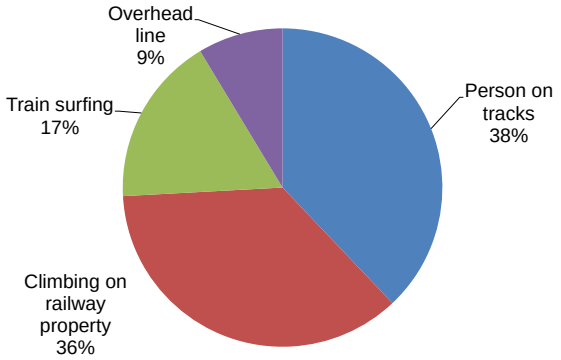
- The majority of people engaged in taking shortcuts do so in stations. Most of these are shortcuts between platforms.
- A sizeable minority are characterised by invalid station access or egress; it is possible that some of these are for the purpose of fare evasion, although that was not recorded.

Chart 136. Shortcuts (137 events)



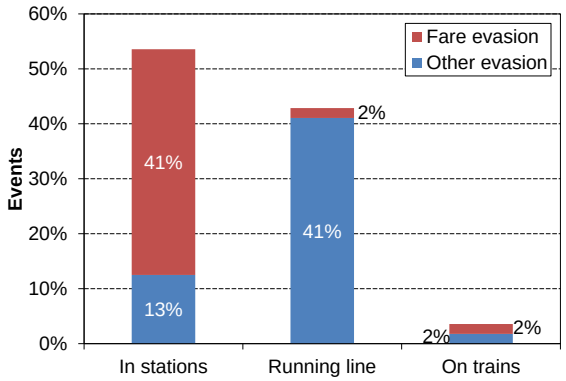
- The events where people were engaged in some sort of horseplay or thrill-seeking behaviour are split between people accessing the track, surfing on trains, climbing on buildings or other structures, or deliberately attempting to make contact with the overhead electricity supply.
- For trespass injuries as a whole, the proportion of children involved is 5%. However, in the case of horseplay/thrill-seeking, the proportion is much higher, at 28%.

Chart 137. Horseplay/thrill-seeking (58 events)



- Of the events recorded as involving evasion of a third party, more than half occurred in stations, and most of these were for the purposes of fare evasion.
- For those cases not involving fare evasion, about half involve people attempting to escape from police, and the other half from other members of the public.

Chart 138. Evading third party (56 events)



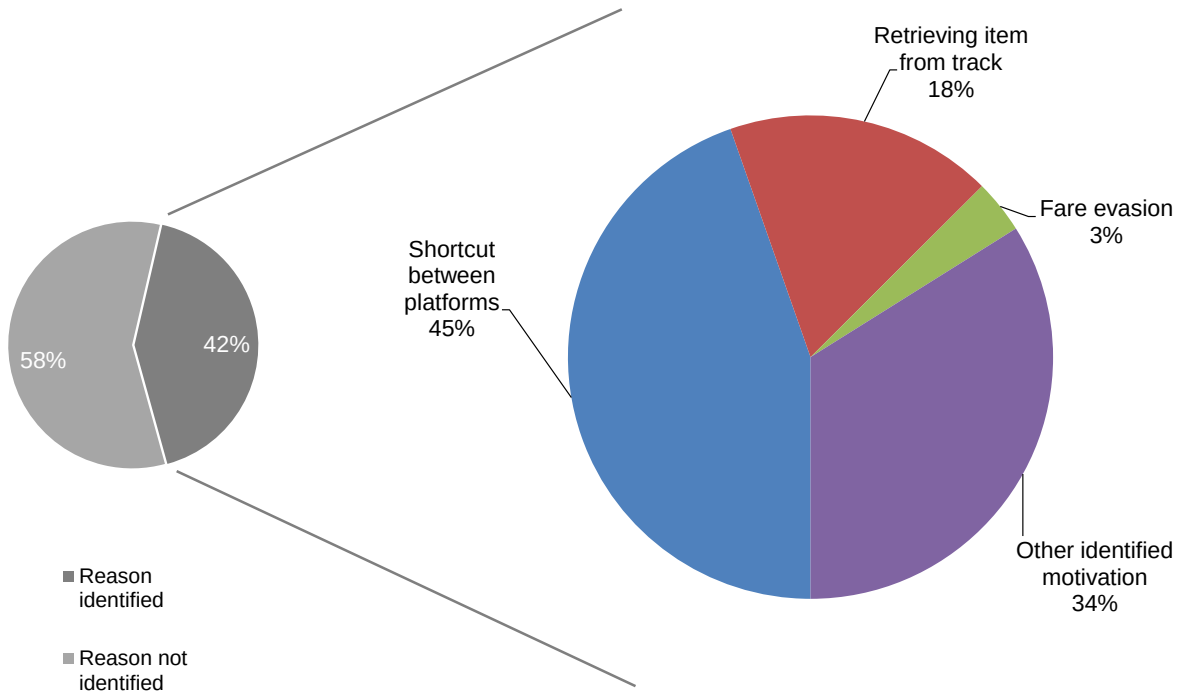
- Retrieving items (30 events): Around three quarters of cases involved people retrieving personal items, such as phones, cigarette lighters or items of clothing. The remaining quarter involved people running after dogs or other pets.
- Theft/damage (21 events): Around half concerned incidents of cable theft, with the remainder comprising graffiti, and other theft/damage.
- Other (23 events): 35% of these events involved people trying to board or alight trains in an invalid manner, for example by pulling the emergency cord when they have missed their stop, or attempting to train surf when they have just missed their train.

Trespass fatalities at stations

Each year, a number of fatalities and injuries occur at stations involving people who, for a variety of reasons have decided to deliberately access the track. In a number of cases, these people are passengers; in the ASPR's analysis and accident statistics, these events are covered under public risk. There were two fatalities of this type recorded in 2013/14. In one case, a young man accessed the track and was electrocuted; he was visiting the UK from abroad for the first time and was apparently unaware of the electrification, as a different system is in operation in his home country. In the second case, a man jumped down from the platform to retrieve an item, and was struck by a train.

Whether passengers or members of the public, the management of people in stations is of continuing importance to the industry. In particular, the prevention of behaviour likely to result in harm to the individual is an issue for the railway. The following analysis is based on all accidental fatalities due to trespass originating at stations. It does not distinguish between passengers or public, since the intention to travel does not change the railway's approach to the subject, or its legal duty under health and safety law.

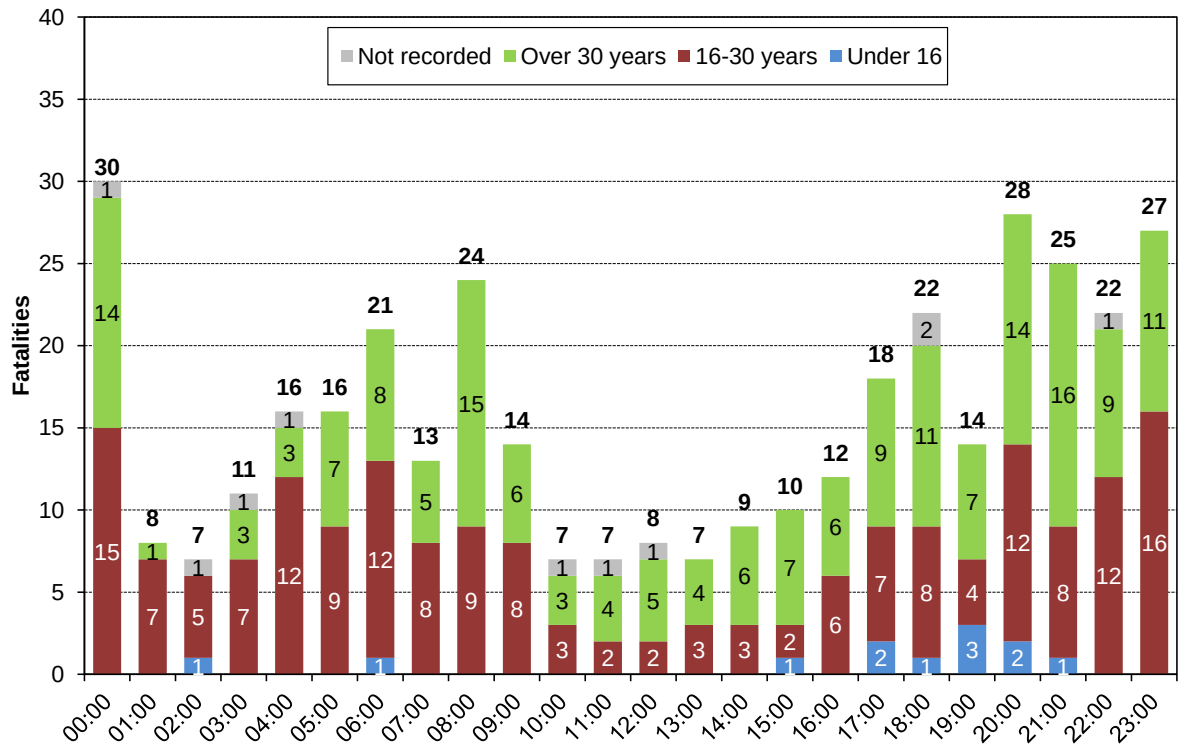
Chart 139. Trespass fatalities at stations, 2004/05 to 2013/14 (133 events in total)



- Of the trespass fatalities occurring at stations over the past ten years, 58% do not have sufficient information recorded to determine the motivation.
- Of the remaining station trespass fatalities where the motivation is recorded, 45% were shortcuts between platforms, 18% were people retrieving items from the track, and 3% were people evading fares. It is likely that many of the people in these categories were passengers. Over the period as a whole, there were 44 fatalities recorded in these categories combined.
- The *other identified motivation* category covers horseplay/thrill-seeking, theft/damage and evading police or members of the public.

7.4.2 Trespass fatalities by time of day, week and month

Chart 140. Trespass fatalities by time of day and age, 2004/05 to 2013/14



- The majority of the fatalities involving the *Under 16* age group have occurred in the late afternoon to early evening. During term times, this would form the after-school hours. The *16-30 years* 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 the *Over 30 years* age group have peaks around the morning rush hour period, and around the early evening. A notable number also occur around midnight, similar to younger adults.
- Chart 141 shows that over the past ten years, the greatest number of trespasser fatalities has occurred on a Saturday, particularly within the 16-30 years age group.
- Chart 142 shows that December is the month with the highest number of trespass fatalities for all ages groups except those under 16. The summer months of July, August and September are when more of the under 16 fatalities have occurred; the occurrence of school holidays is likely to be a factor.

Chart 141. Trespass fatalities by day, 2004/05 to 2013/14

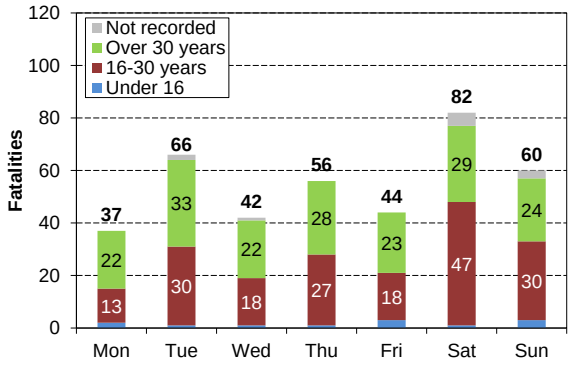
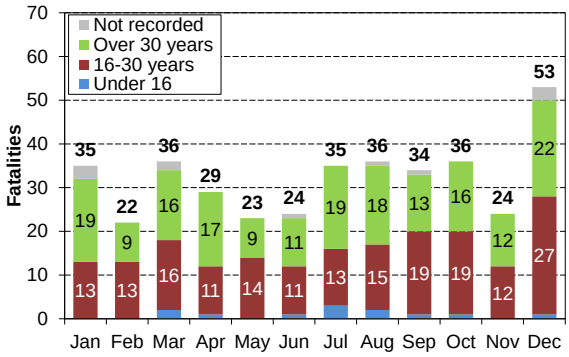


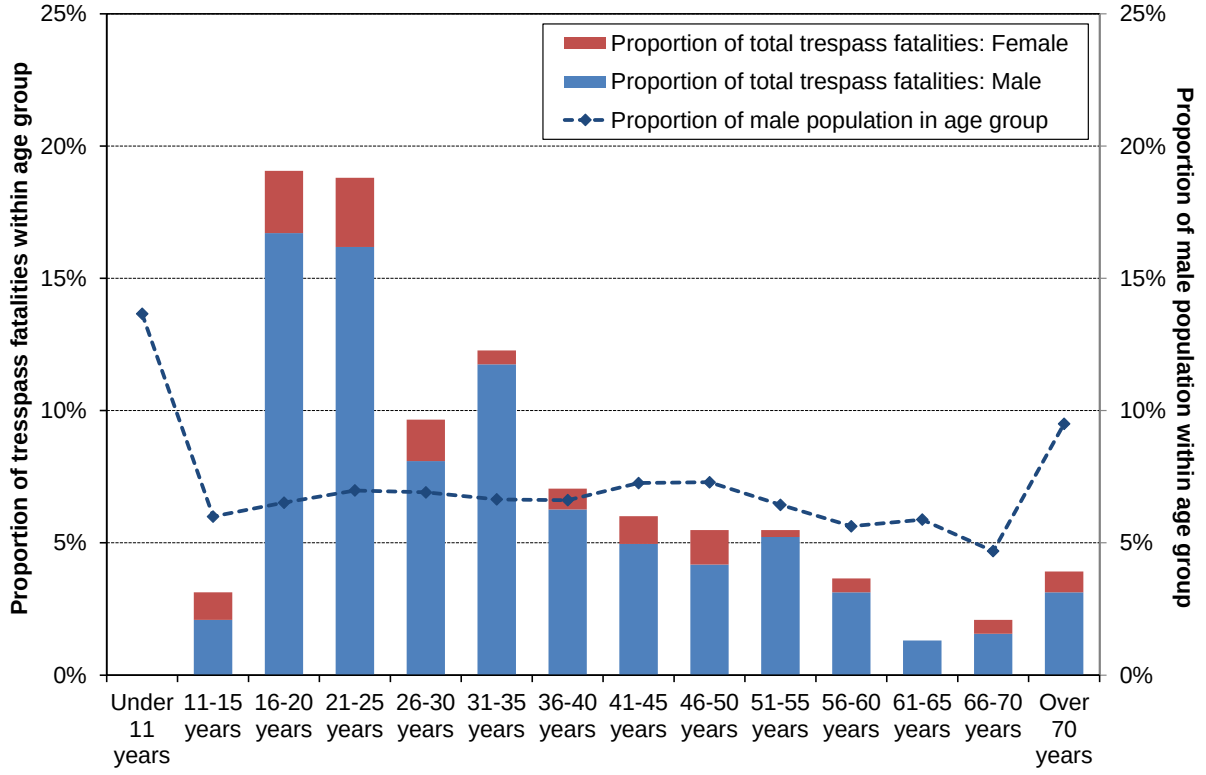
Chart 142. Trespass fatalities by month, 2004/05 to 2013/14



7.4.3 Trespass fatalities by age and gender

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

Chart 143. Breakdown of trespass fatalities by age and gender 2004/05 to 2013/14



Source: SMIS for trespass fatality data; Office for National Statistics for population data (2012 census data)

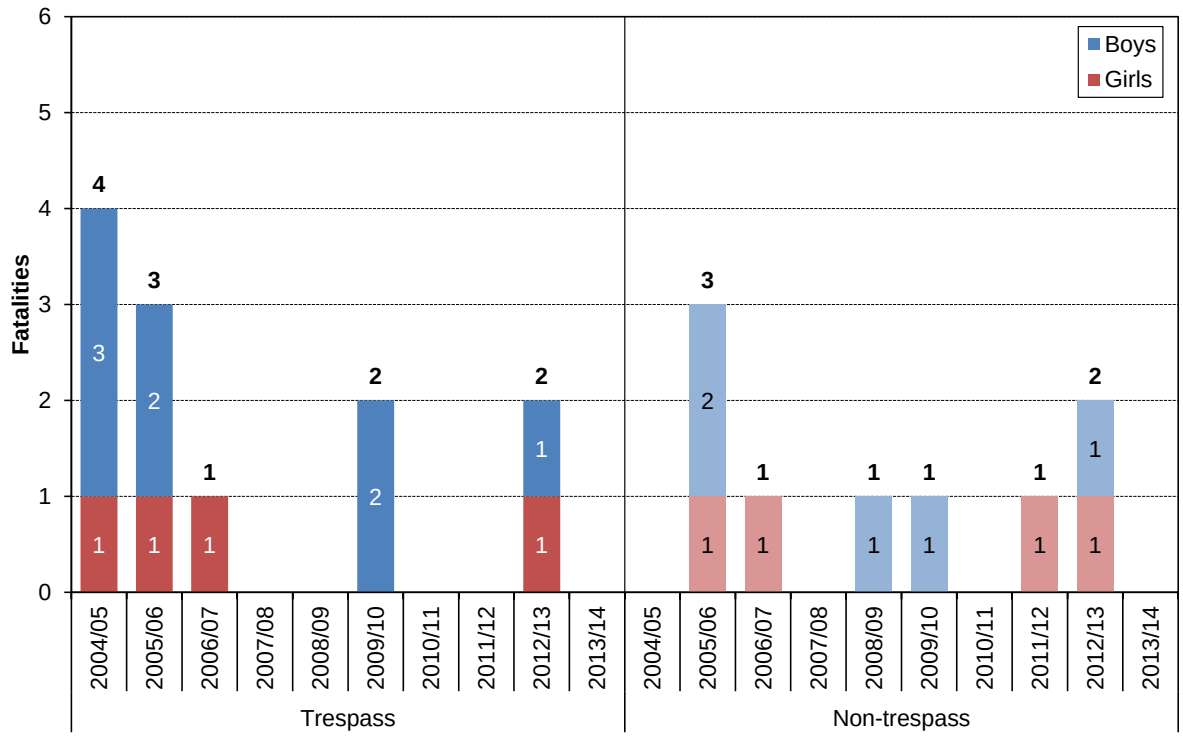
- A disproportionately high number of trespass fatalities are males aged between 16 and 35.
- The peak ages for trespass fatalities are the later teens and earlier twenties.
- The percentage of male trespass fatalities is disproportionately high compared to their level of the overall population; although males make up just less than 50% of the total population, they have accounted for 87% of trespass fatalities over the past ten years.
- The chart is based on 399 trespass fatalities occurring between 2004/05 and 2013/14, where the age and sex were known. There were a further 12 trespass fatalities where insufficient information was recorded. In eight cases, the gender but not the age was recorded, in one case the age but not the gender was recorded, and in three cases neither the age nor the gender was specified.

Public fatalities to children

Fatalities to children are relatively rare. Since 2004/05, 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.

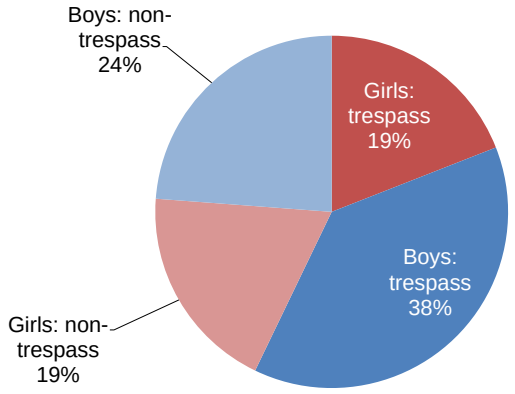
In conjunction with other railway stakeholders, Network Rail puts much effort into educating young people of the dangers on the railway, including the provision of the *No Messin'!* and *Trackoff* websites[53], school visits, and recreational activities.

Chart 144. Public fatalities occurring to children



- There were no fatalities during 2013/14 involving children.
- In the last ten years, the ratio of boy to girl trespass fatalities has been around 2:1. The ratio of male to female trespass fatalities for those 16 and over is closer to 7:1.

Chart 145. Child fatalities since 2004/05



[53] http://www.no-messin.com/ and http://www.trackoff.org/

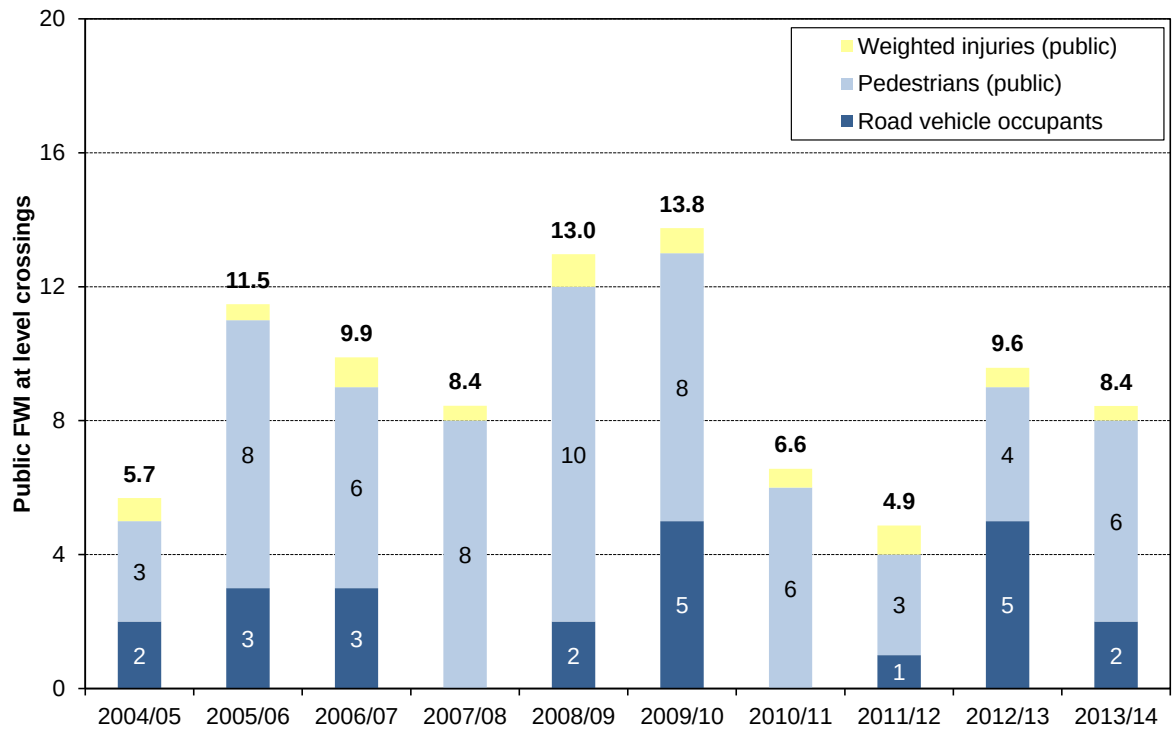
7.5 Level crossing users

Between 2004/05 and 2013/14, the average level of harm to members of the public at level crossings was 9.2 FWI per year, and the average number of fatalities was 8.5.

Chart 146 does not include level crossing fatalities or injuries involving passengers or workforce. There were no passenger or workforce fatalities at level crossings in 2013/14. Over the period shown in the chart, there has been one train accident at a level crossing with train occupant fatalities. In November 2004, at Ufton, a train collision with a road vehicle resulted in the deaths of five passengers and the train driver. There have also been four fatalities to passenger users of station crossings. These additional fatalities to passengers and workforce are included in Chapter 9: *Road-rail interface*, which contains wider analysis of level crossing safety.

Suicides by level crossing users are not shown in the chart. Since 2004/05, there have been around 250 suicides at level crossings, six of which were road vehicle drivers (including the incident at Ufton, described above). For analysis of suicide by location, see Section 7.8.

Chart 146. Trend in public injuries at level crossings

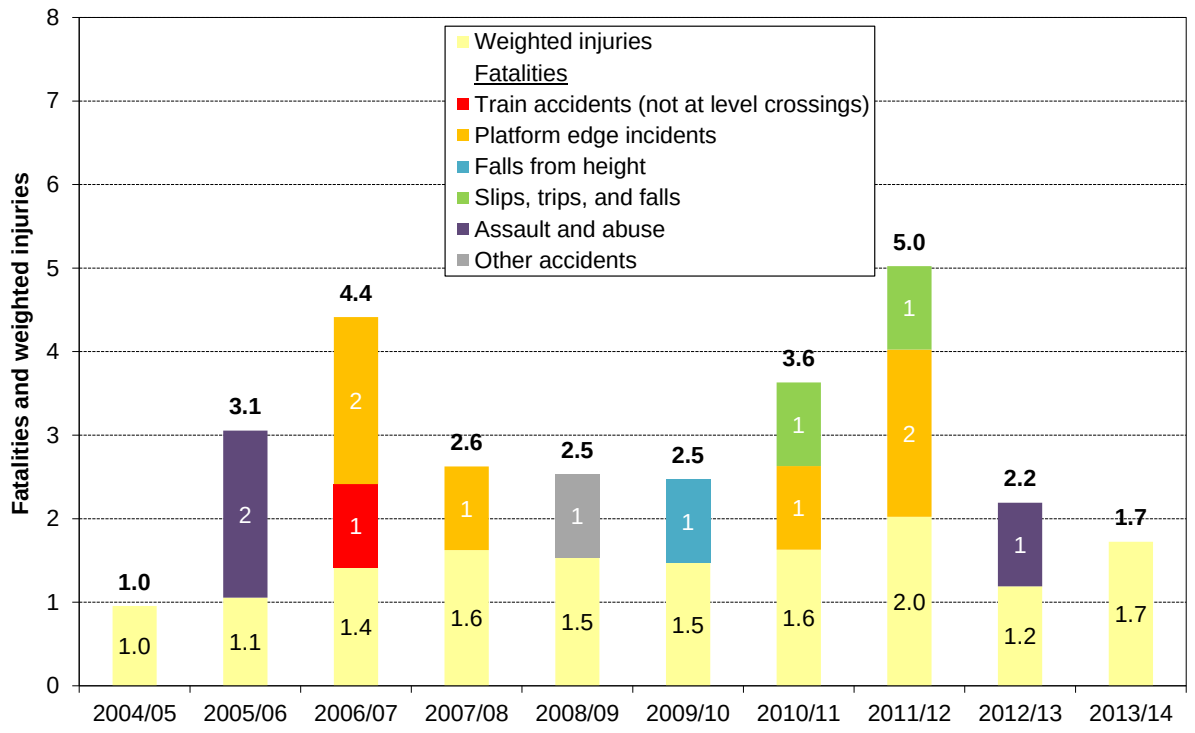


- At eight, the number of public fatalities at level crossings recorded in 2013/14 is close to the ten-year average of 8.5, and one fewer than 2012/13.
- Six of the fatalities were pedestrians. The other two fatalities were occupants of the same road vehicle, which was involved in a collision with a train.

7.6 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 147. Public harm not involving trespass or level crossings

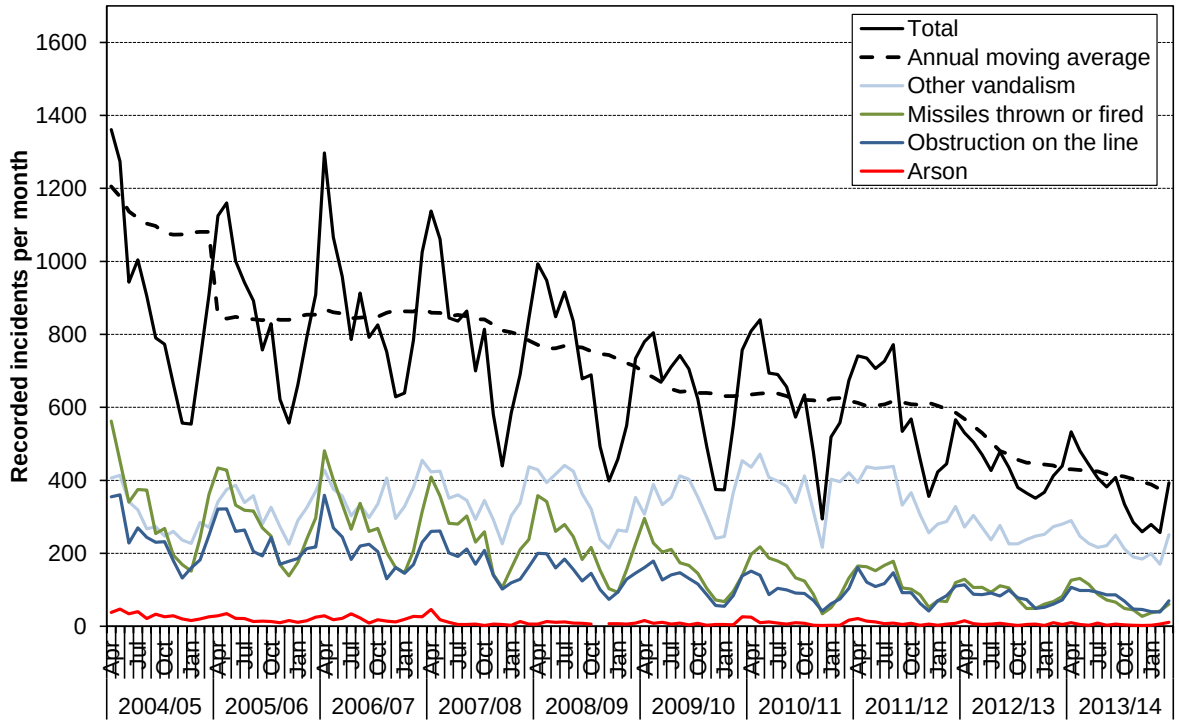


- In 2013/14, all public fatalities involved either trespass or level crossings. The last year with such an occurrence was 2004/05.

7.7 Vandalism

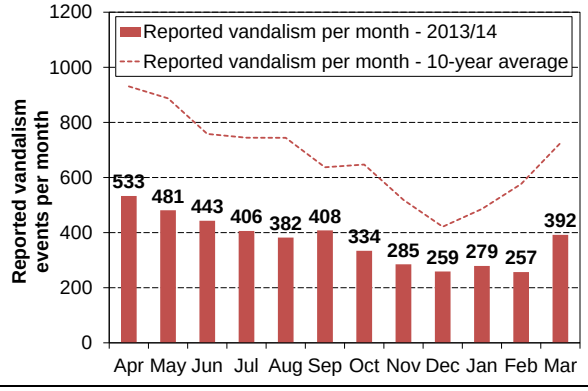
Vandalism on the railway encompasses any kind of deliberate damage or defacement to the property of the railway. 'Superficial' vandalism, like graffiti, can cause fear among passengers and raise doubts about the safety of public transportation. 'Structural' vandalism has the real potential to cause an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

Chart 148. Trends in reported vandalism



- Over the past ten years, the trend in reported vandalism has fallen by 63%. All types of vandalism shown in the chart have seen reductions over this period, although it is the incidence of missile-throwing and line obstructions that have seen the greatest absolute decreases, and have driven the overall reduction over the decade as whole.
- Looking more recently, the reduction in risk that has occurred over the past two years has been due to a fall in the number of incidents in the *Other vandalism* category. The main contributor to this has been a fall in the number of equipment thefts, including cable theft (see next section).
- A clear seasonal pattern is generally evident: reported vandalism usually peaks around April at over twice the number of incidents seen in December. Chart 149 shows how the current reporting year compares with the average variation seen over the past decade.

Chart 149. Seasonal trend in vandalism



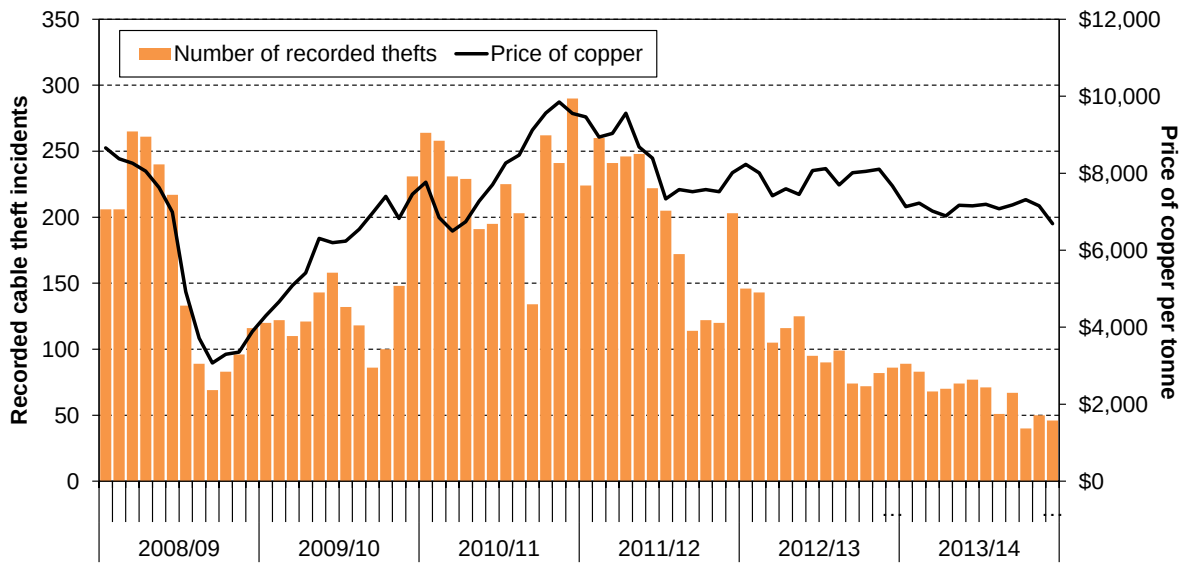
7.7.1 Cable theft

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 May 2013, a man suffered 30% burns and fractured vertebrae after receiving an electric shock from overhead line equipment, while he was trespassing in the act of cable theft.

In 2012 and 2013, legislation was introduced as a result of cross-industry lobbying highlighting the need for changes to the law regarding scrap metal dealers. The *Legal Aid, Sentencing and Punishment of Offenders Act 2012* received Royal Assent on 1 May 2012 prohibiting scrap metal dealers from paying for scrap metal in cash. The *Scrap Metal Dealers Act 2013* received Royal Assent on 28 February 2013; this comprised an update of the 1964 legislation.

Network Rail's strategy for dealing with cable theft has continued over the past three years. This includes 'target hardening' of hot spot locations to make thefts more difficult to commit and easier to identify, and funding for additional BTP officers. Network Rail develops relationships with cross-industry stakeholders including the British Transport Police and the Highways Agency as part of the Fusion Intelligence Unit and through the National Cable Theft Steering Group.

Chart 150. Incidents of cable theft and trends in copper price



Sources: BTP for data on incidence of cable theft and copper prices

- Up to around the middle of 2011/12, the incidence of cable theft showed a fairly close correlation with the price of copper. Since then, although copper prices have stabilised, there has been a decreasing trend in the recorded incidence of thefts, which provides evidence that the national and industry-specific initiatives are having an effect. At £3.5m, the total cost to the industry is at its lowest level over the period shown. The total number of delay minutes for 2013/14 was the lowest recorded for the period shown.

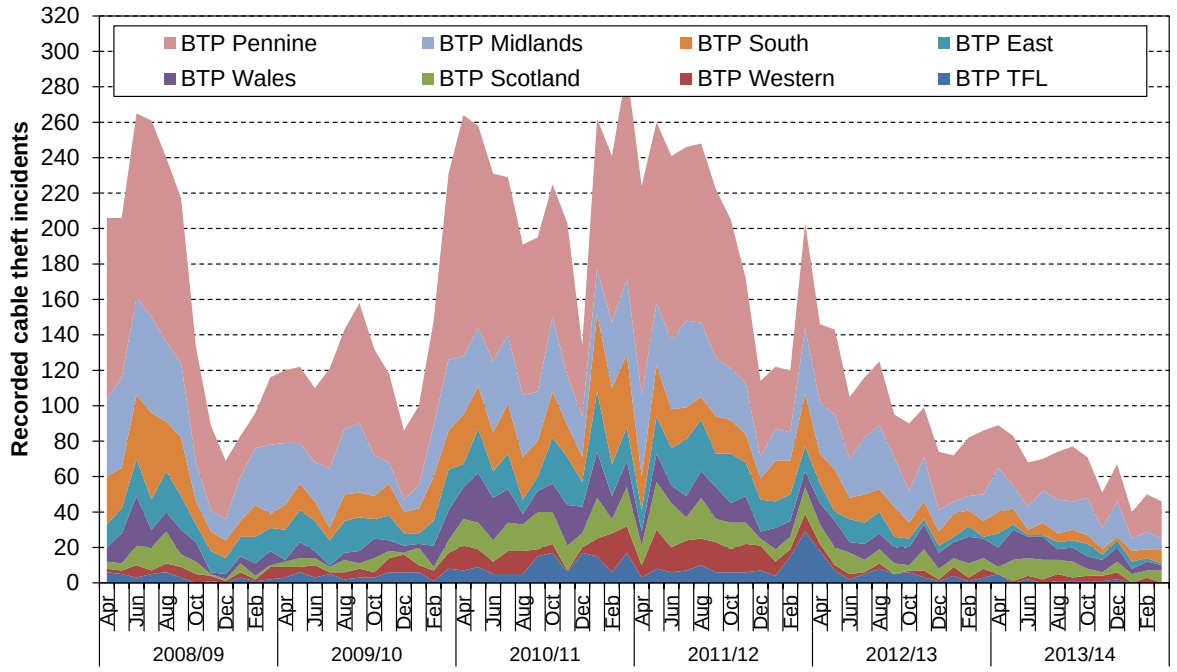
Table 19. Total cable theft costs and delay minutes (source: Network Rail)

	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Cost	£8.0m	£10.4m	£10.9m	£13.5m	£16.2m	£15.4m	£6.8m	£3.5m
Delay	244,653	250,704	293,156	326,207	370,771	350,346	160,269	71,359

7.7.2 Cable theft by BTP area

As of March 2014, BTP is divided into eight territorial areas, seven 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 151. Incidents of cable theft by BTP mainline areas

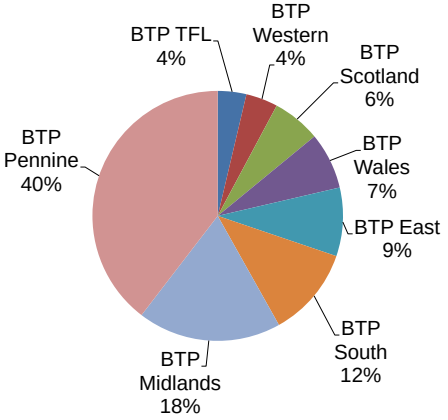


Source: BTP

- All BTP areas have recorded a reduction in incidents in the last financial year, against a background of stable copper prices.
- BTP Pennine area and BTP Midlands are the areas recording the highest number of thefts, but 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.

Chart 152. BTP mainline rail areas

Chart 153. Cable theft by area (2008/09 – 2013/14)

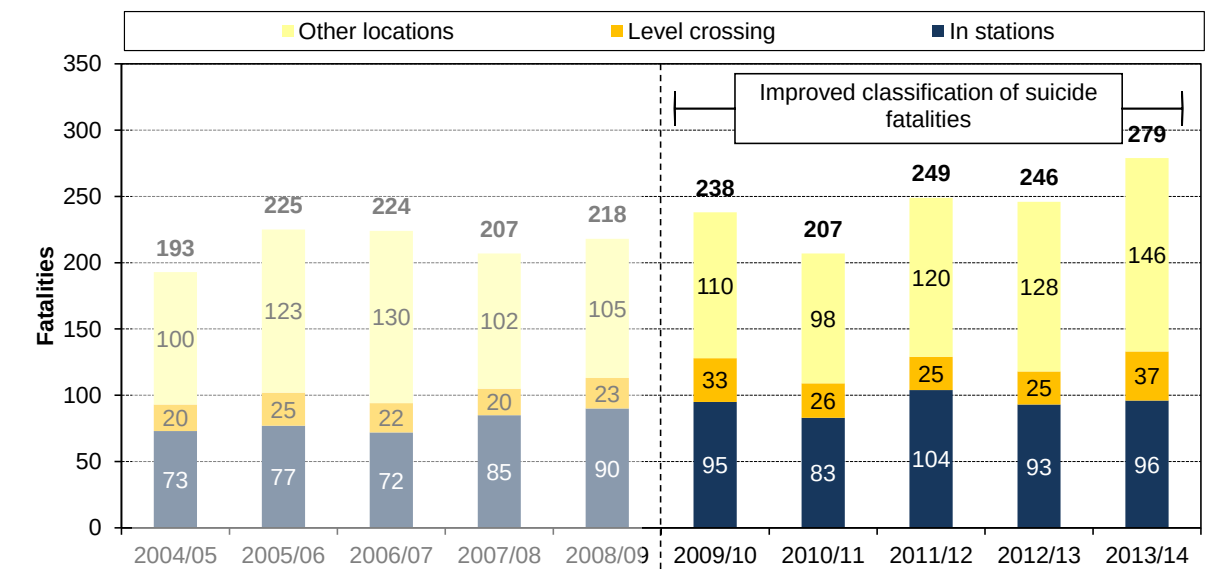


Source: BTP

7.8 Suicide

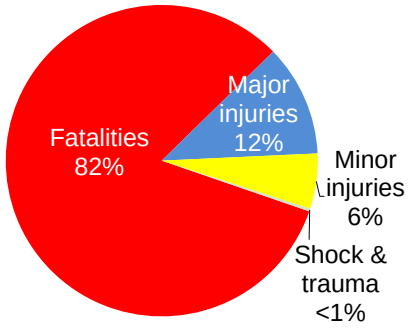
Due to the improvement in the quality of suicide classification (see section 7.2 for details) for data from 2009/10 onwards, comparisons are made for the past five years. The criteria that the railway uses to differentiate between suicides and accidental fatalities are explained in Appendix 6. Over the past five years, there has been an average of 244 suicides per year on the railway. Any passengers or members of the workforce who take their own lives on the railway are classed as members of the public for the purposes of this report, and are included in the analysis in this section.

Chart 154. Suicides and suspected suicides by location



- The number of suicides occurring on the railway in 2013/14 was 13% higher than the previous year and the highest level seen in the analysis period.
- Compared with the previous year, the numbers of suicides at level crossings and away from stations have both increased, while the number in stations has remained relatively constant. The category *other locations* mostly comprises suicides on the running line, but also includes a small proportion occurring at other railway locations, eg bridges. It is worth noting that in some instances, although the event takes place on the running line, the person may have accessed the track via a station or crossing.
- Around 82% of recorded suicide attempts have a fatal outcome. Of those that do not, more than half result in major injuries, many of which will be severe and life-affecting. In 2013/14 alone, there were 11 occasions where people attempting to commit suicide were left severely maimed, with losses of limb.

Chart 155. Suicide attempts by outcome, 2004/05 to 2013/14



Suicide prevention initiatives

In 2010, Network Rail entered into a contractual, five year partnership with Samaritans to reduce suicide on the railways. The partnership involves the roll out of a programme of prevention and post incident support initiatives to reduce the impact of suicide. These include multi-agency partnership working at national and local level, bespoke training of railway industry staff, a national public awareness poster campaign, a volunteer call out service providing emotional support to people in distress at railway locations, post-incident support provided by local Samaritans branches and work to encourage responsible media reporting of suicides. Table 20 presents a general overview of the national and local activities covered by the programme.

Table 20. Summary of programme activities

AT NATIONAL LEVEL	AT A LOCAL LEVEL
Partnership working	
• National suicide prevention steering and working groups • Development of guidance and policies • Appointment of programme support teams and leads in key organisations (Samaritans, Network Rail, TOCs) • Collation and dissemination of data centrally (by Network Rail, Samaritans, RSSB, Association of Train Operating Companies (ATOC))	• Local engagement/development of local suicide prevention plans • Station audits • Third party engagement and outreach activities
Prevention activities	
• Design and delivery of public awareness campaigns and information materials for stations and rail staff • Design and delivery of Managing Suicide Contacts and ESOB (Emotional Support Outside Branch) training (for local Samaritan branches) • Co-ordination of the ESOB service	• Priority location identification • Recruitment of station staff to Managing Suicide Contacts training • Public awareness (poster) campaign, Samaritans metal signs and distribution of information for station and Network Rail personnel • Physical mitigation measures • Call out of Samaritans on identification of a vulnerable person.
Post-event activities	
• Development and delivery of Trauma Support Training for management & unions • Development of driver fatality guidance • Development of guidance to prevent copycat suicides (media guidance, memorials policy)	• Recruitment to Trauma Support Training • Post-incident visits to stations by Samaritans to support staff and public who have witnessed or been involved in fatal and non-fatal incidents

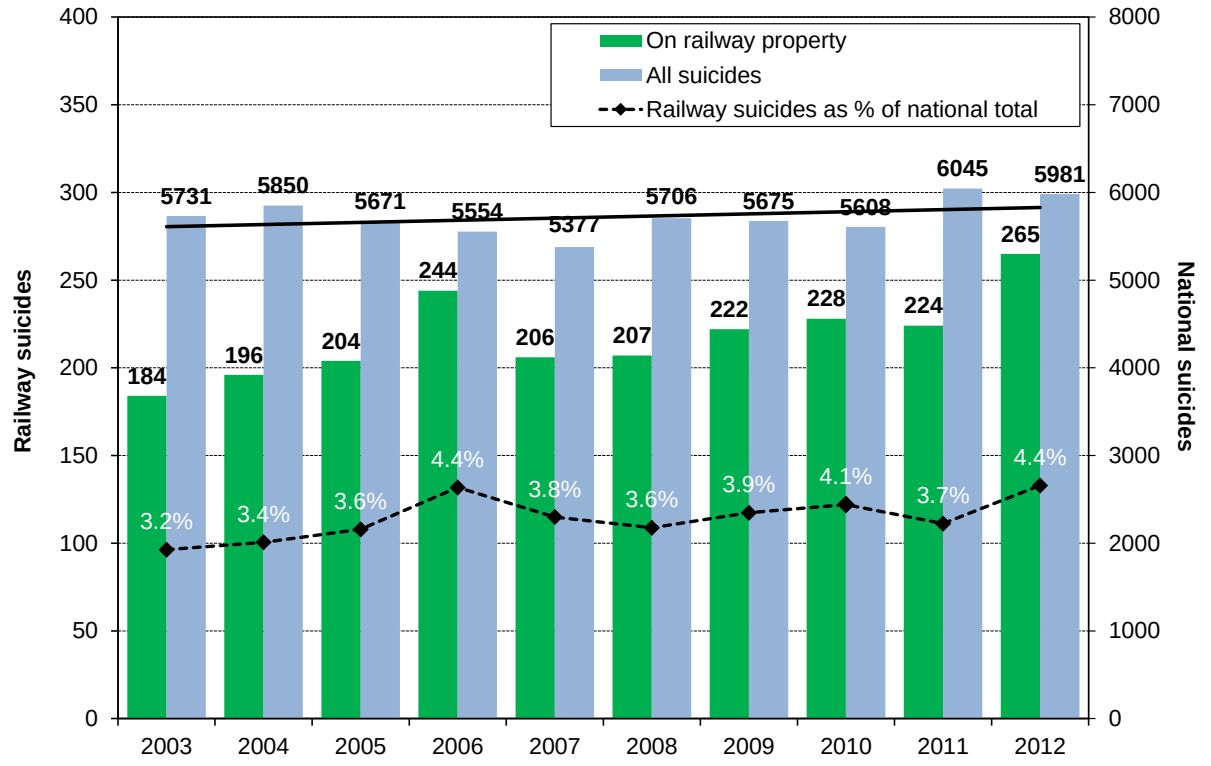
By the end of 2013/14, over 5,600 frontline railway personnel had been trained on how to intervene in suicide attempts and there have been outreach working meetings taking place between priority locations and Samaritans branches across the country. In addition, around 1,100 personnel have had Trauma Support Training.

During 2013/14, BTP recorded a total of 631 interventions that had been made in situations judged as having the potential to result in suicide.

7.8.1 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 as recently as railway figures, and are published on a calendar year basis; the chart shows the latest available calendar year comparisons. The national figures used are based on the year when the death was registered.

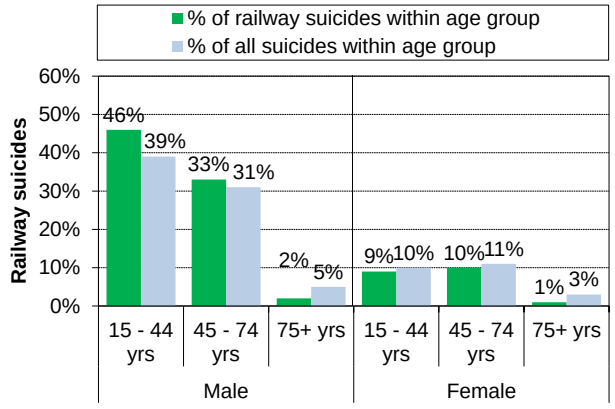
Chart 156. Railway suicide trends in the wider context



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

- Over the period shown in the chart, the number of national suicides has shown an increasing linear trend. Over the same period, railway suicides have also been increasing, but because of the change in the amount of information available for the classification of railway suicides (which occurred from 2009/10 onwards and is explained in section 7.2), fitting a trend line to the periods as whole is not sensible. For 2012, the proportion of the national total occurring on railway property was 4.4%.
- Chart 157 indicates that the age and gender demographics of railway suicides vary somewhat from national suicides. Compared with the national profile, a greater proportion of railway suicides are male; this is particularly the case in the *15-44 yrs* age group. In contrast, a smaller proportion of railway suicides are female. The *75+ yrs* age group is under-represented for both genders.

Chart 157. Suicides by age and gender, 2003 to 2012



7.9 Learning from operational experience: public

The Learning from Operational Experience Annual Report 2013/14 covers public safety in Chapter 10: *Lessons learned 2013/14 – members of the public*.

The chapter focuses on risk at level crossings, and includes a review of:

- The outcome of the RAIB investigation into a fatal accident at Beech Hill level crossing on 4 December 2012 (published September 2013). The issues, identified by RAIB, focused on the visibility of the lighting and barriers, arising from both inherent and environmental factors, as well as the crossing management.
- The outcome of the RAIB investigation into a fatal accident at Motts Lane level crossing on 24 January 2013 (published January 2014). The issues, identified by RAIB, relate to signalling and track design and layout.

7.10 Public key safety facts

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

Public	2009/10	2010/11	2011/12	2012/13	2013/14
Trespass					
Fatalities	46	25	40	32	21
Major injuries	19	18	15	28	26
Minor injuries	36	30	26	30	23
Shock/trauma	1	1	1	1	1
Total trespass FWI	**48.04**	**26.92**	**41.60**	**34.92**	**23.68**
Level crossings					
Fatalities	13	6	4	9	8
Major injuries	7	5	8	5	4
Minor injuries	24	20	25	28	15
Shock/trauma	2	1	1	4	0
Total level crossings FWI	**13.75**	**6.56**	**4.87**	**9.58**	**8.44**
Non-trespass non-LX					
Fatalities	1	2	3	1	0
Major injuries	12	13	17	9	14
Minor injuries	130	136	135	118	124
Shock/trauma	1	2	1	1	1
Total non-trespass non-LX FWI	**2.47**	**3.63**	**5.02**	**2.19**	**1.73**
Total public accidental FWI					
Fatalities	60	33	47	42	29
Major injuries	3.80	3.60	4.00	4.20	4.40
Minor injuries	0.45	0.49	0.49	0.47	0.44
Shock/trauma	0.02	0.01	0.01	0.02	0.01
Total accidental FWI	**64.26**	**37.11**	**51.49**	**46.69**	**33.85**
Suicide					
Fatalities	238	207	249	246	279
Major injuries	26	36	23	34	54
Minor injuries	15	17	21	16	25
Shock/trauma	1	0	1	0	3
Total suicide FWI	**240.67**	**210.67**	**251.39**	**249.47**	**284.52**

8 Train accidents

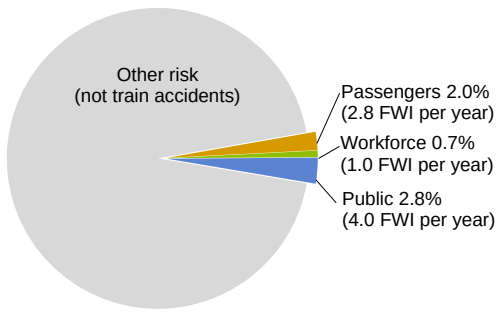
This chapter covers the risk from all types of train accident, from collisions and derailments to those with typically less serious consequences, such as trains being struck by stones.

2013/14 Headlines

- There were no passenger or workforce fatalities in train accidents in 2013/14. There have been seven consecutive years without passenger or workforce fatalities in train accidents.
- Two members of the public were fatally injured in a train accident; both were occupants of the same road vehicle, which collided with a train at a level crossing.
- The total harm from train accidents in 2013/14 comprised two fatalities, two major injuries, 74 minor injuries and 38 cases of shock or trauma. This equates to 2.5 FWI.
- There were 32 potentially higher-risk train accidents (PHRTAs). This is three lower than the previous year's total of 35.
- Six of the PHRTAs were collisions between trains: one occurred at high speed when a passenger train collided at around 70mph with an engineering trolley placed incorrectly on an open line, four involving passenger trains occurred at low speed during permissive working in stations and one involved two trains within an engineering possession.
- Eleven of the PHRTAs were collisions between trains and road vehicles; ten occurred at level crossings and one was the result of a road vehicle incursion. None of these accidents derailed the trains involved.
- Four of the PHRTAs were buffer stop collisions; three involved passenger trains and one was a runaway freight wagon.
- Eleven of the PHRTAs were train derailments; none involved passenger trains. Five occurred on points and the remainder were due to track issues, rolling stock failures, SPADs and operational incidents.
- At 293, the number of SPADs was higher than the 250 occurring in 2012/13. At the end of 2013/14, SPAD risk stood at 73% of the September 2006 baseline level.
- The PIM provides a measure of changes in the risk from PHRTAs by tracking trends in their precursors. At the end of 2013/14, the PIM stood at 7.5 FWI per year.

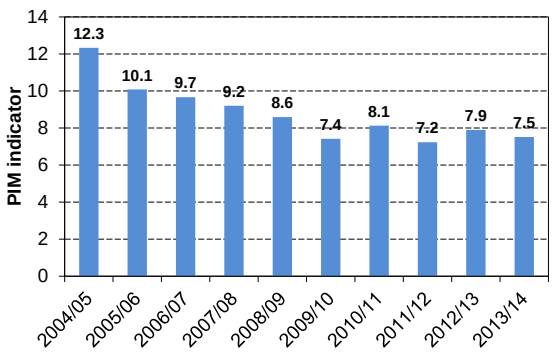
Train accident risk at a glance

Train accident risk in context (SRMv8)



Train accident risk = 7.8 FWI per year (5.4% of total risk)

Trends in train accident risk (PIM)



8.1 Types of train accident and measures of 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.

8.1.1 RIDDOR-reportable train accidents

In this report, the term *train accident* covers the events set out in Table 21.[54] 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 9. 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. Generally, train accidents occurring wholly within possessions are not reportable under RIDDOR and are not recorded in the safety performance statistics in this chapter, however their contribution to overall train accident risk is estimated by the SRM (see Appendix 9 for exceptions).

Measuring the risk from RIDDOR-reportable train accidents

The SRM models all sources of risk on the railway, including the risk from train accidents. Of the total SRMv8 modelled risk of 143.4 FWI per year, train accidents account for 7.8 FWI (5.4%). Train accidents have the potential to result in a large number of casualties, but accidents with on-board fatalities now occur infrequently. The SRM contains models of the causes and consequences of train accidents, encompassing 23 hazardous events and more than 1,700 separate accident precursors. It provides an estimate of the underlying level of risk associated with accident types that have not occurred for many years, or have never occurred.

8.1.2 Potentially higher-risk train accidents (PHRTAs)

Many train accidents carry little risk. The types of train accident occurring on the running line, with the most potential to result in harm are known as PHRTAs. The PHRTA category 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.

Tracking the risk from PHRTAs

The PIM provides a measure of underlying train accident risk by tracking changes in the occurrence of accident precursors. It uses risk weightings derived from the SRM and allows risk to be monitored on an on-going basis.

In 2013, the scope of the PIM was modified to match the scope of PHRTAs. Since then, the PIM has no longer included the risk from roll-back collisions and train fires, but includes the risk from train explosions and trains being struck by large falling objects. This modification enables the PIM to be a specific measure of the risk from the highest-consequence train accidents.

[54] The term *train* covers a wide range of rail vehicles, including on-track plant. See Appendix 9 for more detail.

The PIM has been improved this year to include better precursor event data and to state its output as an estimate of FWI per year. The PIM and its outputs are discussed in more detail in Section 8.7.

8.1.3 Train accidents by type

Table 21 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 within the scope of PIM/PHRTAs and which are not.

The SRM models the overall risk from train accidents by modelling each type of train accident separately, taking into account the characteristics of all possible potential precursors.

Table 21. Types of train accident and their associated risk (SRMv8)[55]

	PHRTA & PIM	Risk (FWI per year)				Constituent hazardous events in the Safety Risk Model (SRM)
		Passengers	Workforce	Public	Total	
Derailments (excluding striking road vehicles on level crossings)	✓	1.5	0.4	0.2	2.1	HET-12, HET-13
Collisions between trains (excluding roll backs and open doors)	✓	0.7	0.3	0.1	1.2	HET-01,HET-02, HET-03, HET-06B, HET-06C, HET-26
Roll back collisions	×	<0.1	<0.1	0.0	<0.1	HET-06A
Buffer stop collisions	✓	0.1	<0.1	0.0	0.1	HET-09
Collisions with road vehicles at level crossings (including derailments)	✓	0.2	0.1	3.3	3.6	HET-10, HET-11
Collisions with road vehicles at other locations (excluding derailments)	✓	<0.1	<0.1	0.3	0.3	Part of HET-04
Open door collisions	×	<0.1	<0.1	0.0	<0.1	Part of HET-04
Collisions with animals (excluding derailments)	× (but used as a PIM precursor)	<0.1	<0.1	<0.1	<0.1	Part of HET-04
Collisions with other objects (excluding derailments)	× (but used as a PIM precursor)	<0.1	0.1	<0.1	0.1	Part of HET-04
Trains struck by missiles	×	<0.1	<0.1	<0.1	0.1	Part of HET-04
Struck by large falling object	✓	0.1	<0.1	<0.1	0.1	HET-21, HET-22
Train fire	×	<0.1	<0.1	<0.1	0.1	HET-17, HET-20
Train explosion	✓	<0.1	<0.1	0.1	0.1	HET-23, HET-24
Train division	×	<0.1	<0.1	0.0	<0.1	HET-25

Source: SRMv8
Note: The risk values in the table include the risk from train accidents occurring within possessions, in contrast to Chart 159, which separates this portion of the risk. Train accidents in possessions are not reportable under RIDDOR and are therefore not included in the scope of PHRTAs or the PIM. However, their contribution to overall train accident risk is estimated by the SRM.

- Collisions with road vehicles at level crossings account for most risk overall, with members of the public incurring the majority of the risk (3.3 public FWI per year).
- Most of the risk to passengers arises from train derailments, which account for 1.5 passenger FWI per year. The total risk for all person types from train derailments is 2.1 FWI per year. These figures include the risk from collisions or fires following a derailment.
- PHRTAs comprise 93% of all train accident risk (7.3 FWI per year), and the PIM models only this part of train accident risk.

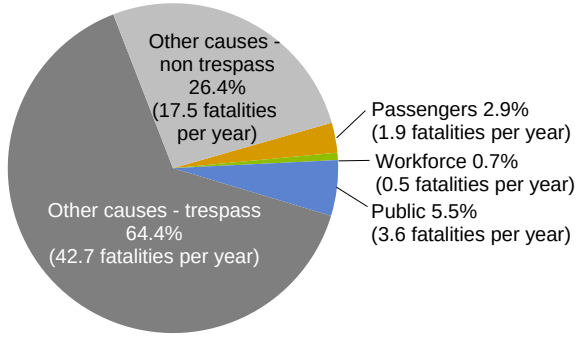
[55] For all accident types, events that are not reportable under RIDDOR are generally omitted from the analysis in this chapter.

8.2 Train accident risk profile by accident type

The SRMv8 modelled risk from train accidents is 7.8 FWI per annum, which is 5.4% of the total risk (excluding suicide). Of this, fatality risk is 6.0 per year, which is around 9.1% of the total fatality risk.

The group with the highest modelled fatality risk (3.6 per year) is members of the public. The greatest risk arises from collisions between trains and vehicles at level crossings. The next highest risk group (1.9 fatalities per year) is passengers. The greatest risk in this group arises from train derailments.

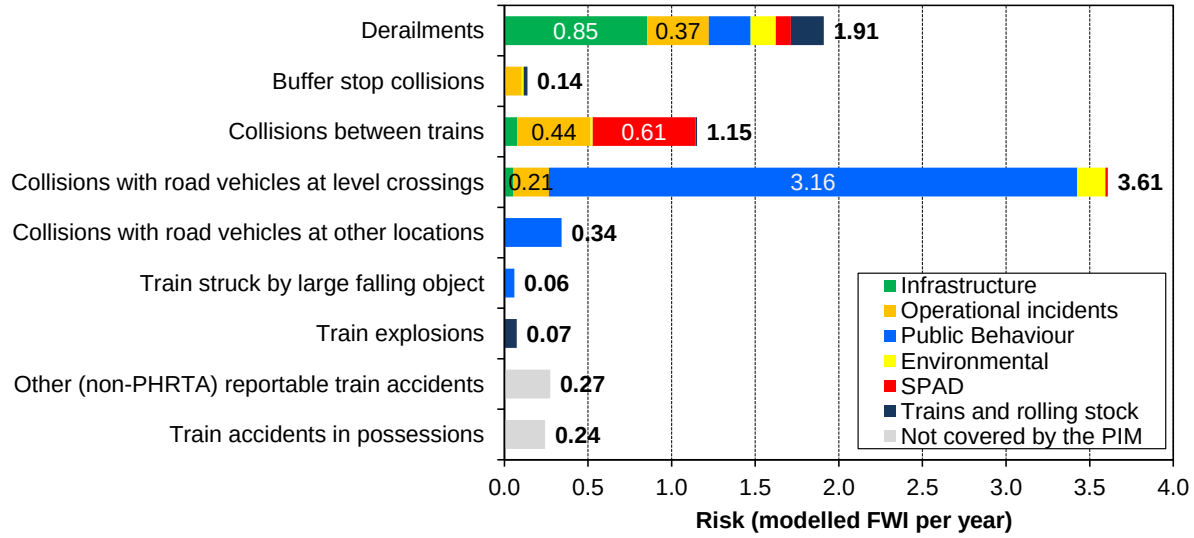
Chart 158. Train accident fatality risk in context



Train accident risk 6.0 fatalities per year
(9.1% of the total fatality risk of 66.2 fatalities per year)

The PIM is structured around causes of train accidents, and comprises six main groups. Chart 159 shows train accident risk broken down by accident type and PIM group. More information on the PIM, and each of its categories can be found in Section 8.7.

Chart 159. Train accident FWI risk by accident type and cause (PIM group)



Source: SRMv8
Note: Train accidents in possessions are generally not reportable under RIDDOR and are therefore not included in the scope of PHRTAs or the PIM, however their contribution to overall train accident risk is estimated by the SRM.

- 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 45% of derailment risk.
- Collisions between trains account for around two-thirds as much risk as derailments. Most of the risk from collisions between trains arises as a result of signals passed at danger (SPADs).

8.3 Train accident fatalities and injuries in 2013/14

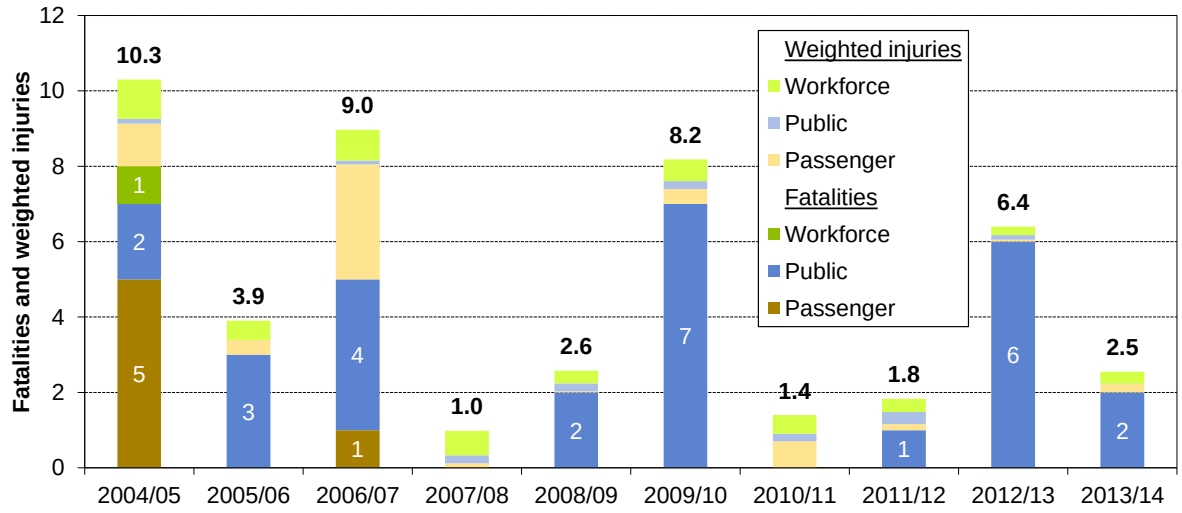
There were two fatalities in train accidents during 2013/14. Both were members of the public; the driver and a passenger of a road vehicle, which was struck by a train on a level crossing at Great Coates station.

One passenger suffered major injuries in a train accident at Norwich in July 2013, when a train collided with units already stabled at the platform.

A member of the workforce sustained major injuries when a rail-mounted mobile elevated work platform ran away whilst being placed on the track: it struck scaffolding, causing the worker to fall.

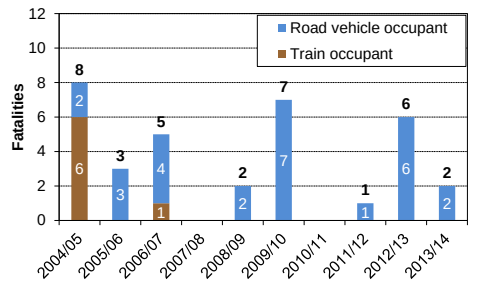
There were 74 reports of minor injuries as a result of 72 train accidents in 2013/14. These arose from collisions with objects (28), collisions with road vehicles at level crossings (17), and other collisions and derailments (27). There were also 38 reports of shock or trauma caused by train accidents.

Chart 160. Fatalities and weighted injuries from train accidents (excluding suicides)



- At 2.5 FWI, the level of harm from train accidents was below the ten-year average of 4.7 FWI.
- 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 160: an accident at Ufton, in 2004/05 resulted in the death of six on-board the train (the train driver and five passengers).
- Chart 161 shows that, since 2004/05, seven train occupants and 27 road vehicle occupants have died in train accidents.

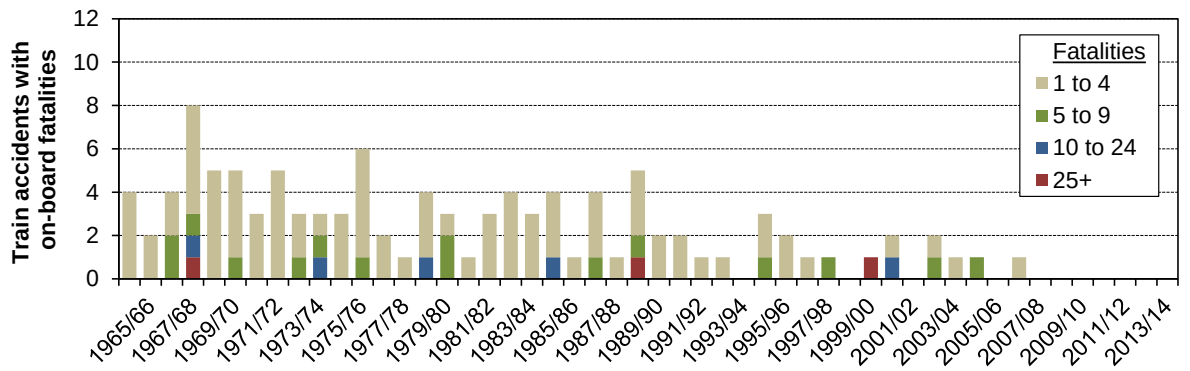
Chart 161. Train accident fatalities



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-light 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 162. Train accidents leading to on-board fatalities



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

- The rate of fatal accidents has fallen significantly over the last 50 years.
- The most recent train accident involving an on-board fatality occurred in February 2007, at Grayrigg: one passenger was fatally injured following a train derailment. The last train accident with ten or more fatalities was at Great Heck in February 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 five or more fatalities would occur around once every seven years, on average.

Table 22. SRM estimated frequency of train accidents by severity

		SRM v1 / v2	SRM v3	SRM v4	SRM v5 / v5.5	SRM v6	SRM v7 / v7.5	SRM v8
	Publication date	*Jul 2001*	*Feb 2003*	*Jan 2005*	*Aug 2006*	*May 2009*	*May 2011*	*March 2014*
Average number of years between events with…	**5 or more fatalities**	1.4	2.4	3.8	5.3	5.4	5.8	6.9
	10 or more fatalities	3.1	5.6	7.9	9.1	15.3	18.3	21.2

Note: Train accident risk was not remodelled between v7/v7.5, v5/v5.5 or v1/v2

- The expected time intervals between multi-fatality events has increased since version 1 of the SRM was published, indicating that the likelihood of such accidents is decreasing. This reflects the industry's success in tackling train accident risk, including the system improvements that have taken place over the past decade such as TPWS, the removal of Mark I rolling stock, and improvements in train crashworthiness and track quality.

8.4.1 Causes of historic train accidents

In the past 50 years, there have been three train accidents in which 25 or more people died. Two train accidents have caused passenger or workforce fatalities in the past ten years.

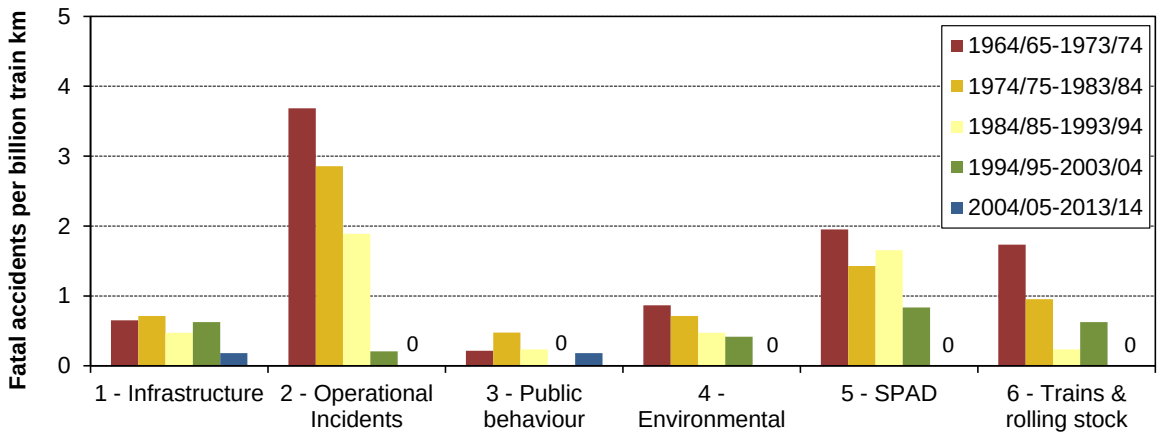
Table 23. Historic train accidents

Year	Location	Nature and cause of accident	Fatalities		
			Passengers	Workforce	Public
Train accidents with 25 or more fatalities in the past 50 years					
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 in the past 10 years					
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

Note: 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 analysis of fatality and injury statistics presented in this report, but are covered in section 7.6.

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

Chart 163. Ten-year trends in train accidents leading to on-board fatalities by cause



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

- There has been a substantial reduction in the frequency of fatal train accidents caused by factors that are largely within the industry's control, particularly operational incidents, SPADs, and train and rolling stock failures. While the downward trend in fatal accidents caused by infrastructure failures is less pronounced, the last decade has seen notably fewer.
- The trend is less clear for causes over which the industry can exert some influence, but which are often not under its direct control, particularly public behaviour, which influences level crossing risk. With the causes of risk under the direct control of the railway reducing, public behaviour now accounts for a higher proportion of train accident risk than was historically the case.

8.4.2 Potentially higher-risk train accidents in 2013/14

Table 24 and Table 25 list the 32 PHRTAs that occurred in 2013/14. The events coloured in red are those that the Rail Accident Investigation Branch (RAIB) is investigating, or for which it has published a report.

Table 24. Passenger train PHRTAs

Date	Location	Territory	Train Operators	Description
Derailments (excluding level crossings)				**0**
Collisions between trains				**5**
Date	**Location**	**Territory**	**Train Operators**	**Description**
06/04/2013	Glasgow Central High Level	Scotland	First ScotRail	A passenger train collision at low speed upon arriving at the destination.
21/07/2013	Norwich	South East	Greater Anglia	On arrival at its destination, a passenger train collided with a train stabled in the same platform.
25/09/2013	Manchester Victoria	London North Western	Northern Rail	A low-speed collision when a passenger train moved off in the wrong direction.
17/12/2013	Faversham (Ramsgate Line)	South East	Southeastern	A low-speed collision between trains which were to be coupled.
17/01/2014	Harlescott LC	London North Western	Arriva Trains Wales	A passenger train struck an engineering trolley at high speed.
Buffer stop collisions				**3**
Date	**Location**	**Territory**	**Train Operator**	**Description**
02/05/2013	Bradford Interchange	London North Eastern	Northern Rail	A passenger train collided with buffer stops at around 5mph.
20/11/2013	Chester	London North Western	Virgin West Coast	A passenger train struck and destroyed buffer stops, injuring five onboard.
11/02/2014	Norwich	South East	Greater Anglia	A low-speed collision with buffer stops whilst coupling train units.
Trains struck by large falling objects				**0**
Collisions with road vehicles on level crossings				**8**
Date	**Location**	**Territory**	**Train Operator**	**Description**
09/04/2013	Great Coates	London North Eastern	First Transpennine Express	Two people died when their car was struck by a passenger train on a half-barrier crossing.
24/06/2013	Ffynnongain LC	Western	Arriva Trains Wales	A passenger train struck an unoccupied mobility scooter on a crossing.
29/06/2013	North Green LC	South East	Greater Anglia	A passenger train was struck by a car on an open crossing.
14/07/2013	Jetty Avenue LC	South East	Greater Anglia	A passenger train struck a car and trailer at a user-worked crossing.
16/07/2013	Buttington LC	Western	Arriva Trains Wales	A passenger train struck a tractor's trailer on a user-worked crossing.
12/11/2013	Sandy Lane LC	Western	CrossCountry	A member of the public placed her car on a crossing and waited there until struck by a passenger train.
31/12/2013	Ruswarp	London North Eastern	Northern Rail	A passenger train struck a pick-up truck on a user-worked crossing.
05/01/2014	Hoghton LC	London North Western	Northern Rail	A passenger train struck a runaway car on a half-barrier crossing.
Collisions with road vehicles not at level crossing (excluding derailment				**1**
Date	**Location**	**Territory**	**Train Operator**	**Description**
11/11/2013	Bingley	London North Eastern	Northern Rail	A parked car rolled away, stopped foul of the line and was struck by a passenger train.
Total passenger train PHRTAs				**17**

Table 25. Non-passenger train PHRTAs

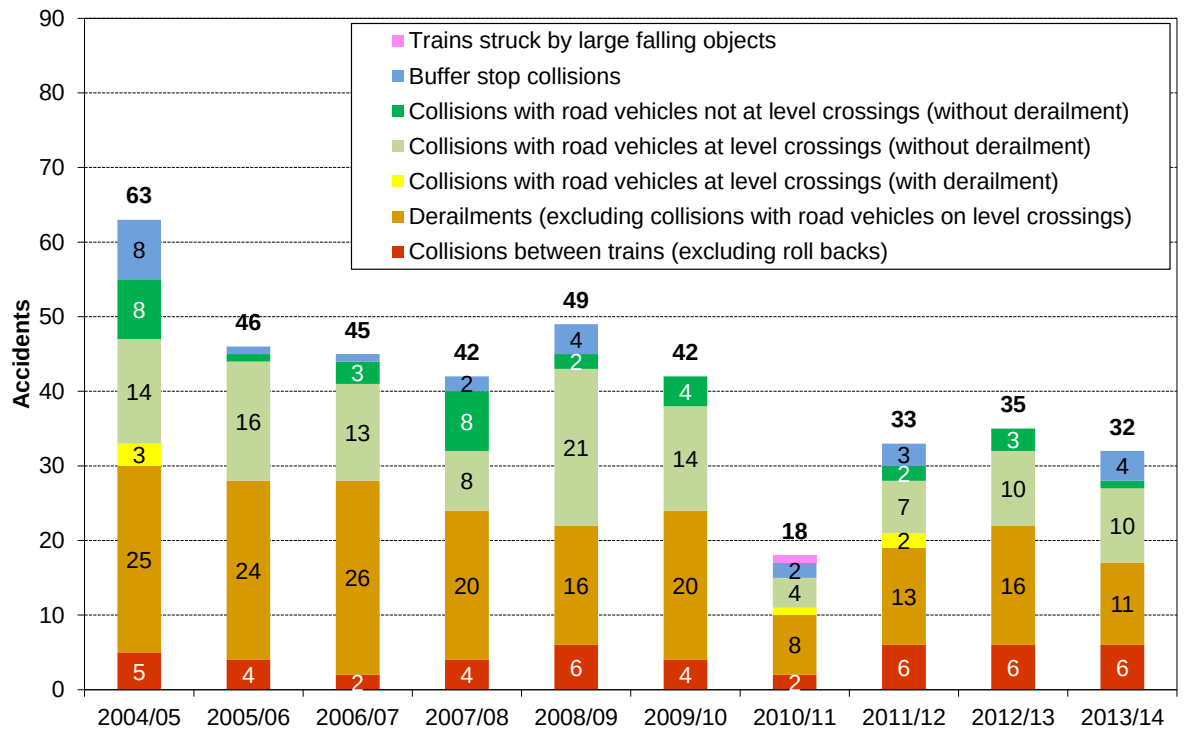
Date	Location	Territory	Train Operator	Description
Derailments (excluding level crossings)				**11**
09/08/2013	Worcester Shrub Hill	Western	First Great Western	An ECS train derailed on points entering a siding.
27/08/2013	Stoke Lane LC	London North Eastern	DB Schenker	A freight train was derailed near an under-track void.
15/10/2013	Gloucester	Western	Direct Rail Services	A freight train derailed, continuing several miles, shedding a wagon's wheelset and its container.
15/10/2013	Primrose Hill	London North Western	Freightliner	A freight train derailed, shedding a container and causing bridge and overhead wire damage.
06/11/2013	Hoo Jcn (Grain Branch)	South East	DB Schenker	A freight train derailed whilst shunting.
20/11/2013	Herbrandston Junction	Western	DB Schenker	A freight train derailed on trap points after a SPAD.
24/11/2013	Altofts Jcn	London North Eastern	VolkerRail	A tamper derailed on points due to an operating incident.
30/12/2013	Goole	London North Eastern	DB Schenker	A freight locomotive derailed on trap points after a SPAD.
03/02/2014	Angerstein Wharf	South East	DB Schenker	A freight locomotive derailed on handpoints whilst entering sidings.
18/02/2014	Castle Bromwich	London North Western	Colas	A train exiting a possession derailed on points due to the route not having been set.
25/02/2014	Doncaster Decoy	London North Eastern	DB Schenker	A freight train derailed on defective handpoints whilst shunting.
Collisions between trains				**1**
Date	**Location**	**Territory**	**Train Operators**	**Description**
12/01/2014	Plumpton (Cumbria)	London North Western	DB Schenker	A collision, with derailment, between trains in a possession but affecting the adjacent line.
Buffer stop collisions				**1**
Date	**Location**	**Territory**	**Train Operators**	**Description**
29/03/2014	Speke Jcn	London North Western	Freightliner	A coal wagon ran away and struck buffer stops, becoming derailed.
Trains struck by large falling objects				**0**
Collisions with road vehicles on level crossings				**2**
Date	**Location**	**Territory**	**Train Operator**	**Description**
09/06/2013	Brompton LC	London North Eastern	GB Railfreight	A train struck a stranded motorcycle on a level crossing.
14/01/2014	Silverdale LC	London North Western	Direct Rail Services	A freight train struck a stranded, unoccupied car on a level crossing.
Collisions with road vehicles not at level crossing (excluding derailments)				**0**
Total non-passenger train PHRTAs				**15**

- During 2013/14, there were 17 PHRTAs involving passenger trains and 15 involving non-passenger trains (12 were freight trains, one was ECS and two were engineering trains). Eight of the accidents (shown in red) are subject to RAIB investigation.
- Nine of the PHRTAs involving passenger trains were collisions with road vehicles (eight of which were at level crossings). Five were collisions between trains and the remaining three were buffer stop collisions.
- Eleven of the non-passenger train PHRTAs were derailments. The remaining four comprised one collision between trains, one collision with buffer stops and two collisions with road vehicles at level crossings.

8.5 Trends in potentially higher-risk train accidents

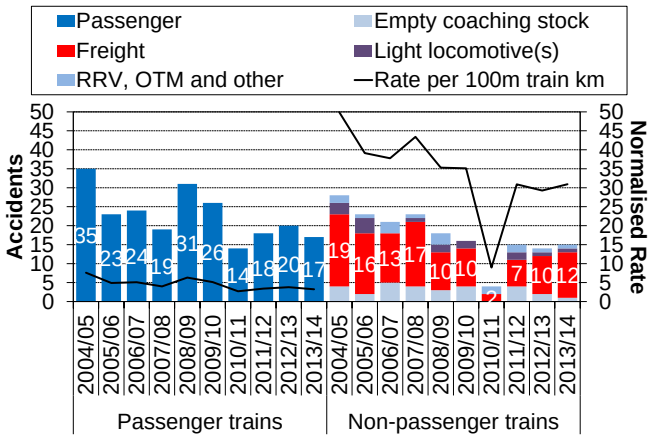
The SRMv8 modelled risk from PHRTAs on the running line equates to 7.3 FWI per year. While PHRTAs comprise the types of train accident that have the greatest potential to result in higher numbers of casualties, the majority result in few or no injuries.

Chart 164. Trends in the numbers of PHRTAs



- The number of PHRTAs in 2013/14 stayed at a similar level to the previous year, and was low compared with the ten-year average of 40.5.
- At 11, the number of derailments was lower than the previous year and below the ten-year average of 17.9. The number of collisions with road vehicles (both at, and not at level crossings) was 11, remaining below the ten-year average of 15.5. There were six collisions between trains, which is slightly above the ten-year average of 4.5. There were four buffer stop collisions compared with the average of 2.5.
- The breakdown of the types of train involved was fairly typical of recent years. Accident rates differ by an order of magnitude for passenger and non-passenger trains, but both types shown a generally reducing trend over the past decade.

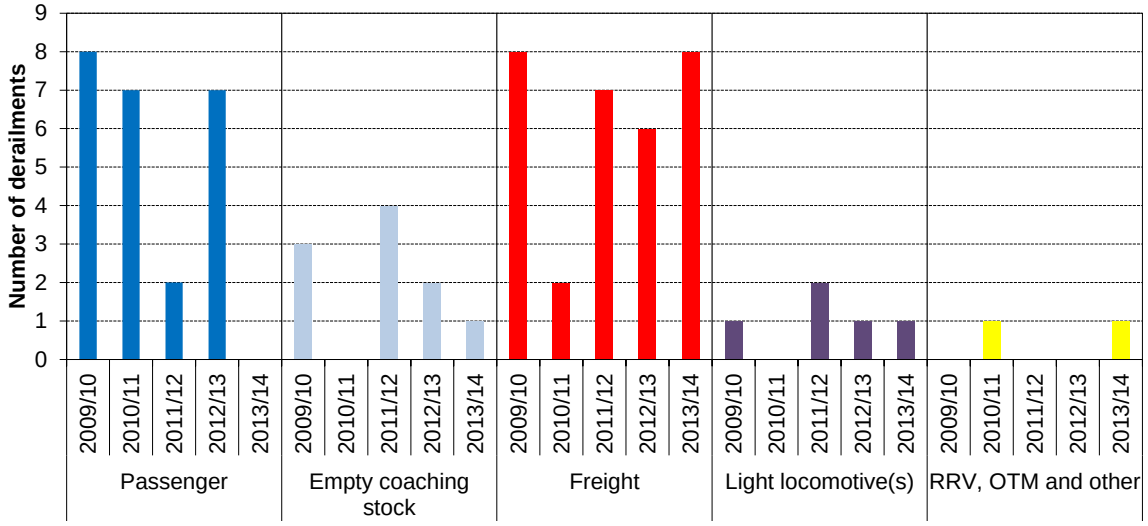
Chart 165. PHRTAs by train type



8.5.1 Derailments

The modelled risk from derailments is 2.4 FWI per year.[56] The last train accident with a train occupant fatality was the derailment at Grayrigg in 2007, which was caused by points failure.

Chart 166. Trends in derailments by train type over the last five years



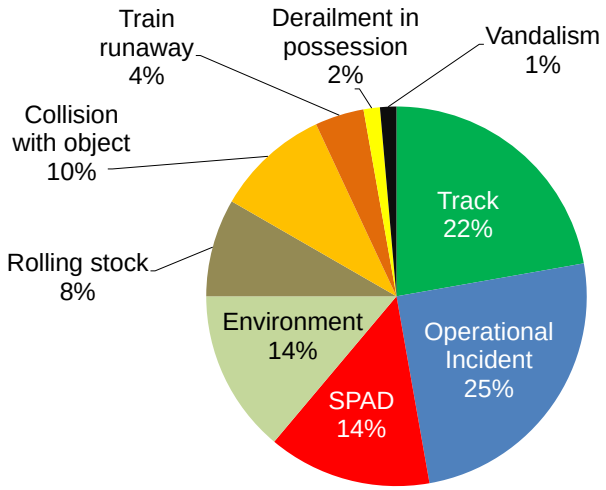
- There were 11 derailments in 2013/14, which is five fewer than the previous year, and low by historical standards.
- There were no derailments of passenger trains in 2013/14. This is the first year with no such derailments since current recording began, more than 20 years ago.
- There were eight freight train derailments, plus one derailment of a light locomotive operated by a freight company, one ECS train and one tamper. Freight train derailments have reduced from a typical rate of around 40-50 per year in the late 1990s. Various factors – including improvements in the quality of both track and rolling stock – have contributed to this success.

[56] Some events involve more than one train accident (for example a collision leading to a derailment). In the key safety fact sheets these are shown against the initiating incident to avoid duplicating the counting. In this section the number of derailments includes derailments following collisions with road vehicles at level crossings or trains being struck by large falling objects (which are shown in separate categories in the key safety fact sheet), but does not include derailments following train collisions or buffer stop collisions.

Causes of derailments

Chart 167 shows the primary causes assigned to train derailments over the past five years. On investigation, train accidents are generally found to have numerous causal factors; they are more often likely to be a result of a metaphorical lining up of the holes in Reason's Swiss cheese model[57] than because one single factor inevitably leads to the end consequences. Nevertheless, this basic approach can be useful for identifying general trends.

Chart 167. Derailments by cause (2009/10–2013/14)



- Over the last five years, operational incidents have been the main cause of derailment, followed by track problems. Operational incidents include a range of workforce errors. Derailment causes in this category in 2013/14 included speeding, miscommunication and route setting errors.
- Around one-third 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 being in the wrong position and not detected, or other failures.
- The most common cause of operational incident related derailments is signaller error. These errors included, for example, points being moved under a moving train, or trains being routed over points which were not set for the movement.

Chart 169. Track-related derailments (2009/10–2013/14)

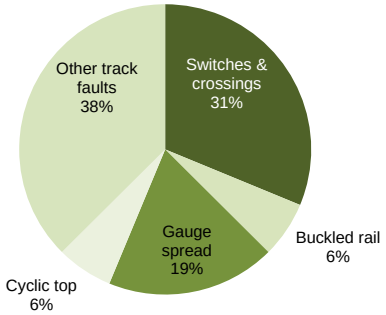
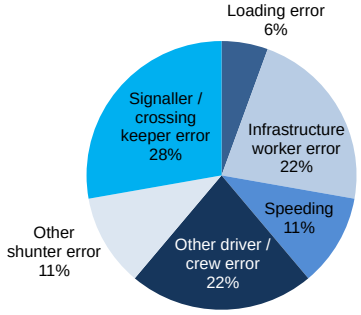


Chart 168. Operational Incident derailments (2009/10–2013/14)



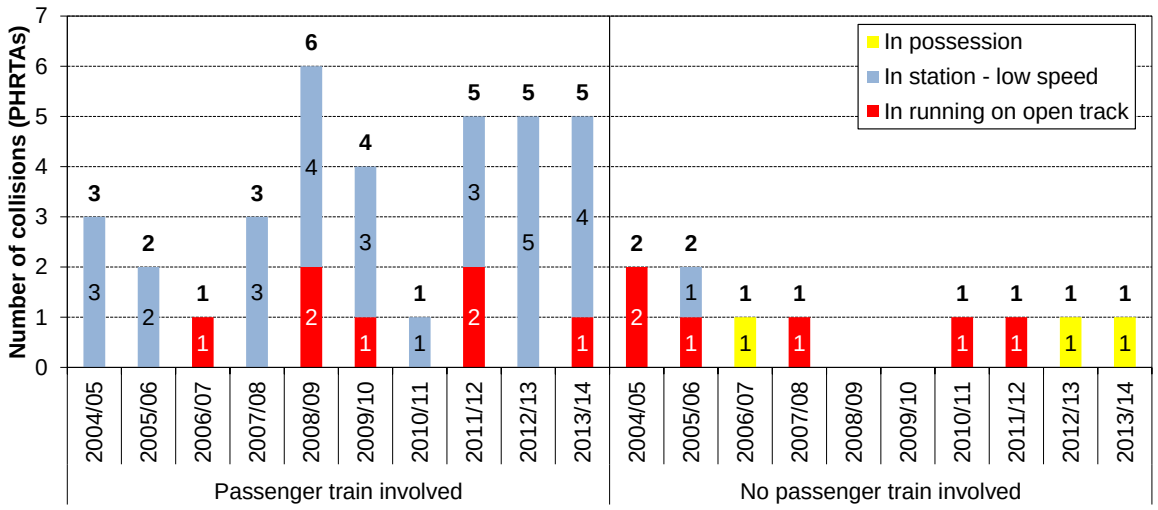
[57] See James Reason, *Managing the Risks of Organizational Accidents* (Ashgate Publishing Ltd, 2002).

8.5.2 Collisions between trains

The SRMv8 modelled risk from collisions between trains is 1.2 FWI per year. Roll back and open door collisions (each of which accounts for a risk of less than 0.01 FWI per year) are excluded from this section, but are covered in Section 8.6.

Collisions between trains are reported every year, but most carry little risk, either because they occur at low speed, or because the trains are on adjacent lines and make contact via an out-of-gauge item. In 2013/14 there was one high-speed collision between a passenger train and an engineering trolley. Whilst only one passenger train was involved, it nonetheless presents a high risk scenario. High-speed collisions between passenger 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 170. Trends in collisions between trains by collision type and location[58]



- There were six collisions between trains in 2013/14. This is same as the previous year and around the annual average (4.5) for the period shown on the chart.
- Four of the collisions involved passenger trains pulling into occupied station platforms at very low speed.
- One collision involving a passenger train occurred at high speed: On 17 January, a passenger train travelling between Manchester Piccadilly and Shrewsbury struck an engineering trolley at 70mph. The trolley had been placed in error on an open line adjacent to a work site. The accident resulted in a minor injury to an infrastructure worker and shock/trauma to the train driver and guard.
- The remaining collision occurred within an engineering possession: On 12 January 2014, a train within an engineering possession at Plumpton (Cumbria) collided with another train it was approaching from behind. It derailed and damaged the track, also affecting the adjacent line. Prior to the impact, the driver of the moving train leapt from the locomotive, suffering minor injuries.

[58] Of the 13 collisions categorised as *In running on open track* over the last ten years, two were the result of runaways, five were collisions with out-of-gauge items on passing trains, and two were collisions with machinery (one an engineering trolley placed on an open line, and one due to equipment on a road-rail vehicle that was working in an adjacent possession and had moved foul of the running line). The remaining four had various causes but none resulted in a fatality.

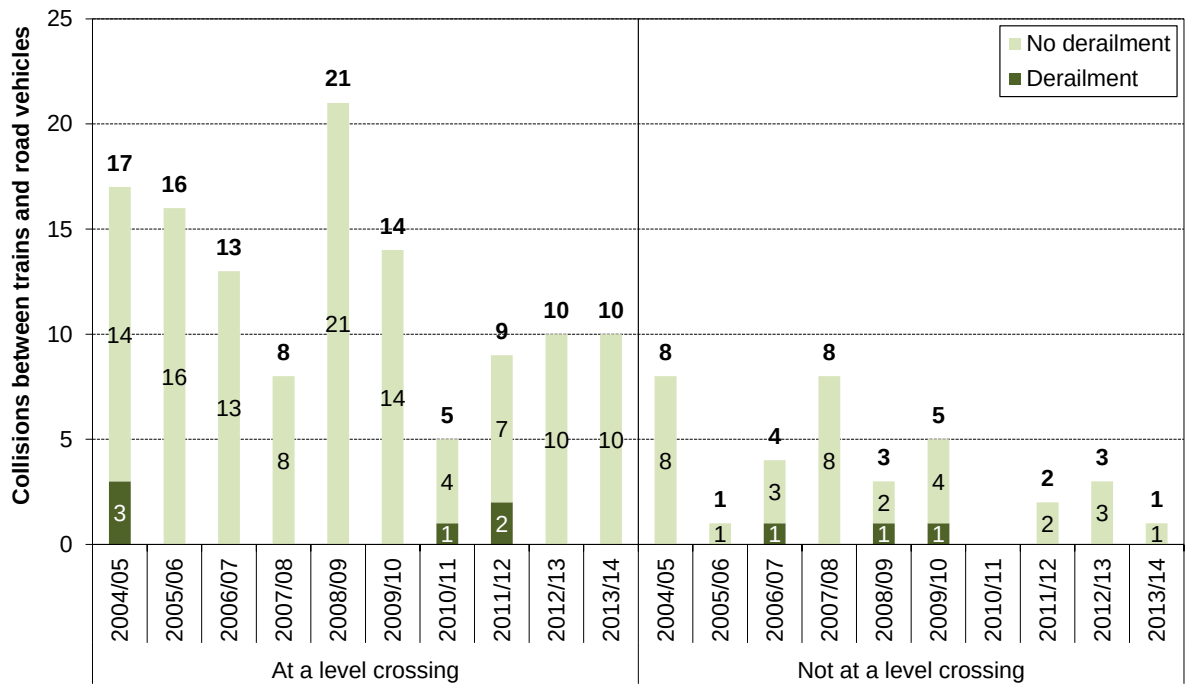
8.5.3 Collisions between trains and road vehicles

The SRMv8 modelled risk from collisions between trains and road vehicles is 4.0 FWI per year.[59] Accidents at level crossings account for 91% of this. Most of the risk is to road vehicle occupants rather than to people on the train.

In the last ten years, one train accident with passenger fatalities was caused by the train striking a road vehicle. This was at Ufton in November 2004, when a vehicle had been parked on a level crossing by a motorist committing suicide.

Two members of the public died in one of the 11 collisions between trains and road vehicles occurring in 2013/14.

Chart 171. Trends in collisions between trains and road vehicles



- Over the past ten years there have been 123 collisions with road vehicles at level crossings and 35 collisions at other locations.
- The numbers of collisions with road vehicles both at or away from level crossings were both lower than average in 2013/14. Because the annual numbers are fairly small, it is not easy to differentiate between trends and statistical fluctuations. However, there is some evidence that the underlying rate of level crossing collisions has reduced.
- None of the collisions at level crossings in 2013/14 resulted in the train derailing.
- There was one collision with a road vehicle in 2013/14 that did not happen on a level crossing, which occurred when a parked car rolled away down an embankment, stopping foul of the line where it was struck by a passenger train.

[59] 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*.

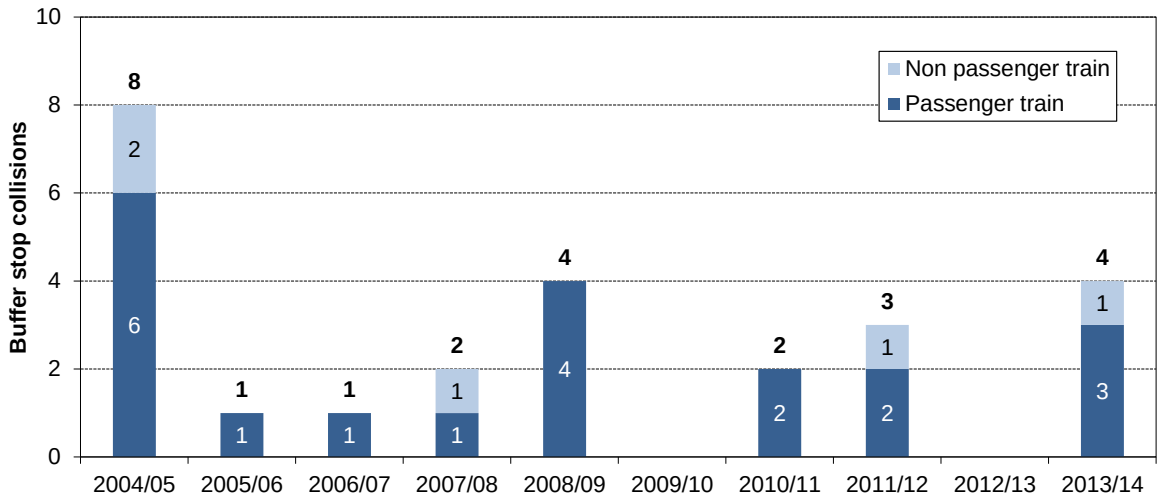
8.5.4 Buffer stop collisions

The SRMv8 modelled risk from buffer stop collisions is 0.1 FWI per year. Most buffer stop collisions occur at very low speeds and carry little risk.

Although the risk from buffer stop collisions is low, severe consequences are possible. In 2012, a 12mph collision with buffer stops in Buenos Aires killed 51 and injured more than 700. The severity of the accident was due, in part, to carriages over-riding each other. This less likely to occur in Great Britain since the removal of Mark I rolling stock.

The last fatal buffer stop collision in Great Britain occurred at Cannon Street in 1991. Two passengers on the train died and more than 500 were injured when the service collided with the hydraulic buffers, causing the fifth carriage to partially over-ride the sixth.

Chart 172. Buffer stop collisions

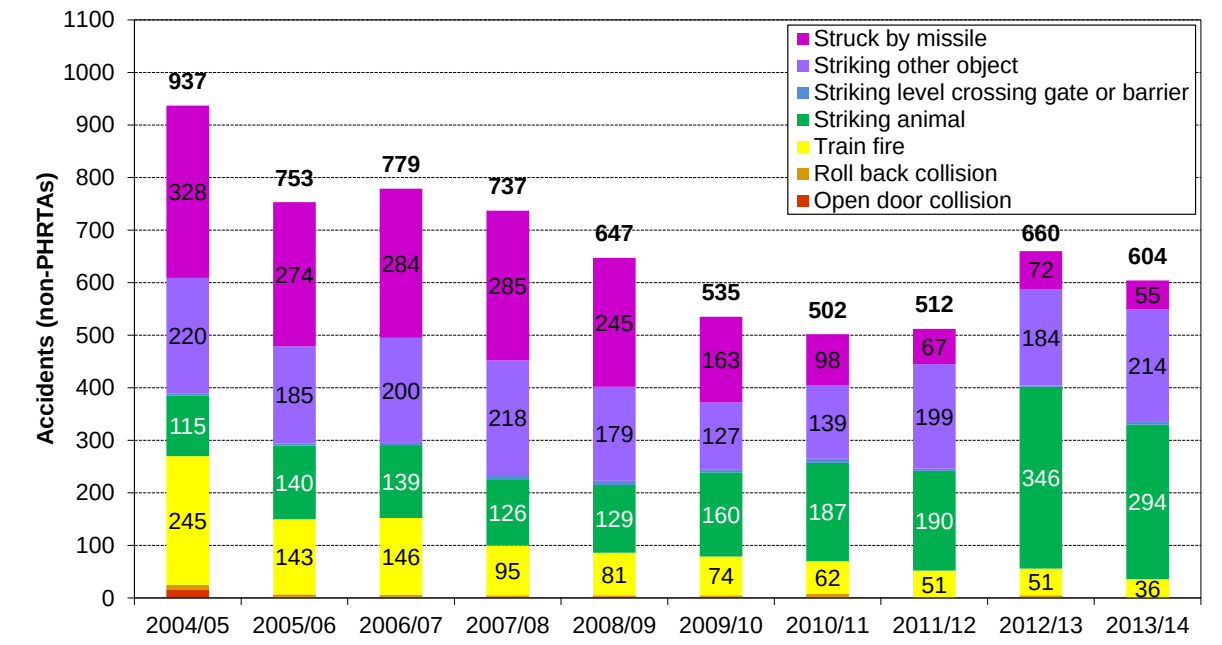


- There were four buffer stop collisions in 2013/14, involving three passenger trains and one freight train.
- The freight train collision involved a runaway wagon.
- One passenger train collision was at very low speed whilst coupling units at Norwich.
- A passenger train collided with buffer stops at around 5mph at Bradford Interchange.
- A passenger train struck and destroyed buffer stops at Chester, injuring five on board.
- Over the period shown, the most common cause of buffer stop collisions has been driver error, usually involving misjudgement of braking distance, loss of concentration, or error using the couple/uncouple button.

8.6 Other train accidents

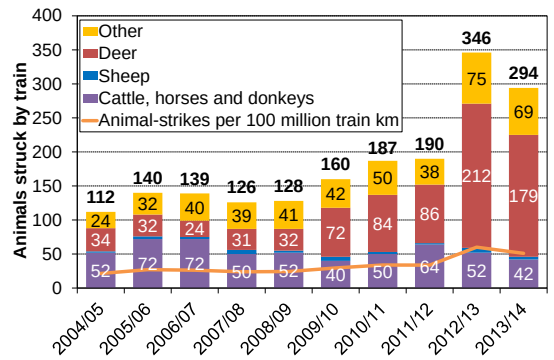
The SRM v8 modelled risk from types of train accident other than PHRTAs is relatively low, at 0.3 FWI per year.[60] Trains struck by missiles account for around 27% of this.

Chart 173. Trends in number of non-PHRTAs



- Over the past ten years, there has been a generally decreasing trend in all types of non-PHRTAs apart from train collisions with animals. In particular, the past two years have seen notably high numbers recorded for these types of events. Chart 174 shows that the trend in animal strikes has been driven mostly by incidents involving deer; such incidents represent a low risk in terms of serious injury, but have implications for driver shock/trauma and rolling stock damage. The second edition of a special topic report on the risk from animal strikes was published in June 2014.

Chart 174. Animals struck by train



- The risk from train fires has reduced in recent years, largely due to the increased use of fire-resistant materials. Incident numbers have fallen by over 80% since 2004/05.
- Reports of trains struck by missiles have also fallen by around 80% since 2004/05. This reflects a general reduction in vandalism (see Section 7.7) and the laminated glass that is used on modern rolling stock.[61]
- Open door collisions have been virtually eliminated by the removal of Mark I 'slam door' rolling stock, which was completed in 2005.

[60] Train accidents in possessions are generally outside the scope of this chapter, and are therefore not included in this figure.
[61] 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 potentially higher risk train accidents (PHRTAs) 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. In 2013, the scope of the PIM was modified to be in line with the types of train accidents classed as PHRTAs.

Structure

The PIM monitors the risk from train derailments; train collisions, including those with other trains, buffer stops and road vehicles (both at and not at level crossings); trains struck by large falling objects; and train explosions. Train fires and roll-back collisions are no longer included as these are not PHRTAs. The precursors covered by the PIM fall into six main groups, encompassing 28 separate subgroups of the 51 PIM precursors.

Figure 3. PIM structure

Infrastructure	Operational incidents	Public Behaviour	Environmental	SPAD	Trains and rolling stock
Animals	Irregular loading of freight trains	Bridge strikes	Adhesion	SPADs	Brake failures
Structural failures	Operational incidents affecting level crossings	Train struck by large falling objects	Level Crossing incidents due to weather		Train failures other than Brakes
Earthwork failures	Objects left foul of the line	Objects on the line due to vandalism	Trees blown onto the line		
Track drainage	Signaller errors other than Routing	Public behaviour at level crossings	Other objects blown onto the line		
Level crossing failures	Wrong routing	Vehicle incursions			
Track	Track left in unsafe condition				
Wrongside signal failures	Runaway trains				
	Train speeding				
	Other operational incidents				

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 kilometres, to account for changes in the level of activity on the railway.

The PIM uses the basic equation

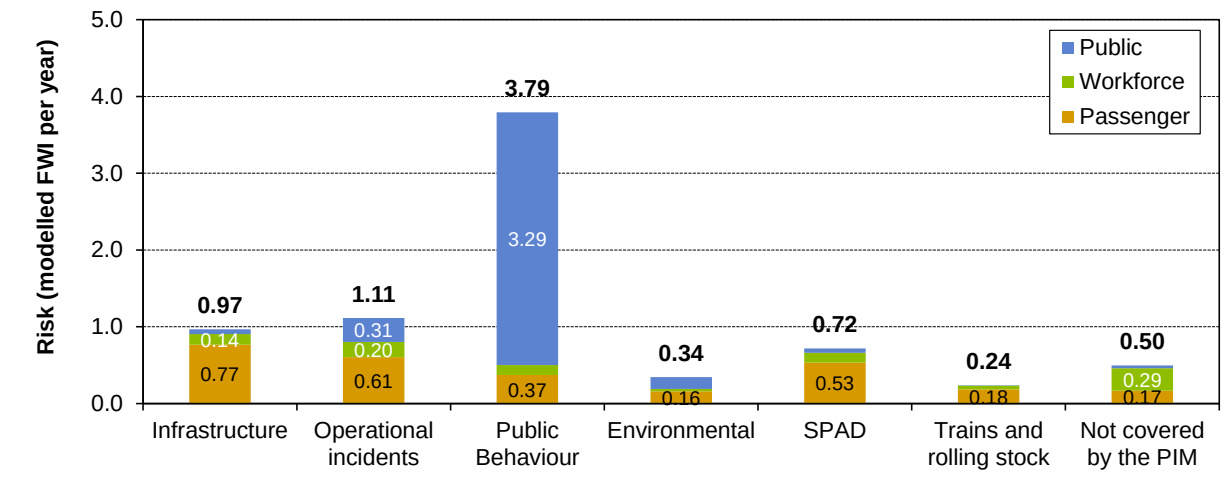
risk = frequency x consequence

Frequency estimates are based on accident precursor data and 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. To calculate the PIM, the number of occurrences each month of each accident precursor is multiplied by the average consequence per event for that precursor (as estimated from the most recent version of the SRM). This gives an estimate of the associated risk from that precursor, to be used in the PIM. Hazard rankings, assigned to certain types of precursor events by technical specialists, are used to understand the risk from them. The PIM uses risk rankings derived from these to lend weight to the potentially most severe events. For 2013/14 the model was reworked to use risk-ranked data on track faults, wrongside signalling failures and earthworks; in line with the existing approach used for SPADs and operational incidents. The risk from all precursors over the previous 12 months is then summed and scaled to reflect the increased risk exposure due to increases in rail traffic. In a further recent development, the figures are no longer rebased to a reference point in time: they are instead quoted as an estimate of FWI per year.

Train accident risk as measured by the PIM

Chart 175 shows the modelled contribution to train accident risk from each PIM group.

Chart 175. Train accident risk by PIM group and person type (SRMv8)



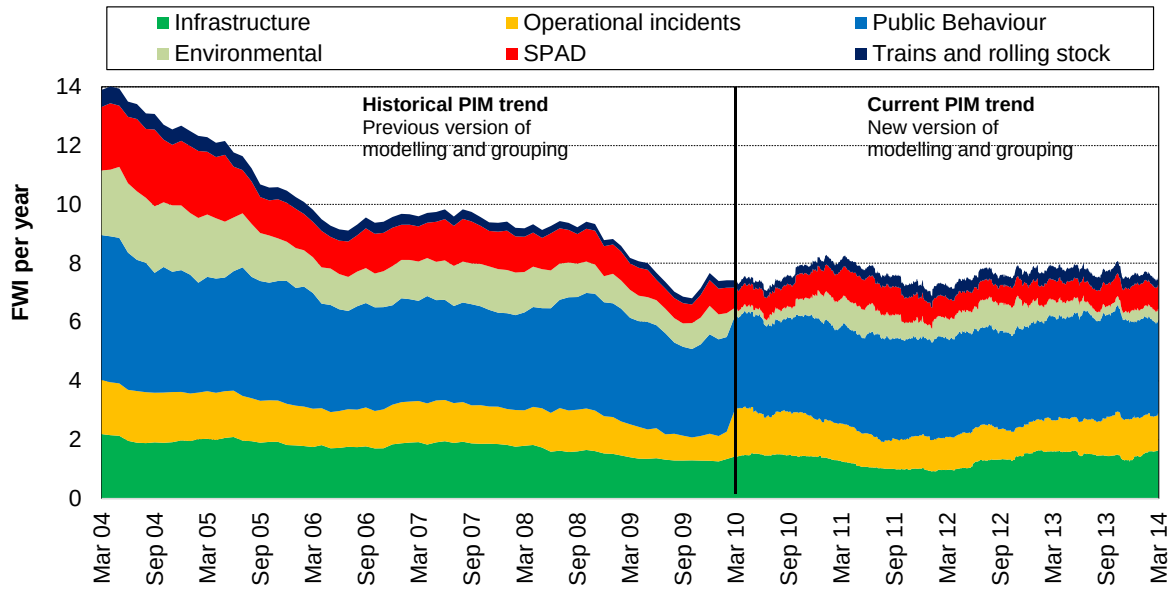
- While public behaviour at level crossings contributes most to overall risk, it has a relatively low impact on passenger and workforce safety.
- The largest contribution to passenger risk comes from infrastructure failures.

Recent developments in the PIM

In early 2012/13, the scope of the PIM was altered to bring it in line with the definition of Potentially Higher Risk Train Accidents (PHRTAs).

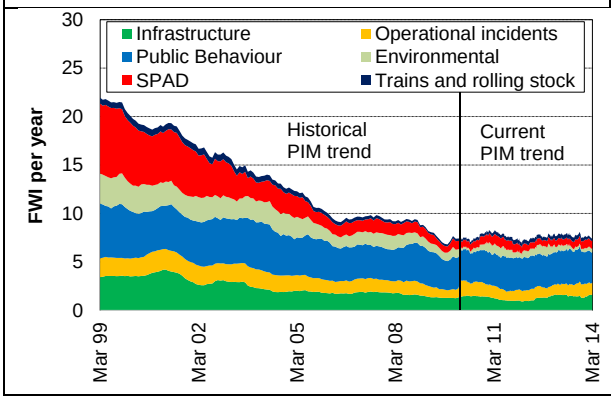
In 2013/14, the output from the PIM was changed to be an estimate of the underlying level of the risk from PHRTAs, given in FWI per year. Prior to 2013/14, the output was given as an index number, benchmarked against the PIM value at September 2006. Also in 2013/14, improvements were made that allow the model to use better sources of data as inputs and that allow for presentation of the results in a more accessible way for the industry. These data sources allow improved modelling as far back as April 2010. For this reason, the PIM ten-year trend contains a discontinuity at April 2010 and, although the trend in the total value is unaffected, the trends in the PIM subgroups cannot be compared across the discontinuity.

Chart 176. Ten-year trend in the overall PIM



- Public behaviour accounts for the greatest share of the risk, and this is suffered in a large part by members of the public using level crossings. Network Rail continues to put substantial resource into improving level crossing safety in recent years, including tackling areas to do with public behaviour that are outside of their direct control.
- At the end of 2013/14, the PIM stood at 7.52 FWI, compared with 7.90 FWI at the end of 2012/13. The main reasons behind the reduction were decreases in the PIM subgroups of *trains and rolling stock*, *public behaviour* and *environmental.*
- Looking back further, Chart 177 illustrates the large reduction in SPAD risk that was achieved prior to 2004 due to the introduction of TPWS and other SPAD initiatives.

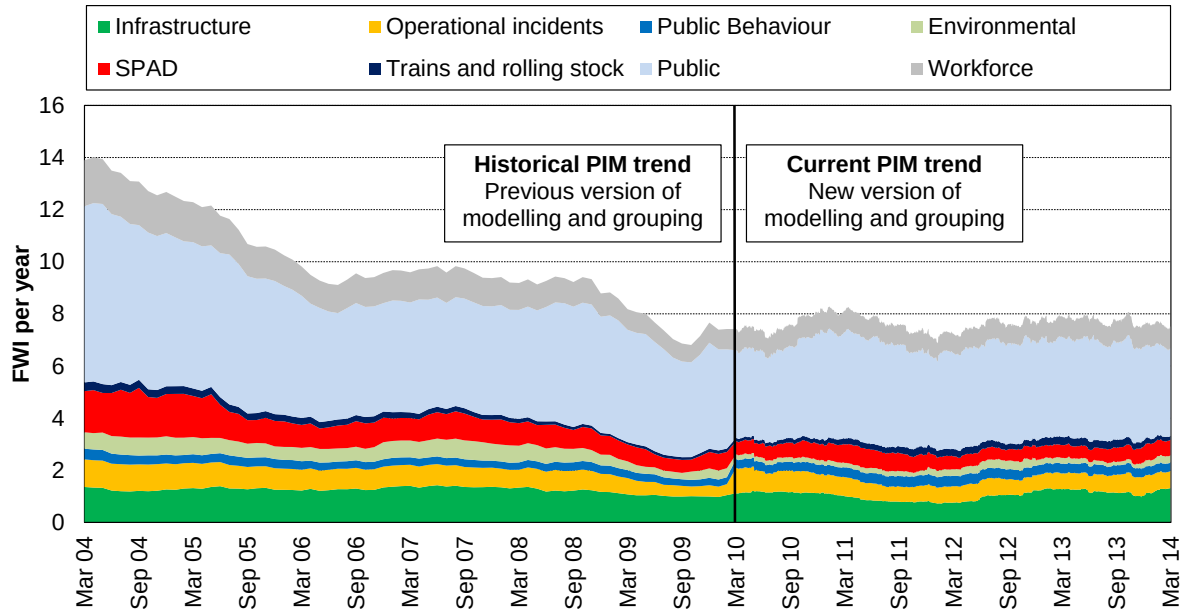
Chart 177. PIM indicator – all risk



8.7.2 Trends in the PIM indicator for passengers

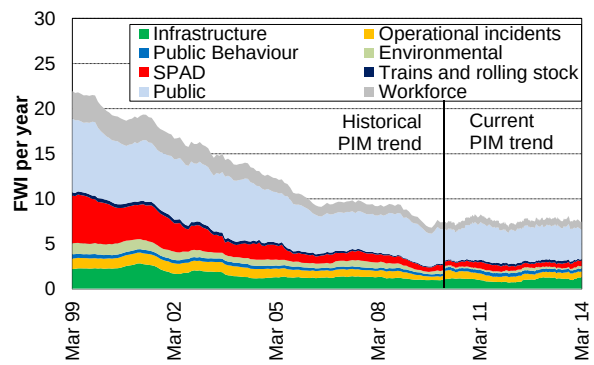
Chart 178 shows trends in the overall PIM indicator (the topmost line), and trends in the contribution of the six PIM groups to passenger risk.

Chart 178. Ten-year trend in the PIM for passengers



- The greatest share of the risk to passengers is from the *infrastructure* grouping, followed by *operational incidents* and *SPADs*.
- The passenger proportion of the PIM remained essentially level; at March 2014, it stood at 3.32 FWI, compared with 3.28 FWI at the end of the previous year.
- There has been a decrease in train accident risk as measured by the PIM over the past year from 7.9 to 7.5 FWI per year but (included within that) the indicator of passenger risk has remained very close to 3.3 FWI per year.
- In the overall train accident risk estimated by the PIM, there have been increases in Operational Incidents (0.2) and SPAD (0.1) elements, while there were reductions in Environmental (-0.2), Public behaviour (-0.4) and Trains & rolling stock (-0.2) precursor groups. The Infrastructure group showed no change since a year ago.
- The largest reduction in passengers' train accident risk over the past decade is due to SPADs. This results largely from the introduction of TPWS which was completed by the end of 2005/06 but had been reducing SPAD risk over several years prior to that.
- Over the decade Environmental and Rolling stock sections of the PIM also reduced by a large proportion, albeit of a smaller risk. The other three categories of risk (infrastructure failures, operational incidents and public behaviour) have also reduced over the same term.

Chart 179. PIM indicator – all passenger risk



Trends in the subgroups of the PIM

Table 26 shows how individual PIM subgroups have changed over the past four years. As the PIM is fully recalculated at each update, the current groupings are used throughout the period shown. Due to the change in scope to match that of PHRTAs, the current groups will not match exactly the scope of previously-reported groups.

Table 26. Changes in the PIM indicator by precursor group

	March 2011	March 2012	March 2013	March 2014
Overall PIM estimate / FWI per year	**8.13**	**7.24**	**7.90**	**7.52**
Environmental	**0.94**	**0.68**	**0.57**	**0.39**
Adhesion	0.06	0.02	0.04	0.06
Level crossing incidents due to weather	0.77	0.41	0.32	0.06
Other objects blown onto the line	0.07	0.09	0.08	0.10
Trees blown onto the line	0.04	0.16	0.13	0.16
Infrastructure	**1.26**	**0.97**	**1.60**	**1.63**
Animals on the line	0.03	0.03	0.03	0.03
Earthwork failures	0.26	0.20	0.84	0.65
Level crossing failures	0.04	0.03	0.06	0.05
Structural failures	0.08	0.06	0.09	0.18
Track faults	0.67	0.50	0.44	0.55
Wrongside signalling failures	0.18	0.14	0.13	0.16
Track drainage failures	0.00	0.00	0.00	0.00
Operational incidents	**1.28**	**1.12**	**1.06**	**1.27**
Irregular loading of freight trains	0.00	0.00	0.00	0.01
Objects left foul of the line	0.03	0.03	0.05	0.04
Operational incidents affecting level crossing	0.45	0.37	0.42	0.39
Other operational incidents	0.24	0.24	0.24	0.23
Runaway trains	0.24	0.29	0.20	0.41
Signaller errors other than Routing	0.16	0.04	0.03	0.03
Track left in unsafe condition	0.08	0.10	0.07	0.04
Train speeding	0.04	0.02	0.03	0.04
Wrong routing	0.05	0.03	0.03	0.08
Public behaviour	**3.31**	**3.35**	**3.54**	**3.17**
Bridge strikes	0.05	0.05	0.03	0.02
Objects on the line due to vandalism	0.02	0.02	0.01	0.03
Public behaviour at level crossings	2.65	2.57	2.89	2.63
Train struck by large falling objects	0.05	0.05	0.05	0.06
Vehicle incursions	0.55	0.65	0.55	0.43
SPAD	**0.98**	**0.70**	**0.68**	**0.81**
SPAD	0.98	0.70	0.68	0.81
Trains and rolling stock	**0.35**	**0.42**	**0.45**	**0.25**
Brake failures	0.04	0.07	0.03	0.01
Train failures other than Brakes	0.31	0.35	0.43	0.24

	March 2011	March 2012	March 2013	March 2014
Passenger PIM estimate / FWI per year	**3.22**	**2.82**	**3.28**	**3.32**
Environmental	0.17	0.25	0.22	0.27
Infrastructure	1.01	0.76	1.27	1.31
Operational incidents	0.73	0.63	0.60	0.67
Public Behaviour	0.38	0.40	0.37	0.33
SPAD	0.71	0.50	0.49	0.59
Trains and rolling stock	0.23	0.28	0.31	0.15

Comparing the PIM index with other measures of train accident risk

As the number of PHRTAs declines, the statistical variation in their number from one year to the next becomes greater, in relative terms.

The different risk modelling tools should not be equated, even though FWI per year is the common measurement unit. SRMv8 provides an estimate of 7.3 FWI per year for PHRTAs (out of the 7.8 FWI per year for all train accidents) based on long-term event monitoring and expert judgement. This includes some very rare scenarios which have a chance of occurring but may not yet have done so, and hence the observed safety performance (harm) can often be less than the modelled risk. This was particularly the case with the unusually low number of PHRTAs occurring in 2010/11. The PIM uses understanding taken from the SRM as a baseline of its risk knowledge and as such will give a closely aligned value at the points nominally at the completion of each SRM version's assessment period.

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.

Year-on-year changes can be difficult to interpret because factors such as the weather and chance play a role. The following points should be borne in mind when considering the different indicators of train accident risk:

- The PIM aims to provide an indication 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 being used to track. RSSB continues to examine the PIM precursors to ensure they remain good indicators of underlying train accident risk.
- The SRM provides the most thorough assessment of train accident risk, but the train accident part of the model is updated only every 18 months to two years.
- Overall, the PIM provides the best measure of short-term changes in underlying 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 providence determining which precursors materialise into train accidents.

8.7.3 Infrastructure

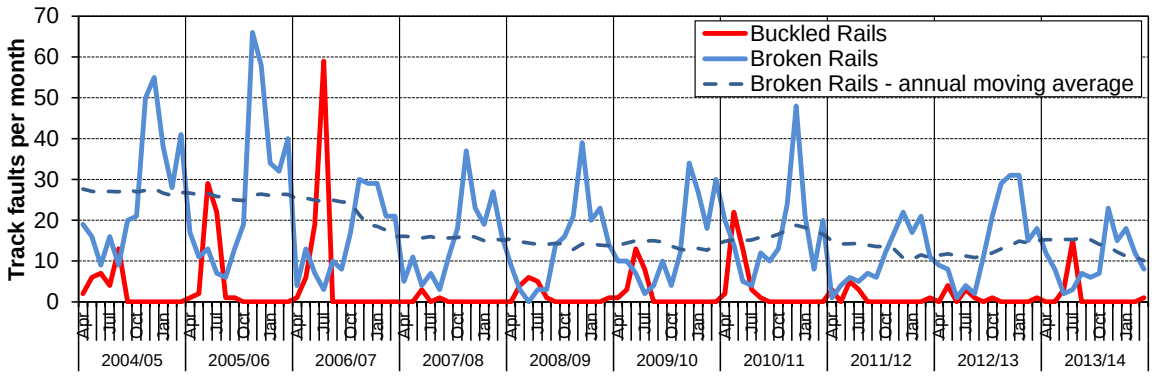
The infrastructure group of precursors covers track faults, structural failures (such as bridge and tunnel failures), environmental effects, and faults with the signalling system and level crossings. Track problems were associated with three of the most recent fatal derailments: the accidents at Potters Bar (2002) and Grayrigg (2007) were caused by facing points failure, and that at Hatfield (2000) was caused by gauge corner cracking.

The last two winters have been characterised by extensive wet weather effects, leading to increased infrastructure damage, for example, as embankments and cuttings have given way in landslips. This was a factor in many of the derailments of 2012/13 but it is notable that no passenger trains derailed in 2013/14 as a result of this or any other cause. There is a concerted effort from Network Rail in this area, both in managing the infrastructure itself and in mitigating the effects should it fail.

Track faults

The track sub-group of the PIM is informed by six separate measures – broken rails, buckled rails (as shown on Chart 180), broken fishplates, gauge faults, switch & crossing (ie points) faults, and twist & geometry faults. These are all hazard-ranked for input to the PIM. The strongly seasonal frequency of breaks and buckles is notable.

Chart 180. Trends in track failures



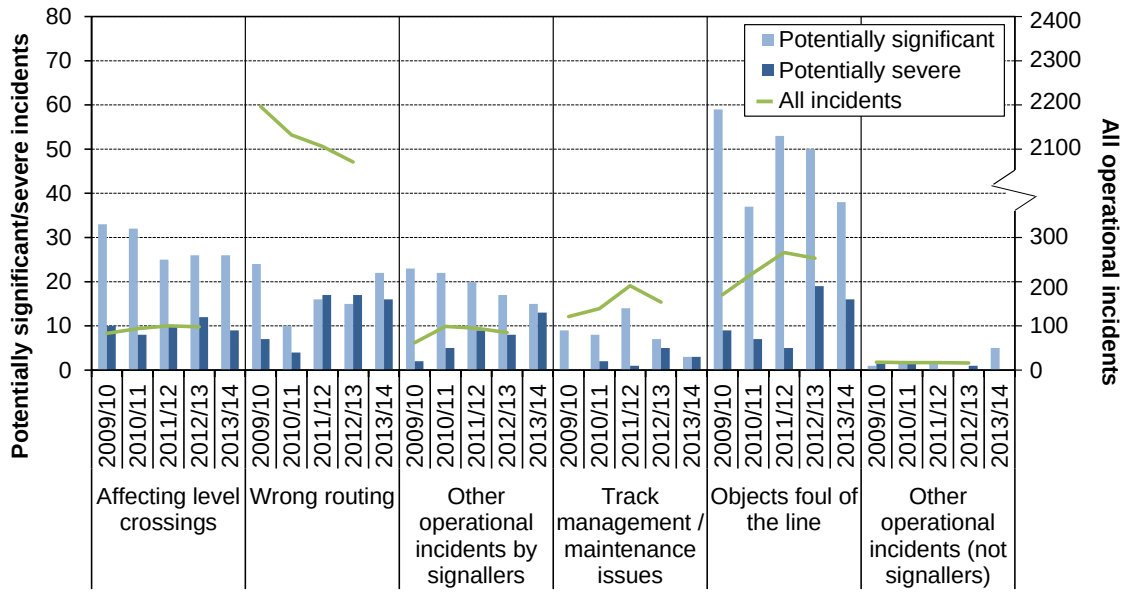
Data source: Network Rail

- Broken rails and track buckles both show seasonal trends. Broken rails are more common in cold winters (such as 2010); rails are more prone to buckling in hot summers (such as 2006).
- There was a notable reduction in the number of broken rails over the first half of the decade, due to the substantial improvements in track management that occurred after the derailment at Hatfield in October 2000. Following a fairly sustained peak during the winter of 2012/13, 2013/14 has shown a generally decreasing trend.

8.7.4 Operational Incidents

The operational incident 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 *Operational Incident* component. In 2013/14 there were 166 of these incidents that had the potential to result in a train accident and were ranked as being potentially significant or potentially severe.[62] Chart 181 shows trends in the number of these high-risk events in each of the PIM sub-groups.

Chart 181. Operational incidents by PIM subgroup



- Network Rail no longer record the rank explicitly for operational incidents which would present a negligible risk, so the total event count is not readily available for any category beyond 2012/13, hence they are not shown above for 2013/14.
- The most common cause of potentially severe and potentially significant events in 2013/14 is objects foul of the line. Most of these incidents are caused by infrastructure worker error and include incorrectly placed protection, equipment placed or left on open lines, road-rail vehicle runaways and mobile parts of machinery (such as jibs) moving too close to an open line.
- Wrong routing typically involves trains being incorrectly signalled into engineering possessions, or into sections of track that are already occupied by a train. More than two thousand incidents of wrong routing are recorded each year, but over 95% of these are ranked as having negligible risk; interlocking in the signalling system means that most signaller errors result in a fail-safe situation that does not compromise safety.

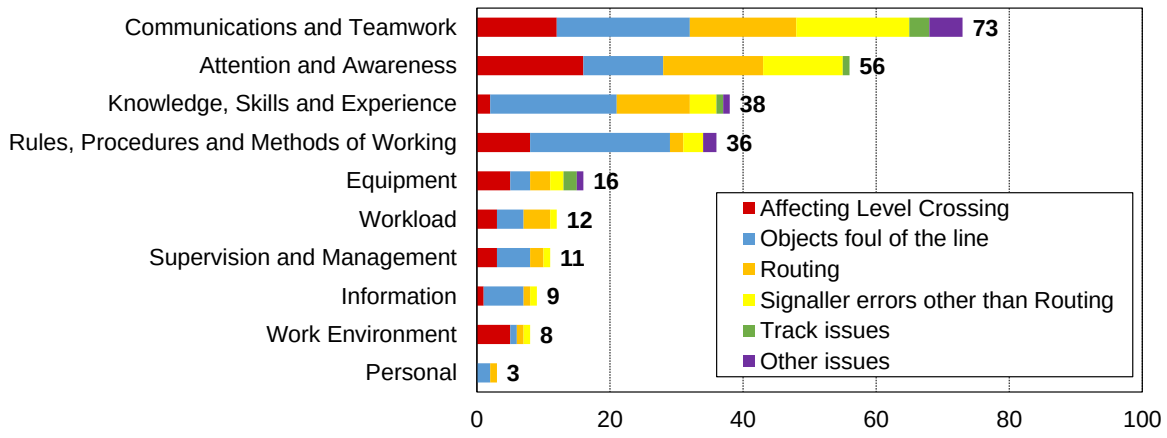
[62] Risk ranking of operational incidents is carried out by Network Rail. After an initial filter to remove those that carry no risk, the remaining events are risk ranked into one of four categories: negligible risk, low risk, potentially significant and potentially severe, based on the potential for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

- Operational incidents affecting level crossings can present a potentially severe risk due to the possibility of a collision with a road vehicle, which as well as affecting the road vehicle occupants, carries the potential for train derailment. They include, for example, signallers giving permission for road vehicles to use a crossing when a train is approaching, or failing to caution trains when a crossing is under local control. See section 9.2.11 for further analysis of these incidents.
- The Other Operational Incidents category contains very few events and thus had been generating somewhat volatile PIM results, as the model relies on reasonable precursor frequency to indicate the trend. For example, one single event in 2012/13 (which undoubtedly presented a potentially severe outcome) led to an overstated modelled risk for one year of the PIM because the baseline period for comparison included nothing of this magnitude. This scenario is not believed to represent an actual underlying risk change of quite that size, and handling this low-frequency precursor more robustly has now been addressed within the modelling used in the PIM. The categorisation of Operational Incident precursor events has been improved to remove this oversensitivity. The Other Operational Incidents section of risk remains static within the model but its trend will once again be based on precursor event frequency when a more frequent, causally related, type of event is available.

Human factors

In 2013/14, there were 166 operational incidents had the potential to result in a train accident and were ranked as being potentially significant or potentially severe. Of these, 98% were due to an error rather than a violation

Chart 182. Causal factors in operational incidents in 2013/14

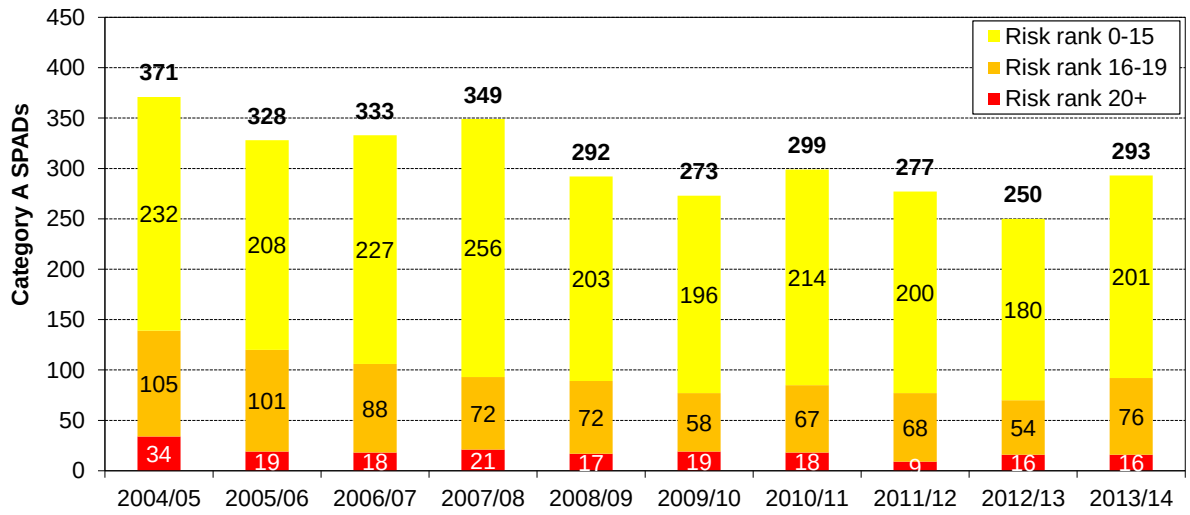


- Weaknesses involving communications and teamwork was a factor in 44% of the potentially significant or severe events.
- Just over a third of the incidents also involved some deficiency in attention and awareness.

8.7.5 SPADs

Historically, SPADs have been the cause of some of the most serious train accidents. The last fatal accident due to this cause occurred at Ladbroke Grove in 1999, where 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 183. Trend in the number of SPADs by risk ranking score[63]



- There were 293 SPADs in 2013/14, compared with 250 during the previous year.
- There were 16 SPADs with a risk ranking score of 20+ (potentially severe), which is the same as in 2012/13.
- Since TPWS was introduced, there have been a number of events where the driver has reset TPWS and continued forward without the signaller's authority. Although such events are relatively rare, they are potentially serious because they negate the safety benefits of TPWS.
- Table 27 shows instances of reset and continue events following a SPAD. There were three TPWS reset and continue incidents in 2013/14.

Table 27. TPWS reset and continue events

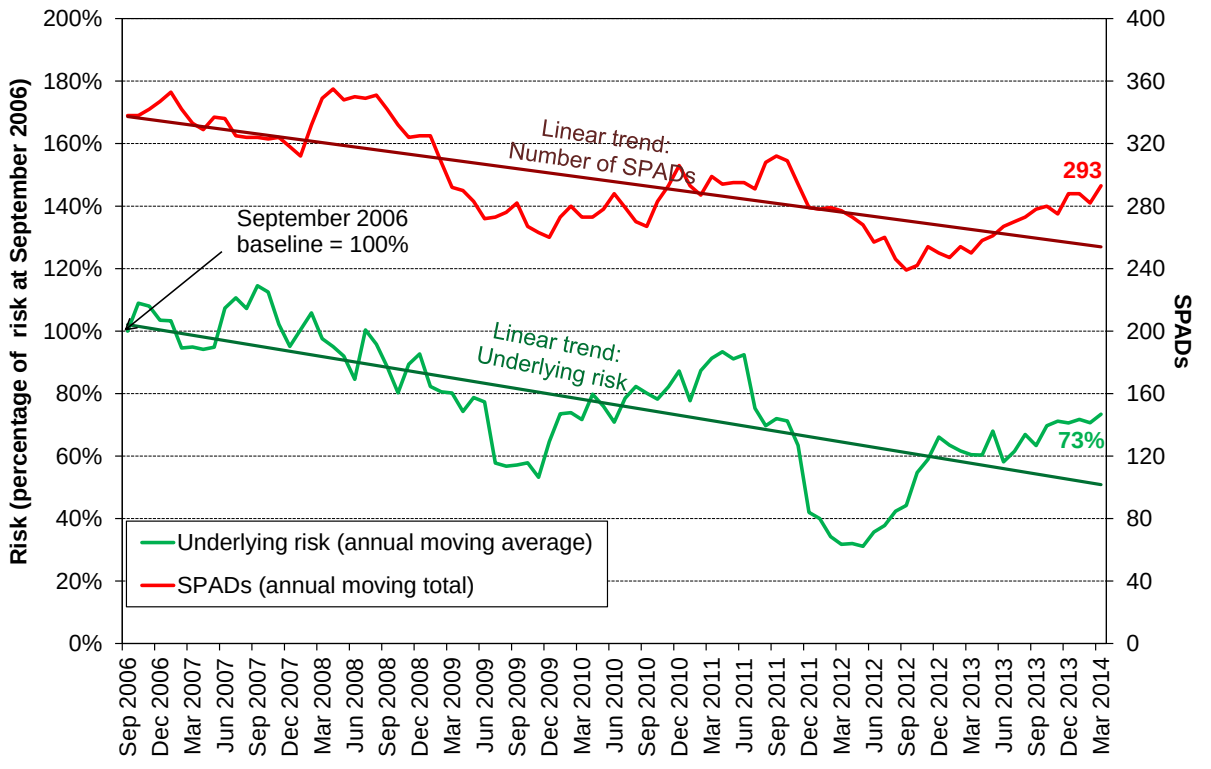
Year	Events
2009/10	1
2010/11	3
2011/12	2
2012/13	2
2013/14	3

[63] 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. The estimated risk, labelled *Underlying risk* in Chart 184, is based on the number and characteristics of SPADs that have occurred during the previous 12 months. The baseline date is set to September 2006, after the introduction of TPWS and removal of Mark I rolling stock.

Chart 184. Trend in SPADs and SPAD risk



- At the end of 2013/14, the number of SPADs showed a 17% increase on the number for 2012/13. The estimated level of SPAD risk also increased from the level seen at the end of 2012/13. Nevertheless, at the end of March 2014 it was still 27% lower than the September 2006 baseline level.
- RSSB and the wider industry are continuing to focus on SPAD risk to understand both the underlying causes behind it, and how to model it more effectively.

8.7.7 Public behaviour

The public behaviour group include incidents such as objects on the line due to vandalism or vehicle incursions, and accidents at level crossings due to actions of the crossing user.

Most of the risk from striking objects on the line is attributable to any subsequent train derailment, with larger objects (such as road vehicles involved in incursions) generally presenting a higher likelihood of serious consequences. In total, the year saw 48 road vehicle incursions compared with 57 in 2012/13. See Section 9.3 for further analysis.

There was one incident of a train colliding with a road vehicle other than at level crossings in 2013/14: a car, which had been parked, rolled onto a running line and was struck by a passenger train. The car was unoccupied at the time of the event, and there were no injuries on the train.

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

The PIM measure of risk from user action at level crossings reduced during 2013/14. Network Rail continues to put a lot of resource into reducing level crossing risk, for example through its programme of crossing closures and its media campaigns to raise awareness among level crossing users. See Chapter 9: *Road-rail interface* for more information.

8.7.8 Trains and rolling stock

The modelled risk from trains and rolling stock defects is one of the smallest of the six PIM groups. Nevertheless, rolling stock failures have the potential to cause serious accidents.

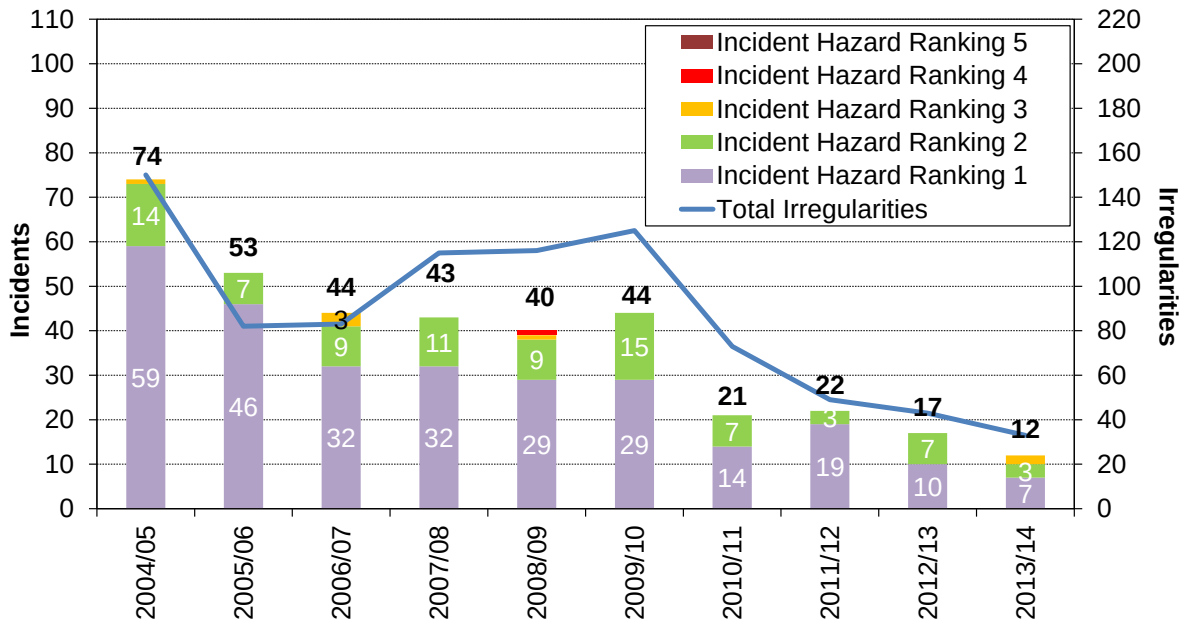
The last fatality from a rolling stock defect in Great Britain occurred at Rickerscote in 1996. A freight train derailed when an axle fitted to one of its wagons completely fractured. It was struck by a Post Office train running in the opposite direction, killing a Royal Mail employee.

8.8 Dangerous goods

The consequences of a train accident are potentially more severe if dangerous goods are involved. In 2013/14, there were three PHRTAs that involved trains conveying dangerous goods, but no dangerous goods incidents were reportable under RID (the Regulations concerning the International Carriage of Dangerous Goods by Rail, part of the Convention concerning International Carriage by Rail). There have been significant dangerous goods accidents outside Great Britain; the most recent occurred in July 2013 in Quebec, Canada and involved a train carrying petroleum crude oil, which derailed and caught fire, killing forty-seven members of the public. For more information, see section 4.3.2.

The industry prioritises and addresses issues arising from trains conveying dangerous goods by identifying incidents (ie those events where personal injury, material damage, or loss of dangerous goods occurs) and irregularities (ie those events where, typically, a procedural error such as incorrect documentation occurs). Incidents account for around one-third of reported events, and irregularities for the remaining two-thirds. A hazard ranking system is used to reflect criteria including the type of goods carried, the nature of the event and the location. Hazard Rank 1 is used for the least serious events, and Hazard Rank 5 is used for the most serious. Over the past ten years, incidents and irregularities of all hazard rankings have been generally declining.

Chart 185. Incidents and irregularities involving trains conveying dangerous goods



- Two Hazard Rank 3 incidents occurred in 2013/14. In the first incident, a wagon with a loaded flask ran away and collided with a security gate, but did not derail and the flask was not damaged. In the second incident, a locomotive carrying radioactive substances (hence the higher ranking) was halted after activating a hot axle detector, due to slightly dragging brakes. The last incident of this ranking occurred in 2008/09, along with the only Hazard Rank 4 incident recorded in the last ten years.
- A common type of Hazard Rank 2 event is dragging brakes, caused by either a technical defect or human error, such as a handbrake left on. The heat from dragging brakes is frequently detected by hot axle box detectors (HABD). These are track-mounted systems intended to identify excessive heat generated in axle bearings (indicative of the potential for an imminent axle failure in running, which could lead to a derailment) rather than the lower-risk situation of a dragging brake.

8.9 Learning from operational experience: train accidents

The Learning from Operational Experience Annual Report 2013/14 covers train accident risk in Chapter 7: *Lessons learned 2013/14 – train accidents*.

The chapter focuses on overseas incidents, derailments, SPADs, and the risk from animals on the line. In particular, the report discusses:

- The spate of train accidents occurring during July 2013 in Canada (6 July – 47 fatalities), France (12 July – 6 fatalities), Spain (25 July – 79 fatalities) and Switzerland (29 July – 1 fatality).
- The risks associated with the transportation of crude oil, and other potentially dangerous goods.
- Industry initiatives and investigations into SPADs.
- The publication of the second edition of RSSB's special topic report on the risk from trains striking animals.

8.10 Train accident key safety facts[64]

Train accidents	2009/10	2010/11	2011/12	2012/13	2013/14
Fatalities (excluding suicides)	**7**	**0**	**1**	**6**	**2**
Passengers	0	0	0	0	0
Workforce	0	0	0	0	0
Members of the public	7	0	1	6	2
Weighted injuries (excluding suicides)	**1.18**	**1.40**	**0.83**	**0.40**	**0.55**
Passengers	0.39	0.71	0.16	0.05	0.22
Workforce	0.57	0.50	0.35	0.22	0.32
Members of the public	0.21	0.20	0.32	0.12	0.01
Total train accidents	**577**	**520**	**545**	**695**	**636**
PHRTAs	**42**	**18**	**33**	**35**	**32**
Involving passenger trains	26	14	18	21	17
Collisions between trains	4	1	5	5	5
Derailments	8	5	0	7	0
Collisions with road vehicles not at LC	2	0	2	2	1
Collisions with road vehicles at LC (not derailed)	12	4	7	7	8
Collisions with road vehicles at LC (derailed)	0	1	2	0	0
Striking buffer stops	0	2	2	0	3
Struck by large falling object	0	1	0	0	0
Not involving passenger trains	16	4	15	14	15
Collisions between trains	0	1	1	1	1
Derailments	12	3	13	9	11
Collisions with road vehicles not at LC	2	0	0	1	0
Collisions with road vehicles at LC (not derailed)	2	0	0	3	2
Collisions with road vehicles at LC (derailed)	0	0	0	0	0
Striking buffer stops	0	0	1	0	1
Struck by large falling object	0	0	0	0	0
Non-PHRTA train accidents	**535**	**502**	**512**	**660**	**604**
Involving passenger trains	469	440	432	562	524
Open door collisions	1	0	0	0	0
Roll back collisions	3	6	1	5	0
Striking animals	144	168	169	324	268
Struck by missiles	141	90	57	66	52
Train fires	68	53	43	40	31
Striking level crossing gates/barriers	2	7	2	1	5
Striking other objects	110	116	160	126	168
Not involving passenger trains	66	62	80	98	80
Open door collisions	1	0	0	0	0
Roll back collisions	0	2	0	0	0
Striking animals	16	19	21	22	26
Struck by missiles	22	8	10	6	3
Train fires	6	9	8	11	5
Striking level crossing gates/barriers	4	1	2	1	0
Striking other objects	17	23	39	58	46
PIM risk estimate (FWI per year)	**7.40**	**8.13**	**7.24**	**7.90**	**7.52**
Public behaviour	3.20	3.31	3.35	3.54	3.17
SPAD	0.90	0.98	0.70	0.68	0.81
Trains and rolling stock	0.30	0.35	0.42	0.45	0.25
Operational incidents	0.90	1.28	1.12	1.06	1.27
Environmental	0.80	0.94	0.68	0.57	0.39
Infrastructure	1.30	1.26	0.97	1.60	1.63

[64]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*.

PIM precursors	2010/11	2011/12	2012/13	2013/14
Public behaviour				
Bridge strikes	1598	1541	1507	1634
Non Rail vehicles on the line	59	65	57	47
Non-Passenger trains striking objects due to vandalism	4	7	7	3
Passenger trains striking objects due to vandalism	43	38	20	33
Public behaviour (Active automatic level crossings)	43	40	48	40
Public behaviour (Active manual level crossings)	12	6	19	7
Public behaviour (Passive level crossings)	83	85	67	65
SPADs				
SPADs	299	277	250	293
Trains and rolling stock				
Non-Passenger defects (other than brake/control)	6	7	10	5
Passenger defects (other than brake/control)	51	42	51	32
Brake/control defects	23	33	19	6
Operational incidents				
Displaced or insecure loads	27	29	19	27
Objects foul of the line	366	332	307	272
Other issues	365	366	365	365
Routing	2110	2073	2057	1987
Signaller errors other than routing	23	21	19	18
Track issues	136	172	157	129
Affecting level crossings	83	81	74	87
Runaway trains	6	6	2	5
Train Speeding (approaching bufferstops)	11	10	12	14
Train Speeding (non-passenger)	55	60	42	41
Train Speeding (passenger)	79	73	81	104
Environmental				
Adhesion	206	82	155	280
LC incidents due to weather (Active automatic)	4	2	3	1
LC incidents due to weather (Active manual)	4	4	4	5
LC incidents due to weather (Passive)	3	0	0	1
Non-Passenger trains running into other obstructions	11	19	21	17
Non-Passenger trains running into trees	17	30	39	125
Passenger trains running into other obstructions	61	84	97	129
Passenger trains running into trees	62	242	232	551
Infrastructure				
Animals on the line	1529	1543	1667	1622
Broken fishplates	402	362	431	327
Broken rails	199	129	180	121
Buckled rails	41	12	10	19
Culvert failures	4	3	6	25
Cutting failures	39	30	150	137
Embankment failures	10	3	49	45
Flooding	39	31	223	121
Gauge faults	2	3	4	3
LC failures (Active automatic)	863	729	977	837
LC failures (Passive)	578	612	985	924
Overline bridge failures	9	10	14	28
Rail bridge failures	12	21	33	61
Retaining wall failures	2	4	5	6
S&C faults	646	570	408	386
Tunnel failures	9	5	8	11
Twist and geometry faults	19	8	8	12
Wrongside signalling failures	10115	9442	8842	9049

The PIM uses risk ranked operational incidents, but events in 2013/14 which would have been given zero risk are no longer ranked. Zero-ranked events from prior years are still shown in this table but do not contribute to the PIM.
Only those operational incidents judged to have had the potential to cause a train accident are featured in the table.
The train striking objects measures include all incidents of trains striking objects and not just the RIDDOR-reportable ones shown in the train accident key safety facts sheet.

9 Road-rail interface

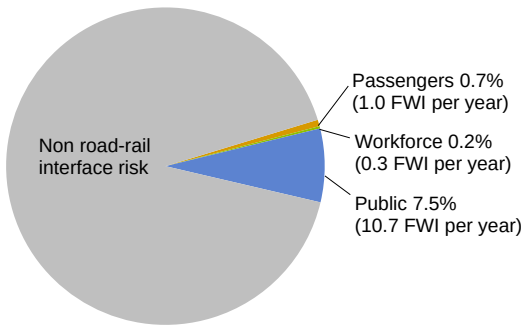
This chapter covers the risk related to level crossings, vehicle incursions onto the railway and bridge strikes. Much of the risk at the road-rail interface is caused by public behaviour, and most casualties are road vehicle[65] occupants and pedestrians. Network Rail put significant resource into reducing the risk at level crossings and, after targeting a 25% reduction in risk by the end of Control Period 4 (March 2014), the total level of FWI for CP4 was 28% lower than the CP3 total.

2013/14 Headlines

- Excluding suicides, six pedestrians, including a cyclist, and two road vehicle occupants died in accidents at level crossings in 2013/14. There were five major injuries, 51 reported minor injuries and 15 cases of shock or trauma. This equated to a total FWI of 8.7, which is lower than the 2012/13 figure and below the average over the past ten years.
- There were ten collisions between trains and road vehicles at level crossings during the year, which is no change from the figure seen in 2012/13. There has been an average of 12.3 accidents per year since 2004/05. There is evidence that the underlying rate of collisions at level crossings has reduced over this period.
- The number of near misses with road vehicles at level crossings was broadly unchanged from the previous year, and has fallen over the past decade. Conversely, reports of near misses with pedestrians and cyclists have increased over the same period, although showed a small decrease in 2013/14.
- Overall, there were fewer road vehicle incursions onto the railway in 2013/14, compared with the previous year. One resulted in a vehicle being struck by a train. Most incursions result from road traffic accidents, and there is no discernable trend in these incidents.
- There was a slight increase in total bridge strikes in 2013/14, as well as an increase in those classified as *serious* or *potentially serious.* Although these are both below their ten year averages.

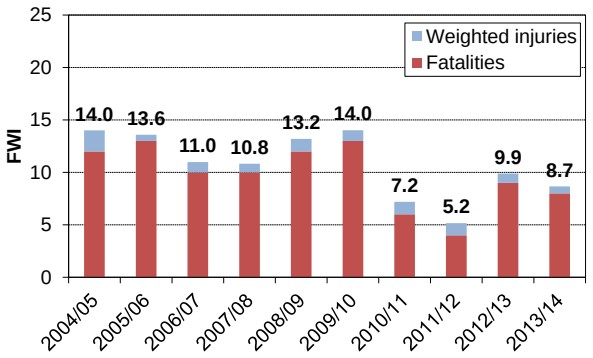
Road-rail interface safety at a glance

Road-rail interface risk in context (SRMv8)



Road-rail interface risk = 12.0 FWI per year (8.4% of total risk)

Trends in level crossing safety



[65] The term *road vehicle* is used in this report to describe a range of vehicles, including farm machinery, motorcycles and off-road vehicles such as quad bikes. It does not include pedal cycles, whose users are grouped with *pedestrians*.

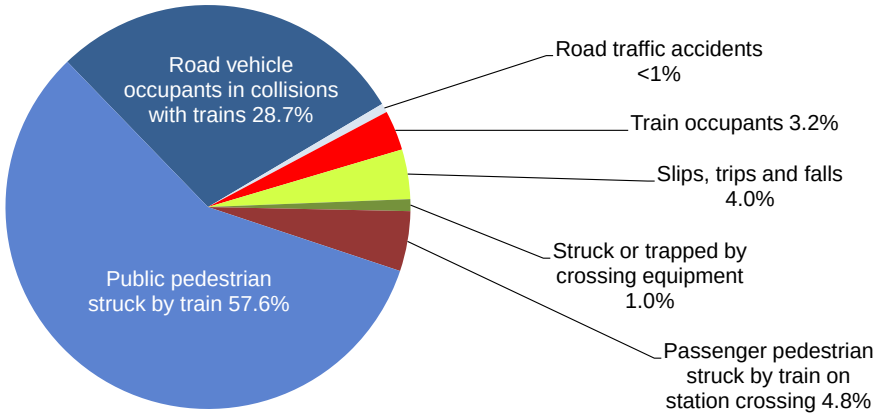
9.1 Risk at the road-rail interface

The modelled risk at the road-rail interface is 12.0 FWI per year,[66] which is 8.4% of the total risk (excluding suicide). The modelled risk at level crossings is 11.4 FWI per year.

- At 11.4 FWI per year, the modelled risk at level crossings accounts for 95% of the road-rail interface risk. Level crossings are an open interface between the road and the railway, so there is increased potential for pedestrian and road user behaviour to affect train operations.
- Road vehicle incursions account for 4% of the remaining risk. This includes the risk from car accidents where the vehicle subsequently crashes through the railway boundary protection.
- Bridge strikes account for the final 1%. 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.

If injuries to road vehicle occupants are included, collisions at level crossings are the largest single cause of train accident risk (see Chapter 8: *Train accidents*). However, level crossing safety in the UK compares favourably with that in other European countries.

Chart 186. Level crossing risk by event and user type, from SRMv8 (11.4 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 (58%), followed by passengers being struck on station crossings (5%).
- 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.
- Approximately 3% of the risk at level crossings is to passengers and members of the workforce on board the train.
- Less than 1% of the risk is due to road traffic accidents that occur in relation to level crossings, but do not result in train accidents (eg collisions with barriers).

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, an updated version is in preparation and will be available from the RSSB website.

[66] 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.

9.2 Level crossings

9.2.1 Types of crossing

Level crossings vary in the level of protection they offer. 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 28. Level crossing categories by class and type (February 2014)

Crossing type				Number
Passive		UWC-T	User-worked crossing with telephone	1654
		UWC	User-worked crossing	620
		OC	Open crossing	50
		FP	Footpath crossing	2406
Active	Manual	MCG	Manually controlled gate	137
		MCB	Manually controlled barrier	200
		MCB-OD	Manually controlled barrier with obstacle detection	18
		MCB-CCTV	MCB monitored by closed-circuit television	416
	Automatic	AHB	Automatic half-barrier	448
		ABCL	Automatic barrier locally monitored	53
		AOCL-B	Automatic open crossing locally monitored with barrier	20
		AOCL/R	Automatic open crossing locally or remotely monitored	89
		UWC-MWL	User-worked crossing with miniature warning lights	99
		FP-MWL	Footpath crossing with miniature warning lights	112
Total				**6322**

- 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 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. Network Rail began a programme of installing half barriers at 70 of these automatic open crossings throughout 2013/14, after a trial installation was completed.
- 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. 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. The category also includes bridleway crossings and barrow crossings.

An illustrated guide to the different level crossing types, may be found in Appendix 7.

Data source: Network Rail level crossing census. The table shows open active level crossings as at 19 January 2014. Numbers have reduced somewhat since that time as a result of Network Rail's programme of level crossing closures. Level crossings that were temporarily closed, no longer used, or on mothballed lines were omitted from the table.

9.2.2 Risk profile at level crossings

Network Rail uses the All Level Crossing Risk Model (ALCRM) to:

- Evaluate safety risks associated with individual level crossings, based on characteristics such as usage, road speed and layout, train speed and frequency, and the level of protection provided by the crossing, as well as factors such as the duration of warnings and closures.
- Estimate operational losses (delay costs) associated with accidents at level crossings.
- Conduct cost-benefit analyses of the options for reducing risk at level crossings.

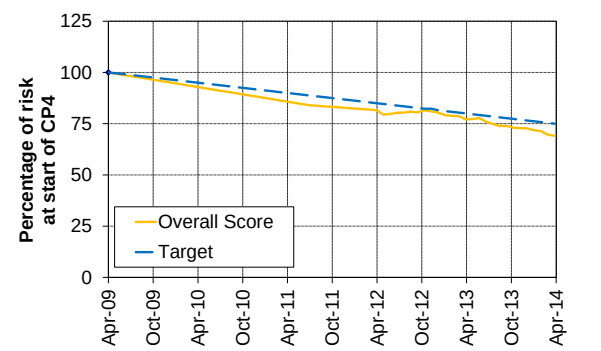
Network Rail developed a model called the Level Crossing Risk Indicator Model (LCRIM) to track risk at level crossings and regularly monitor progress towards the target of reducing risk by 25% over the duration of CP4, actually achieving a reduction of 31%.

Results from the SRM and ALCRM inform the LCRIM. While the SRM is only updated periodically, the development of the LCRIM enables Network Rail to track progress on a more regular basis.

Chart 187 shows the LCRIM and the progress made in CP4. The blue dashed line shows the projected risk reduction target and the orange line is the actual risk reduction score, which has met the 25% risk reduction targeted for CP4.

- The LCRIM uses data from the ALCRM and is updated every four weeks. It is calibrated against risk estimates from the SRM.
- The risk score is expressed as an index, with a baseline score of 100 at the start of CP4. This allows the percentage reduction in risk from the start of the control period to be monitored easily.
- The achieved reduction in FWI at the end of 2013/14 was 31% (69.1 index points). The target was a 25% reduction (to 75 index points).
- The benefits associated with CP4 level crossing initiatives were calculated using the 'optioneering' capability within ALCRM. When initiatives such as closure or diversion and improved technology such as installation of barriers and spoken yodel alarms were implemented, the risk reduction was reflected in ALCRM and also the LCRIM (see section 9.2.3 for more detail on current projects and initiatives).

Chart 187. Level Crossing Risk Indicator Model – overall score



Data source: Network Rail

9.2.3 Initiatives to reduce the risk at level crossings

Improving level crossing safety is currently a major focus for the industry. Network Rail has put a level crossing risk reduction programme in place, and has met the targeted reduction in level crossing risk of 25% over the course of CP4. A further substantial safety improvement is planned for CP5, which runs from April 2014 to March 2019.

Among the safety projects currently underway are:

- Recruitment has been completed for the 100+ dedicated Level Crossing Managers and Route Level Crossing Managers. This initiative is to support the continued improvement of asset inspections as well as data collection for risk assessment and modelling. Their role includes building relationships with authorised users and in the wider local community to understand local risks. All new Route teams have gone operationally live. A new comprehensive training course has been developed and introduced for the level crossing teams. Over 2,000 days of training were provided to support the delivery of the new operating regime.
- The programme of level crossing closures has continued through 2013/14. A further 146 crossings were closed during the year, bringing the total closed since 2009 up to 804. The programme will continue in CP5 with a targeted focus on high risk passive crossings.
- High risk footpath crossings are being replaced by footbridges, in line with a policy decision to remove the need for pedestrians to cross high speed main lines unprotected by barriers. Across the network, 15 new modular footbridges were erected in 2013/14 to close crossings.
- Work has continued for the development of red light safety cameras with number plate recognition technology. Three systems are currently nearing Home Office Type Approval with a planned deployment at 28 AHB or AOCL level crossings. Commissioning is due in October 2014.
- Fifteen mobile safety vehicles continue to operate. The vehicles are staffed by BTP and they have detected and prosecuted more than 1,500 motorists responsible for red light violations since 2012.
- Audible warning devices have been developed, which provide a spoken warning which advise pedestrians; “Warning: another train is approaching”. They have been installed at 117 level crossings. This is to ensure that pedestrians understand that it is not safe to cross when the crossing sequence continues after a first train has entered, or passed through, the station.
- Network Rail continues to develop a range of technologies to locate trains in long signal sections, including GPS and sound wave based solutions. A new overlay system, Vamos, is currently operating in “shadow” mode and is likely to receive product acceptance in July 2014.
- Power operated gate openings are being installed at over 300 user-worked crossings. These devices avoid the need for users to leave their vehicles and make multiple traverses over a crossing on foot. Installation will be complete by November 2014.
- Barrier overlays have been installed at 15 AOCL level crossings in England and Wales and 17 AOCL level crossings in Scotland. A further 30 installations will be completed by November 2014. The provision of barriers enhances user safety.

9.2.4 Level crossing incidents: industry terminology

In The House of Commons Transport Committee met towards the end of 2013, to discuss safety at level crossings. The Committee's report on the subject[67] was published in March 2014.

In the report, the Committee expressed concern that the word 'misuse' is "*..used indiscriminately when referring to level crossing incidents*." It noted that the term 'misuse' "*…does not differentiate between wilful negligence, such as jumping barriers, and situations that impair human decision-making, such as being unable to see clearly the railway boundary*".

The Committee made the following recommendation:

> *76. We recommend that the rail industry, government and Office of Rail Regulation stop using the term "misuse" in relation to accidents at level crossings and instead adopt "deliberate misuse" where the evidence supports this and "accident" where it does not.*

In its response to this recommendation, published May 2014[68], the Government stated:

> *The Government and ORR welcome the Committee's recommendation and agree that the term "misuse" in this context is unhelpful. The Government will work with ORR, the industry and other stakeholders to develop and agree common language and definitions that should be used.*

In line with the Transport Committee recommendation, the term misuse has not been used in the current ASPR.

[67] http://www.publications.parliament.uk/pa/cm201314/cmselect/cmtran/680/680.pdf
[68] http://www.publications.parliament.uk/pa/cm201314/cmselect/cmtran/274/27404.htm

9.2.5 Level crossing fatalities and injuries in 2013/14

Fatalities

Excluding suicides and suspected suicides, eight people (six pedestrians, including a cyclist, and two road vehicle occupants) died in accidents at level crossings in 2013/14. Table 29 shows details of the pedestrian fatalities; the road vehicle fatalities are described alongside other collisions between trains and road vehicles in Table 30.

Table 29. Pedestrian fatalities at level crossings in 2013/14

Date	Location	Territory	Type	Description
07/04/2013	Blackhills Farm (County Durham)	London North Eastern	UWC+T	A 28-year old male was struck by a train. The deceased was chasing his dog at the time of the accident.
27/06/2013	Marlow (Buckinghamshire)	Western	Footpath	A 35-year old male was struck by a train.
11/07/2013	Springfield Road (Highbridge) (Somerset)	Western	Footpath	A 34-year-old male pedestrian was struck by a train. The train driver sounded their horn and applied the emergency brake, but could not prevent the accident.
03/10/2013	Dernford (Cambridgeshire)	South East	Footpath (MWL)	A 75-year old male pedestrian was struck by a train. The train involved was the second over the crossing in a short period.
26/10/2013	Barratts Lane No.2 (Nottinghamshire)	London North Eastern	Footpath	A 90-year old female pedestrian was struck by a train. The train involved was the second over the crossing in a short period.
24/03/2014	Cattishall (Suffolk)	South East	Footpath	A 42-year old male cyclist was struck by a train. The train driver sounded the horn, but could not prevent the accident. It appeared the deceased was wearing headphones.

Major Injuries

There were five major injuries at level crossings in 2013/14.

- Three cyclists received major injuries as a result of falling off their bikes.
- One pedestrian received major injuries as a result of being struck by lowering barriers.
- One member of workforce also received major injuries as a result of falling on the crossing surface.

Minor Injuries

There were 51 reported minor injuries, mostly resulting from falls or being struck by crossing equipment.

- A collision between a tractor and a train at Buttington level crossing resulted in 13 minor injuries to passengers on the train, there were also minor injuries to train driver and train guard.

Shock and trauma

There were 15 reports of shock or trauma, mostly affecting train drivers involved in accidents.

9.2.6 Collisions between trains and road vehicles in 2013/14

There were ten collisions between trains and road vehicles at level crossings during the year. One of the events resulted in two fatalities to occupants of the road vehicle (in italics).

Two collisions, shown in red, were subject to RAIB investigations.

Table 30. Collisions between trains and road vehicles at level crossings in 2013/14

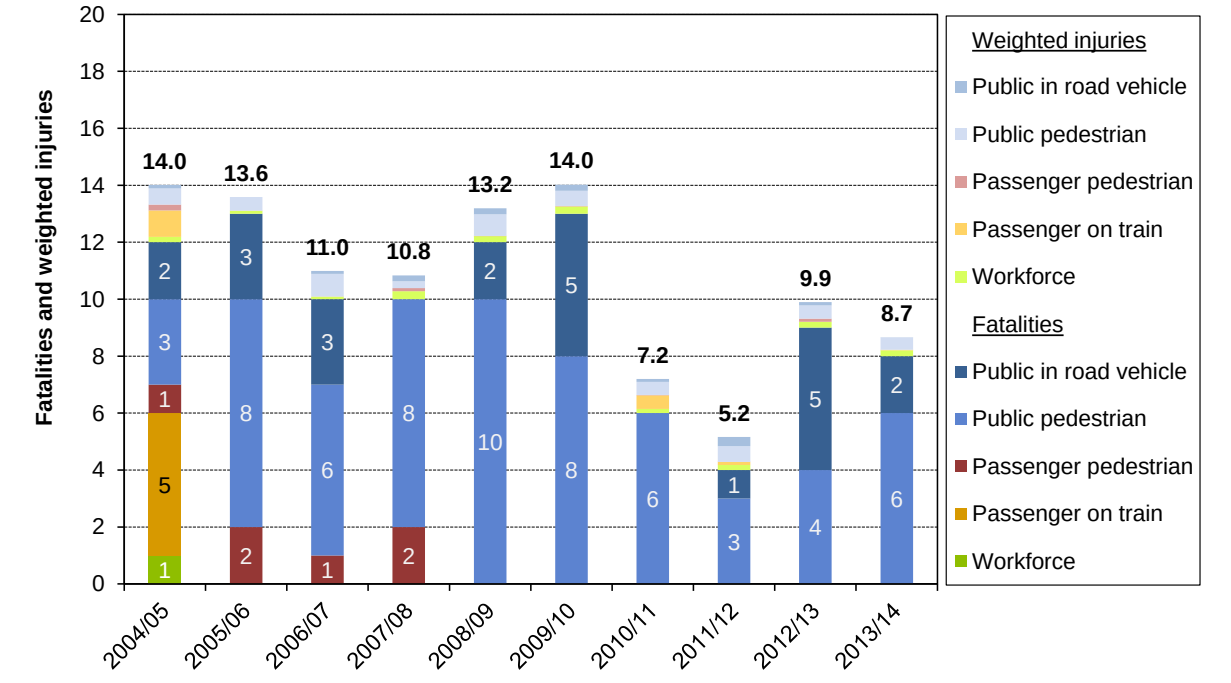
Date	Location	Territory	Type	Description
09/04/2013	*Great Coates (Humberside)*	*London North Eastern*	*AHB*	*A passenger train struck a car at the AHB crossing at Great Coates station. The train was not derailed by the impact. There were two fatalities in the car, which appears to have been driven around the barriers.*
09/06/2013	Brompton (North Yorkshire)	London North Eastern	AHB	A freight train struck a motorcycle which was lying on the crossing after the motorcyclist had become unseated. The train did not derail, and the motorcyclist was not involved in the collsion.
24/06/2013	Ffynnongain (Dyfed)	Western	UWC-MWL	A passenger train struck a mobility scooter on Ffynnongain Crossing. The elderly scooter-user had dismounted, leaving the scooter on the line, in order to re-open the exit-gate which had swung closed.
29/06/2013	North Green (Suffolk)	South East	AOCL	A car driver attempted to cross ahead of an appropaching train despite acknowledging stop signals for road traffic. The car struck the side of the train, which was not derailed. The car driver was taken to hospital with minor injuries.
14/07/2013	Jetty Avenue (Suffolk)	South East	UWC	A passenger train struck a car and trailer at Jetty Avenue user-worked level crossing, The train was not derailed by the impact. Actions of another member of the public had been interpreted by the unfamiliar crossing-user as permission to traverse the crossing.
16/07/2013	Buttington Hall (Powys)	Western	UWC-T	A passenger train struck a trailer being towed across Buttington Hall user-worked crossing by a tractor. The train did not derail, but various passengers reported minor injuries.
12/11/2013	Sandy Lane (Oxfordshire)	Western	AHB	A passenger train struck a car which had been driven onto Sandy Lane AHB crossing in a suicide attempt. The train did not derail. The car driver suffered only minor injuries.
31/12/2013	Ruswarp (North Yorkshire)	London North Eastern	UWC	A train struck a vehicle on a user-worked crossing on the approach to Ruswarp Station. The road user is the sole user of that crossing. The train was slowing down to 20mph on the approach to Market Garden Crossing and was not derailed. The traincrew suffered shock but there were no other injuries.
05/01/2014	Hoghton (Lancashire)	London North Western	AHB	A train struck an unoccupied car at Hoghton AHB crossing. The vehicle had been parked nearby and ran away, coming to rest onto the crossing where it was subsequently struck a glancing blow. The train was not derailed and there were no injuries.
14/01/2014	Silverdale (Lancashire)	London North Western	AHB	A freight train struck an unoccupied car which had become stranded in the cattle grids on Silverdale AHB crossing. The train did not derail and there were no injuries.

In all cases, the crossing equipment was working correctly at the time of the accident.

9.2.7 Trends in harm at level crossings

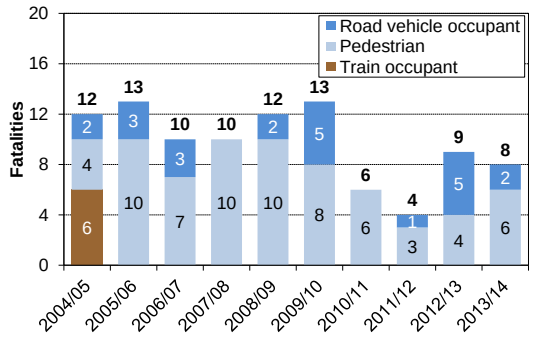
Most of the harm at level crossings arises from pedestrians, cyclists and road vehicles being struck by trains. Some people are also injured each year as a result of being hit by or colliding with crossing barriers, and from slips, trips and falls.

Chart 188. Harm at level crossings (excluding suicides)[69]



- The total level of harm at level crossings in 2013/14 showed a decrease compared with the previous year, and was below the ten-year average of 10.8 FWI per year.
- 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. It is thus difficult to identify trends in harm at level crossings. However, there is some evidence of improvement in safety: the average level of harm in the latter half of the decade is lower than in the first half, and other indicators such as collisions and near misses with road vehicles, and LCRIM also show reductions. The other indicators are reviewed in section 9.2.9.
- The ten years to March 2014 have seen 97 fatalities on level crossings, excluding suicides. This figure comprises 68 pedestrians (including six passengers using station crossings), 23 road vehicle users and the six train occupants who died in the collision at Ufton in 2004.

Chart 189. Fatalities at level crossings

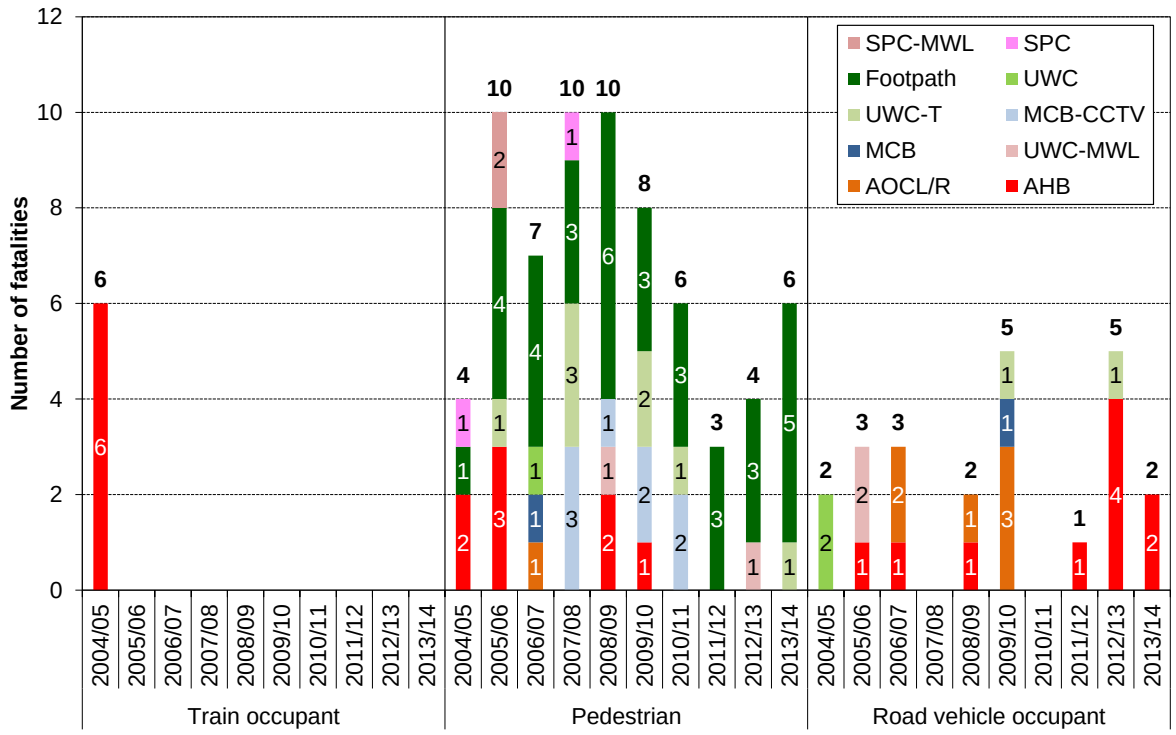


[69] All of the pedestrian fatalities shown in Chart 188 resulted from a person being struck by a train.

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



- Five pedestrian fatalities in 2013/14 occurred on footpath crossings and one on a user-worked crossing with telephones (UWC-T). Since 2004/05, more than half of pedestrian fatalities have occurred on footpath level crossings.
- Eight accidents at level crossings over the past ten years have resulted in more than one fatality: the accident at Ufton mentioned above, four accidents where multiple road vehicle occupants died, and three accidents where two pedestrians were struck. There was one multi-fatality accident in 2013/14: two people were killed when a train struck a car on Great Coates level crossing on 9 April 2013.
- Since April 2004, around 11% of railway suicides have taken place at level crossings.

Table 31. Number of suicides and suspected suicides at level crossings

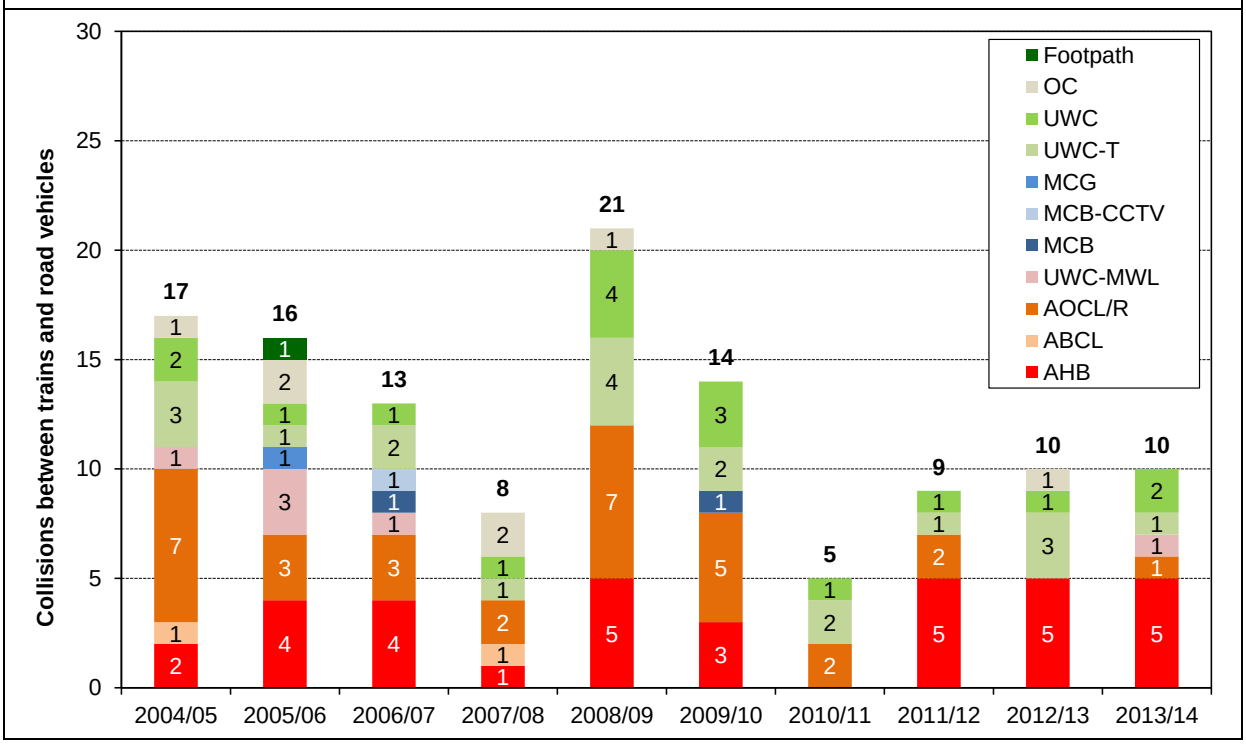
	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Pedestrian	19	23	21	20	22	32	26	25	25	37
Road vehicle occupant	1	2	1	0	1	1	0	0	0	0
Total	20	25	22	20	23	33	26	25	25	37

- The number of suicides recorded at level crossings was 12 higher in 2013/14, and is the highest number in the last 10 years. There has been a continued increase in the number of railway suicides since 2010/11 (see Section 7.8).

9.2.9 Collisions between trains and road vehicles

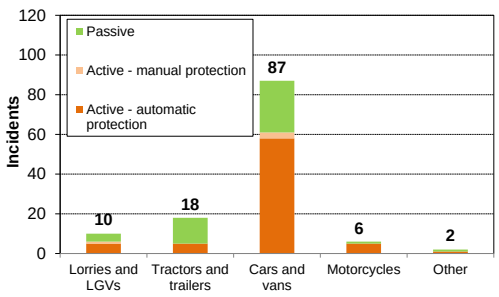
Historically, most collisions have occurred on AHBs, AOCLs and UWCs. The proportion of collisions that result in a fatality varies by crossing type, reflecting factors such as differences in train speed. For example, many AHBs are situated on faster lines and, as a result, collisions with road vehicles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

Chart 191. 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 notable reduction in the number of collisions from the period 2004/05 to 2008/09 (75) to the period 2009/10 to 2013/14 (48).
- The crossing types at which the accidents occurred in 2013/14 were reasonably typical of previous years. Of the 123 collisions in the ten years from April 2004, 32 occurred at AOCL crossings, 34 at AHB crossings and 43 at user-worked crossings (with or without telephones).
- Cars and vans are involved in most collisions at level crossings, as shown in Chart 192. There has been no significant trend in the types of vehicles involved in collisions at level crossings.

Chart 192. Road vehicles in collisions at level crossings (2004/05–2013/14)

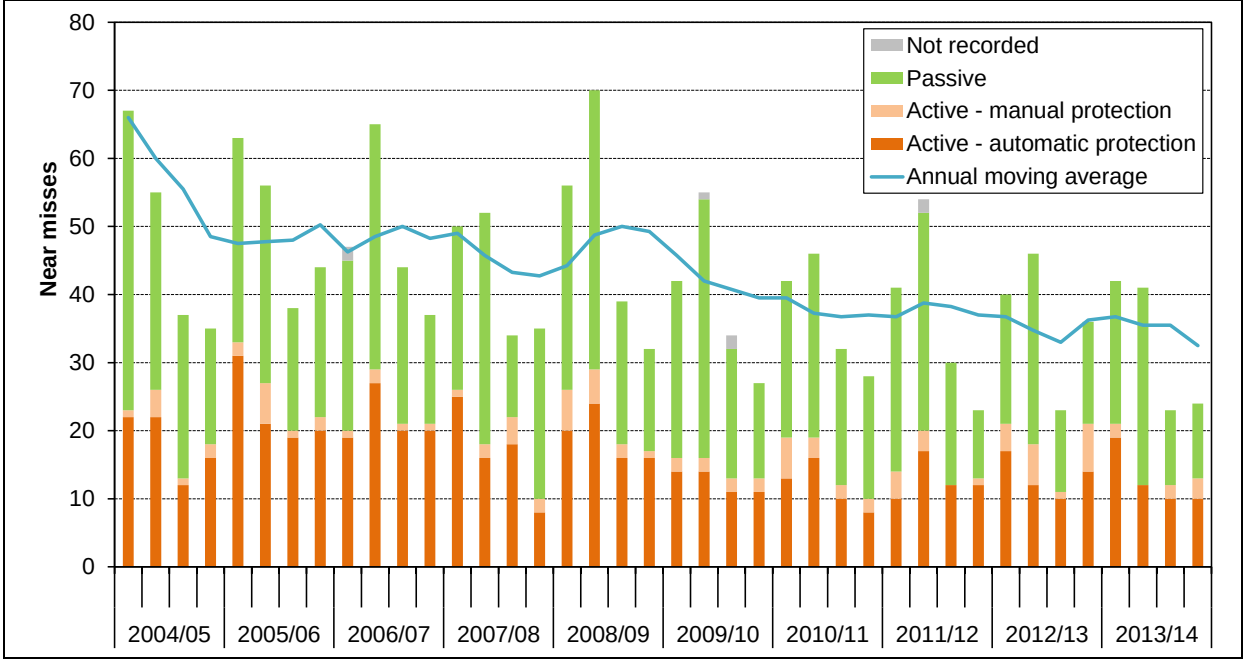


Near misses with road vehicles and pedestrians

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.

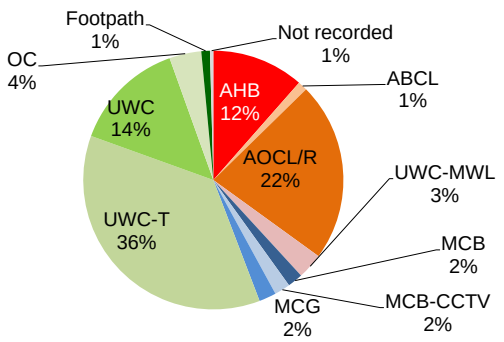
Near misses with road vehicles by crossing type

Chart 193. Trends in reported near misses with road vehicles



- The number of near miss reports in 2013/14 was broadly unchanged from the previous year. There appears to be a long-term downward trend in near misses with road vehicles.
- Chart 194 shows that the majority of near misses occur on UWCs (with or without telephones). It is estimated that around one in seven 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.

Chart 194. Near misses with road vehicles (2004/05-2013/14)[70]

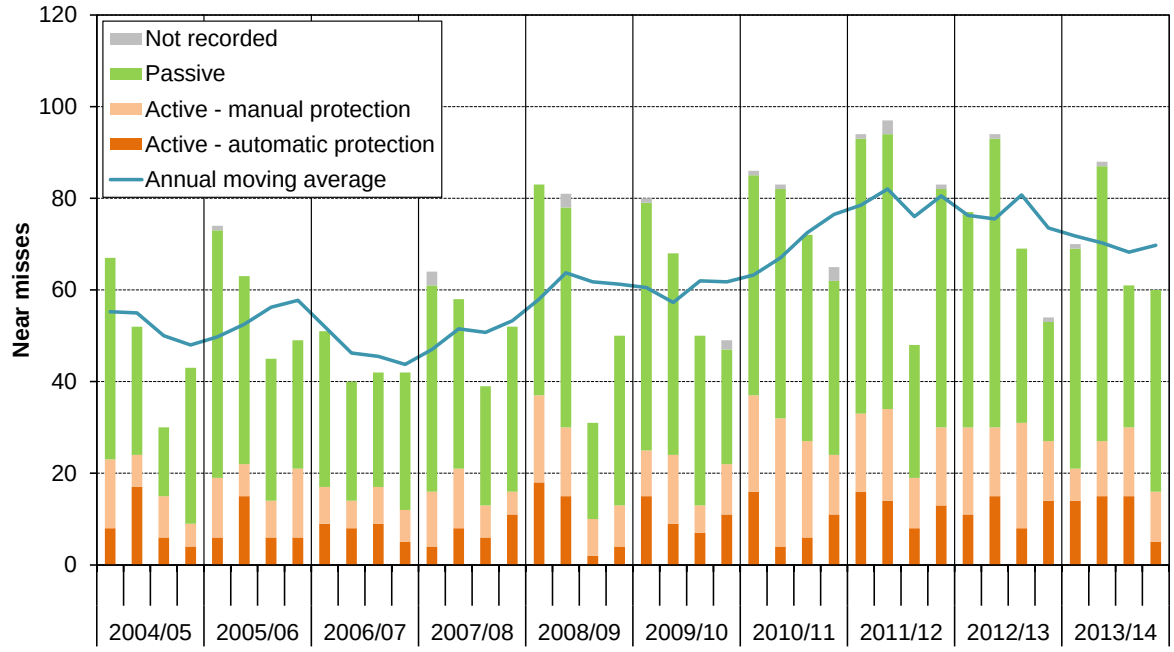


- Other seasonal factors that affect level crossing risk include ice and snow and sunlight, which can make it harder for the motorist to see warning lights.

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

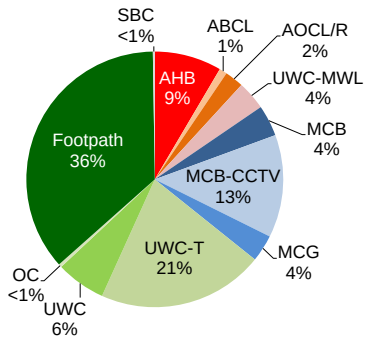
Near misses with pedestrians and cyclists by crossing type

Chart 195. Trends in reported near misses with pedestrians and cyclists



- Up to 2011/12, there was an increasing trend in the number of reported near misses with cyclists and pedestrians. Since then, the trend has been essentially level, albeit with a slight decrease in 2013/14.
- 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, and – 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 13% of reported near misses mention that the person was walking a dog. Auditory distractions, such as personal stereos, also have the potential to increase the risk to level crossing users and have been mentioned in a small number of events over recent years.
- Around one in three reported near misses with pedestrians/cyclists occur on footpath crossings, compared with more than half the fatalities.
- User worked crossings (with or 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.

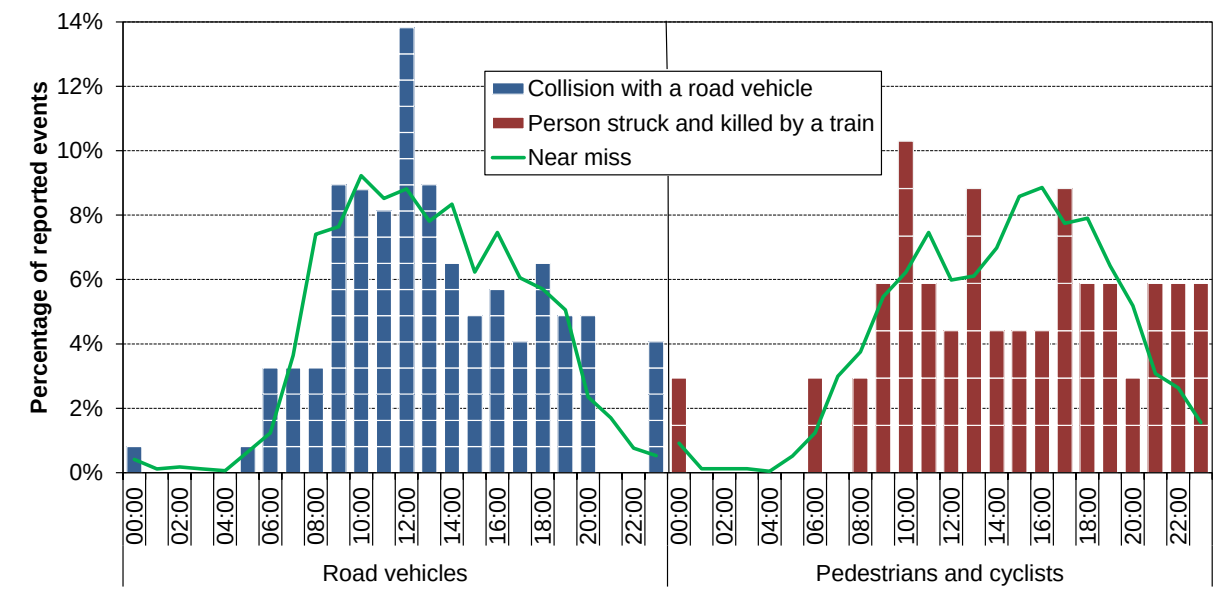
Chart 196. Near misses with pedestrians and cyclists (2004/05-2013/14)



Near misses by time of day

Chart 197 shows the proportion of accidents and near misses at level crossings reported in each hour of the day over the period 2004/05 to 2013/14.

Chart 197. Accidents and near misses by time of day (2004/05 to 2013/14)

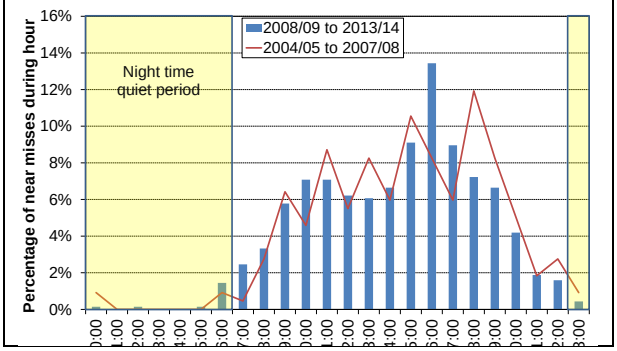


- Accidents and reported near misses with road vehicles tend to peak in the late morning and early afternoon. Accidents and near misses with pedestrians most often occur a little later in the day, although the peak hour for pedestrian fatalities over the past ten years has been between 10:00 and 11:00.
- Accidents and reported near misses tend to occur at broadly similar times of the day. The main exception to this is that a higher proportion of pedestrian/cyclist fatalities occurs in the late evening (21:00 to 01:00) than would be anticipated from near miss reporting. One explanation 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.

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 198 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 is occurring during the quiet period.
- One of the six pedestrian fatalities in 2013/14 occurred during the night time quiet period. This is the second fatality to occur during the quiet period since April 2007; the first occasion was in May 2009. In total since April 2007, there have been 26 fatalities at footpath crossings.

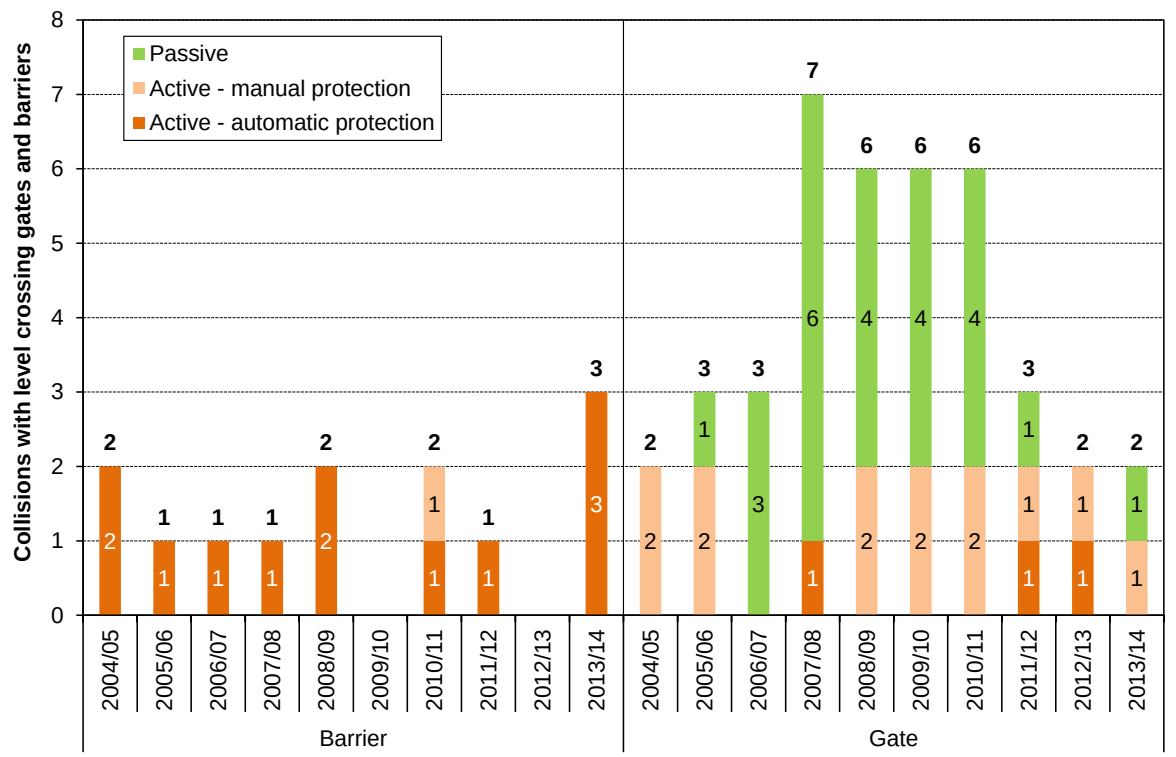
Chart 198. Near misses on footpath crossings



9.2.10 Trains striking level crossing gates or barriers

Usually, 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 199. Trains striking gates or barriers at level crossings



There were two instances of trains striking level crossing gates in 2013/14, and three of a train striking barriers. These represent an increase on the previous year.

- On 5 April 2013, a passenger train struck a crossing gate at Maesteg Ewenny Road footpath level crossing. The gate had been left open.
- On 24 April 2013, a passenger train struck a crossing gate at Park Lane footpath level crossing. The gate was tampered with by vandals who had forced it open foul of the track.
- On 29 May 2013, a passenger train struck a barrier at Hele and Bradninch AHB level crossing. The barrier had become foul of the track after being struck by a lorry.
- On 12 February 2014, a passenger train struck a barrier at Burton Agnes AHB level crossing. This was caused by high winds.
- On 13 February 2014, a passenger train struck a barrier at Aslockton AHB level crossing. The barrier had become foul of the track after being struck by a car.

None of the collisions resulted in an injury.

9.2.11 Factors affecting the risk at level crossings

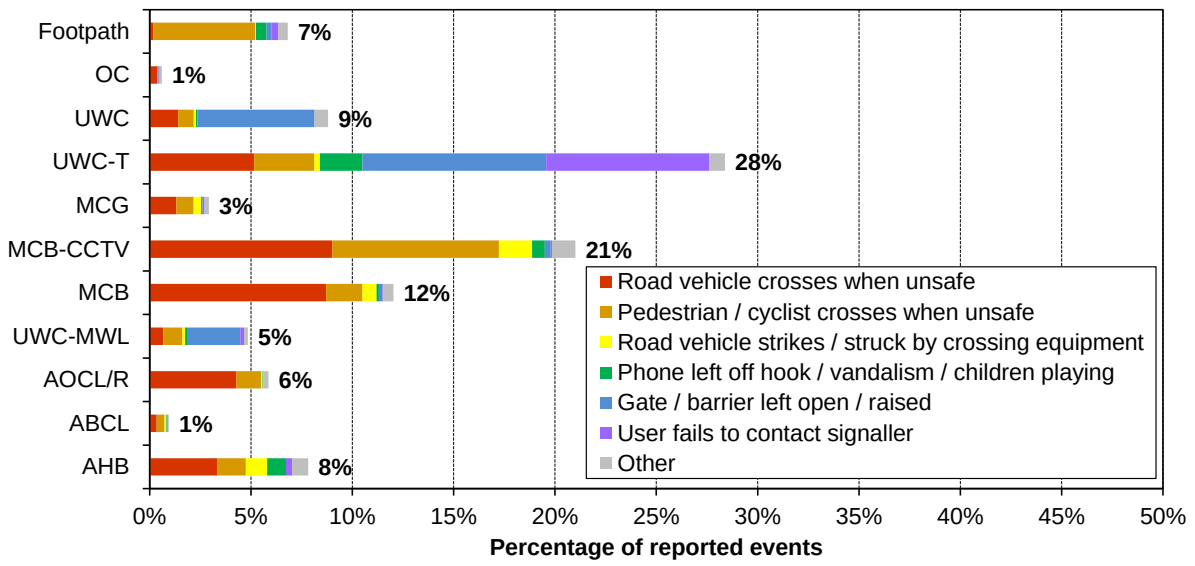
Although the majority of crossing events take place safely, each year there are a number of events where this is not the case, and the crossing event does not take place safely. Reasons include:

- Deliberate action on the part of a user who is aware his actions are incorrect.
- Deliberate action on the part of a user who is not aware his actions are incorrect.
- Unintentional action on the part of a user.
- The crossing is not working correctly, or is being worked incorrectly on the part of the railway, or has been vandalised.

Actions by level crossings users

The following chart looks at user action. It does not distinguish between action that is deliberate or unintentional on the part of the user.

Chart 200. Reported level crossing events by type of user action (2004/05 – 2013/14)



- Around 42% of reported events occur at user-worked crossings. The most commonly recorded type of event 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.
- Around 36% of reported events occur at manually protected crossings. The majority of these events relate to users crossing while it is unsafe to do so. Events at these crossings are more likely to be observed (and therefore reported) by railway personnel.

Level crossing 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 level crossing equipment failures reported into SMIS that are identified as RIDDOR-reportable has increased dramatically over the past few years (from 42 in 2004/05 to 1,477 in 2013/14). 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, reduced in 2013/14 compared with the previous year (see the *Train accident precursors* key safety facts sheet in Section 8.10).
- In 2013/14, around 69% of RIDDOR-reportable equipment failures related to telephones, and 10% to level crossing barriers.

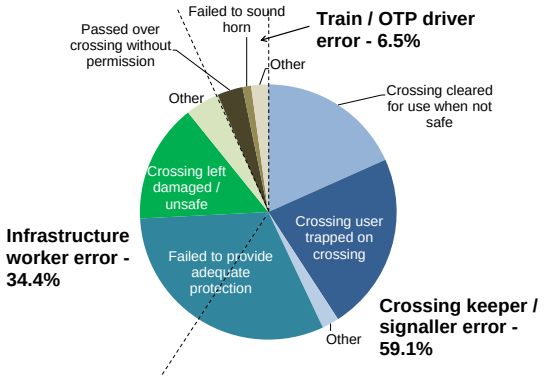
Operational incidents at level crossings

Workforce error contributes around 7% of the modelled risk from collisions between trains and road vehicles at level crossings.

Chart 201 shows the breakdown of workforce errors affecting level crossings that were reported under the *irregular working* component in SMIS in 2013/14.

- The most frequently reported irregular working incidents were of signallers trapping pedestrians or road vehicles between the barriers on CCTV-monitored level crossings, and of signallers or infrastructure workers failing to provide adequate protection to crossing users (for example by signalling trains over the crossing with barriers raised, or covering whistle boards in advance of the crossing).

Chart 201. Workforce errors affecting level crossings



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. These incidents include the defacing of signs and criminal damage to gates, barriers, and telephones.

Table 32. Number of recorded instances of interference with crossing equipment

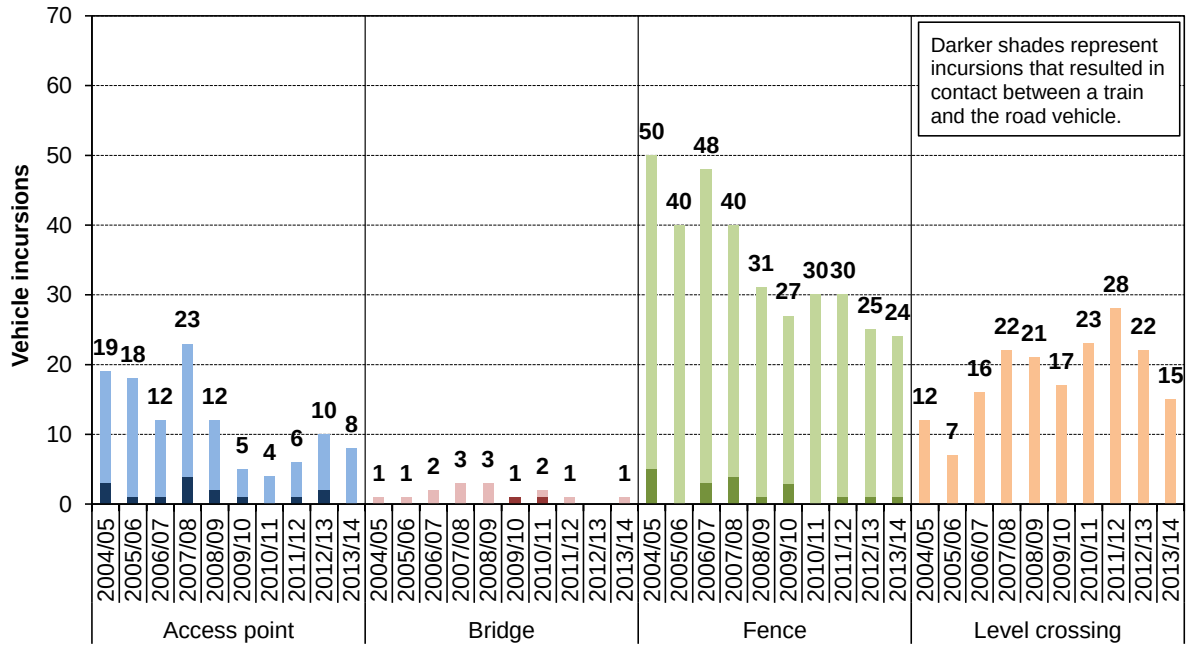
2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
139	68	99	38	40	44	14	28	28	31

- The number of incidents of reported interference with crossing equipment increased in 2013/14, but is still much lower than in earlier years. There has been a general downward trend in railway vandalism (see Section 7.7) but data quality issues mean that the scale of the reduction should be interpreted with some caution.

9.3 Vehicle incursions

Although most incursions result in little harm to people other than the road vehicle occupants, they have the potential to cause a serious train accident. 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, comprising four members of staff and six passengers, lost their lives in the accident.

Chart 202. Vehicle incursions by entry point

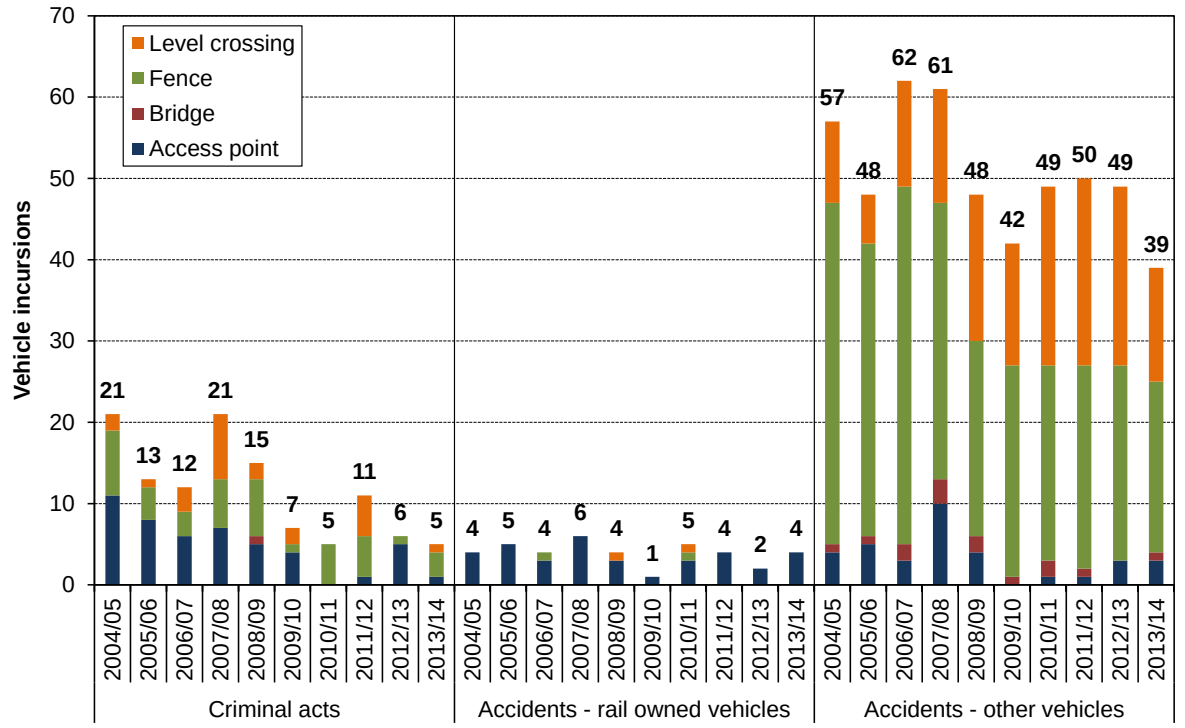


- There were 48 road vehicle incursions in 2013/14. Most of these accessed railway property via fences or level crossings.
- One incursion in 2013/14 resulted in a train accident:
  - On 11 November 2013, a passenger train struck an empty car which had been parked outside the owner's home, but rolled through the boundary fence, down the embankment and onto the track at Bingley. There were no reported injuries.

Trends in incursions by cause

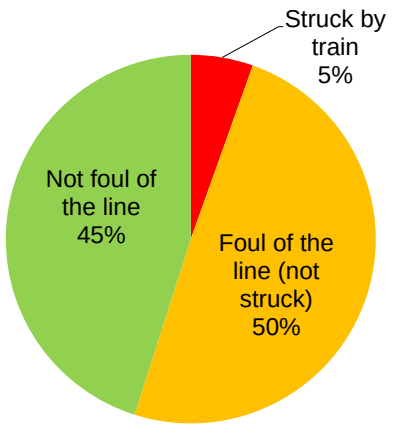
Vehicles can intrude onto the railway as a result of road traffic accidents, deliberate acts of vandalism or trespass and, occasionally, navigational errors. Railway personnel sometimes leave vehicles too close to the line, or not properly secured. There has also been a small number of cases of aircraft crashing onto the railway.[71]

Chart 203. Vehicle incursions by cause



- Most incursions are the result of road traffic accidents.
- There has been a long-term reduction in the number of incidents.
- The long-term 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 7.7).
- The number of incursions caused by criminal acts in 2013/14 was joint lowest in the previous ten years, and below the ten-year average of 11.6.
- Chart 204 shows that half of all vehicle incursions end up foul of the running line, and around 5% are struck by (or otherwise make contact with) trains.

Chart 204. Consequence of vehicle incursions (2004/05 to 2013/14)



[71] Aircraft incursions are included in Chart 202 under the category *Fence*. There have been three such incidents since April 2003 (two light aircraft and one hot air balloon).

9.4 Bridge strikes

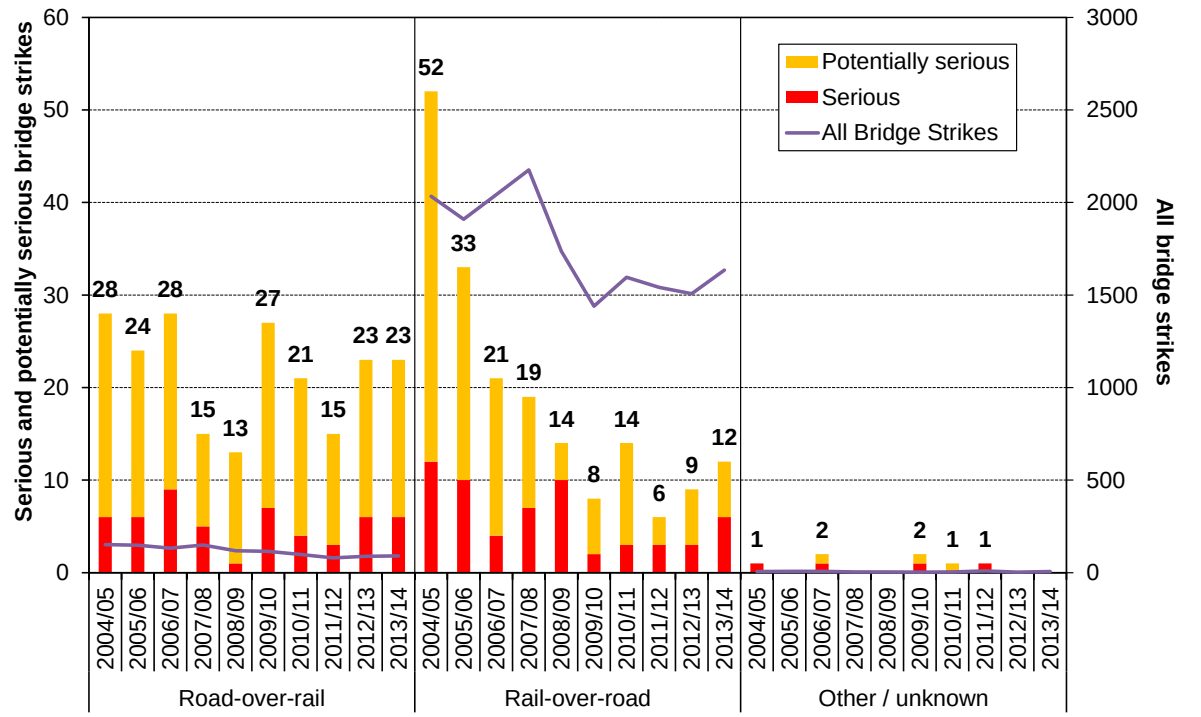
Responsibility for controlling the risk from bridge strikes is shared by the railway industry and highways authorities. Road-over-rail bridge strikes can result in debris or even vehicles on the line, and rail-over-road bridge strikes have the potential to cause track distortion or weaken the bridge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

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.

The modelled risk from train accidents caused by bridge strikes is 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 205. Total number of bridge strikes – all types of bridges[72]



- 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).

[72] 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 Learning from operational experience: road-rail interface

The Learning from Operational Experience Annual Report 2013/14 covers risk at the road-rail interface in Chapter 10: *Lessons learned in 2013/14 – members of the public*, which considers aspects of risk at level crossings.

9.6 Road-rail interface key safety facts

Road-rail interface	2009/10	2010/11	2011/12	2012/13	2013/14
Fatalities at LC (level crossings)	**13**	**6**	**4**	**9**	**8**
Pedestrians	**8**	**6**	**3**	**4**	**6**
Passenger on station crossing	0	0	0	0	0
Member of public	8	6	3	4	6
Road vehicle occupants	**5**	**0**	**1**	**5**	**2**
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	**1.02**	**1.20**	**1.16**	**0.90**	**0.66**
Pedestrians	**0.69**	**0.48**	**0.57**	**0.70**	**0.55**
Road vehicle occupants	**0.21**	**0.10**	**0.32**	**0.12**	**0.01**
Train occupants	**0.12**	**0.62**	**0.27**	**0.08**	**0.10**
Suicide and attempted suicide					
Suicide	**33**	**26**	**25**	**25**	**37**
Attempted suicide	**0.11**	**0.20**	**0.11**	**0.21**	**0.22**
Collisions with road vehicles at LC	**14**	**5**	**9**	**10**	**10**
Resulting in derailment	0	1	2	0	0
Collisions with gates or barriers at LC	**6**	**8**	**4**	**2**	**5**
Gates	6	6	3	2	2
Barriers	0	2	1	0	3
Reported near misses	**405**	**454**	**470**	**439**	**409**
With pedestrians	247	306	322	294	279
With road vehicles	158	148	148	145	130
Reported incidents of crossing events	**2523**	**2936**	**3828**	**3514**	**3989**
With pedestrians	899	1365	1807	1798	2104
With road vehicles	1624	1571	2021	1716	1885
Vehicle incursions	**50**	**59**	**65**	**57**	**48**
Via fences	27	30	30	25	24
Via bridges	1	2	1	0	1
Via level crossings	17	23	28	22	15
Via access points	5	4	6	10	8
Number foul of the track	31	33	38	34	22
Number struck by trains	5	0	2	4	1
Train struck by falling vehicle	0	1	0	0	0

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10 Data quality

10.1 SMIS

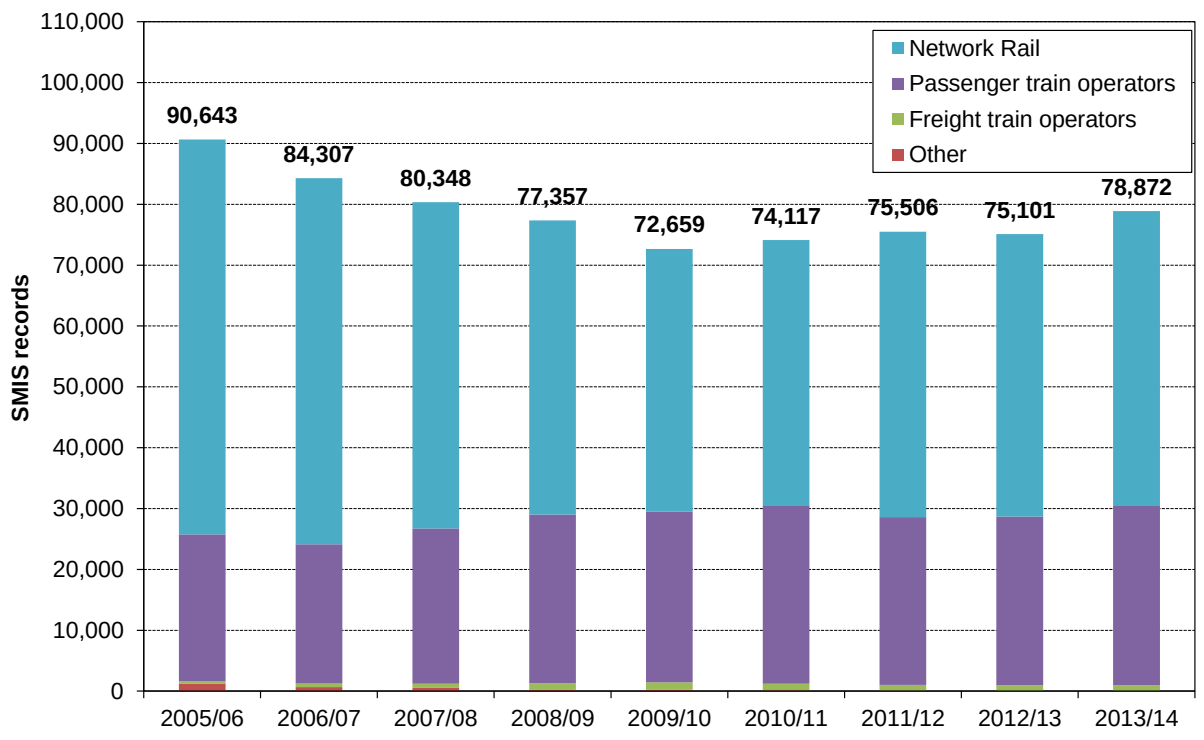
The analysis in this report relies on the quality of the data it uses. The majority of the analysis is based on data from the industry's safety management information system (SMIS). To ensure that the conclusions are meaningful, much effort is put into ensuring that the data is of the highest possible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

SMIS came into force in late 1997, 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 sixth edition went live in March 2014 and can be read at: http://www.rgsonline.co.uk.

In 2013/14 close to 79,000 incidents were reported into the SMIS system, mostly by Network Rail, as shown in Chart 206.

Chart 206. 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 text beneath them describes how RSSB's data quality project works to minimise their 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, as shown by RSSB's independent RIDDOR review in 2011, safety culture. Under-reporting is normally more of a concern for minor events, and the weighting that is attached to Class 2 minor injuries in part mitigates this effect. 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. Section 10.1.3 reports on the number and nature of events from 2012/13 that were reported after the data cut-off for last year's ASPR.

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 1%–2%. RSSB has a process in place for identifying and removing duplicate records.

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 SMIS entry describe the event in the same way.

Incomplete information

To ensure the key fields are entered in SMIS, they are designed to be mandatory, in that the SMIS entry cannot be finalised without them being entered. RSSB alerts event owners to records that have fields missing via the indicator report.

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 33 shows the issues that each measure is tackling. Each issue and measure is then discussed in detail.

Table 33. 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, SPADs, train collisions, derailments, 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 structure of the Safety Risk Model. The review is a check for consistency between the coded fields and the narrative, with a high emphasis placed on the person type and injury degree.

The SRM coding together with RSSB views of the injury degree and person type are then electronically transferred back into SMIS each day and an alert is generated for any record where there is a change in the injury degree or person type from 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. RSSB further validates industry safety data prior to producing the ASPR by verifying the detail and number of significant events, such as fatalities and PHRTA's with both Network Rail and ORR.

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 (see below).

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 on a weekly basis. It uses charts, which show an organisation's reporting error rate compared with the national error rate, and lists of events that require action. It looks at timeliness, incomplete information and wrong reporting.

Data quality ranking

At the end of 2013, each organisation's SMIS data quality was ranked for the fifth 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 organisations, to measure the total quality and to see how companies have changed from the previous year. A new scoring system was introduced in 2012. Amongst other enhancements, the new scoring system measures the input quality on a daily basis, rather than taking a snapshot at review time. This encourages companies to ensure the quality of the data is continually high. RSSB further adjusted this scoring system for 2013 as the input quality measure was being overly pessimistic. The new measure of input quality more accurately reflects the number of errors being made. Each company is advised of its performance and the national benchmark, and the SMIS programme board review the overall results.

The national data quality score for 2013 of 88.2% was similar to the level achieved in 2012.

13 of the 30 stakeholders improved their data quality scores in 2013 compared with the previous year, eight companies saw their level of data quality drop, and nine companies maintained broadly the same level as 2012.

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.

10.1.3 ASPR FWI changes since 2012/13 report

Late reporting has led to an FWI increase for 2012/13 compared with the figures published in last year's ASPR, as well as further information being received from coroners. This has affected the categorisation of public fatalities between accidents and suicide. Further information that comes to light after the publication of the 2012/13 ASPR has resulted in some other events being re-classified. The aggregate impact is shown in the tables below.

Table 34. FWI changes from 2012/13 report

FWI as reported now	2009/10	2010/11	2011/12	2012/13
Passenger	38.76	42.95	42.64	47.44
Workforce	25.19	23.28	24.41	22.81
Public	63.26	37.11	51.49	45.69
Suicide	241.67	210.67	251.39	250.47
Total	**368.88**	**314.00**	**369.93**	**366.41**
FWI as reported in 2012/13 ASPR	**2009/10**	**2010/11**	**2011/12**	**2012/13**
Passenger	38.91	42.77	42.66	45.79
Workforce	25.14	23.18	24.52	22.62
Public	68.24	41.11	63.49	53.88
Suicide	236.60	206.80	240.40	241.70
Total	**368.89**	**313.86**	**371.07**	**363.99**
Percentage difference	**2009/10**	**2010/11**	**2011/12**	**2012/13**
Passenger	0%	0%	0%	4%
Workforce	0%	0%	0%	1%
Public	-7%	-10%	-19%	-15%
Suicide	2%	2%	5%	4%
Total	**0%**	**0%**	**0%**	**1%**

Analysis of the 2012/13 injuries shows that there were 112 late reported events which have been included in this edition of ASPR, which were not present in SMIS at the data cut-off used for the 2012/13 edition. Table 35 shows that 45 of these were workforce injuries, 64 were injuries to passengers and the remaining three were public injuries. These 112 injuries accounted for an additional 2.2 FWI.

Table 35. Late reported injuries from 2012/13

	Number of injuries					FWI
	Fatalities	Major injuries	Minor injuries	Shock / trauma	**Total**	**Total**
Passenger	0	10	53	1	**64**	**1.074**
Public	1	0	2	0	**3**	**1.002**
Workforce	0	0	25	20	**45**	**0.141**
Total	**1**	**10**	**80**	**21**	**112**	**2.217**

In addition to the late reported injuries, 12 others were reclassified as shown in Table 36, including one public fatality that was previously categorised as a major injury –It was later discovered that the person had subsequently died in hospital. These 12 changes increased the reported harm by a further 1.48 FWI.

Table 36. Reclassified injuries from 2012/13

	2012/2013 classification				
Current classification	Fatalities	Major injuries	Minor injuries	Shock / trauma	**Total**
Fatalities	0	1	0	0	**1**
Major injuries	0	0	8	0	**8**
Minor injuries	0	2	0	1	**3**
Shock / trauma	0	0	0	0	**0**
Total	**0**	**3**	**8**	**1**	**12**

The net effect on FWI was less than the combined increase from late reporting and reclassification because other events that were included in the report were subsequently reclassified as suicides or deemed to be out of scope. For example, the 2012/13 report included a fatality involving a fall at a station that has now been deemed out of scope as the coroner concluded that the person had died of a heart attack instead of in the fall. The table below shows the injuries that were previously in scope at the time of the 2012/13 ASPR, that are now no longer in scope.

Table 37. Injuries no longer in scope for 2012/13

	Number of injuries					FWI
	Fatalities	Major injuries	Minor injuries	Shock / trauma	**Total**	**Total**
Passenger	1	3	20	1	**25**	**1.341**
Public		1	2	2	**5**	**0.112**
Workforce			31	7	**38**	**0.066**
Total	**1**	**4**	**53**	**10**	**68**	**1.519**

10.2 Other sources of data

While the majority of the analysis is based on data from SMIS, other data sources have been used in the ASPR. The main sources are outlined below.

BTP CRIME database

The CRIME system is BTP's computerised crime recording system. The Crime Recording Centre receives reports of crime from all BTP sources and undertakes appropriate recording of offences and related information. During 2009, an RSSB-led research project (T723 – *Making the most of data associated with railway crime*[73]) 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 kilometres

Train kilometres is the most commonly used normaliser. It allows the analysis to take into account changes in service (passenger train kilometres have increased by around 13% in the last ten years) and provides a method for benchmarking. Typically, this normaliser is used for SPADs and train accidents. The ASPR uses data generated from Network Rail's Track Access Billing System, and the figures refer to kilometres actually run, not timetabled journeys.

Passenger journeys and kilometres

This data is collated for the industry by the ORR and is based on ticket sales recorded in LENNON[74]. 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 (NTS)

The DfT conducts a continuous NTS, which 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 Chapter 4: *Benchmarking railway performance* and Chapter 5: *Passengers* (including information on passenger profiles).

[73] http://www.rssb.co.uk/SiteCollectionDocuments/pdf/reports/research/T723_rpt_final.pdf

[74] 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.

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 for the mainline railway contained in NRT chapter 10 has been supplied by RSSB and is consistent with the information reported in the corresponding ASPR.

National Passenger Survey

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

European data

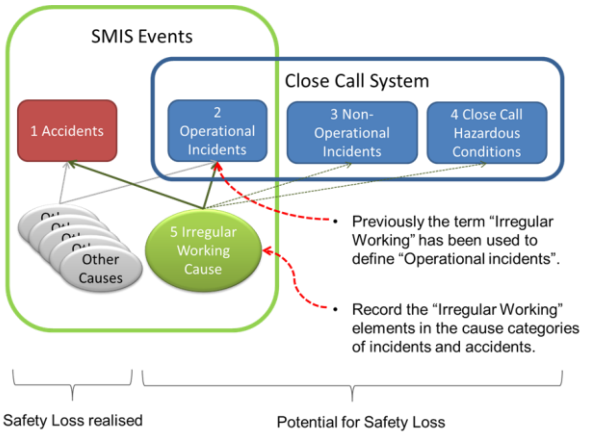
GB rail safety data tends to be more detailed and generally of higher quality than for most other European railways. There are also issues surrounding definitions, which are often quite technical and have historically had differing meanings in different countries. For example, the national definition of a fatality varies from country to country.

Operational incidents

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 previous versions of the ASPR these incidents have been referred to as *irregular working* incidents. After an extensive review and a process of consultation with the industry, the category is now referred to as *operational incidents*. This new term covers events affecting, or with the potential to affect, the safe operation of the mainline railway, in accordance with GE/RT8047 *Reporting of Safety Related Information*.

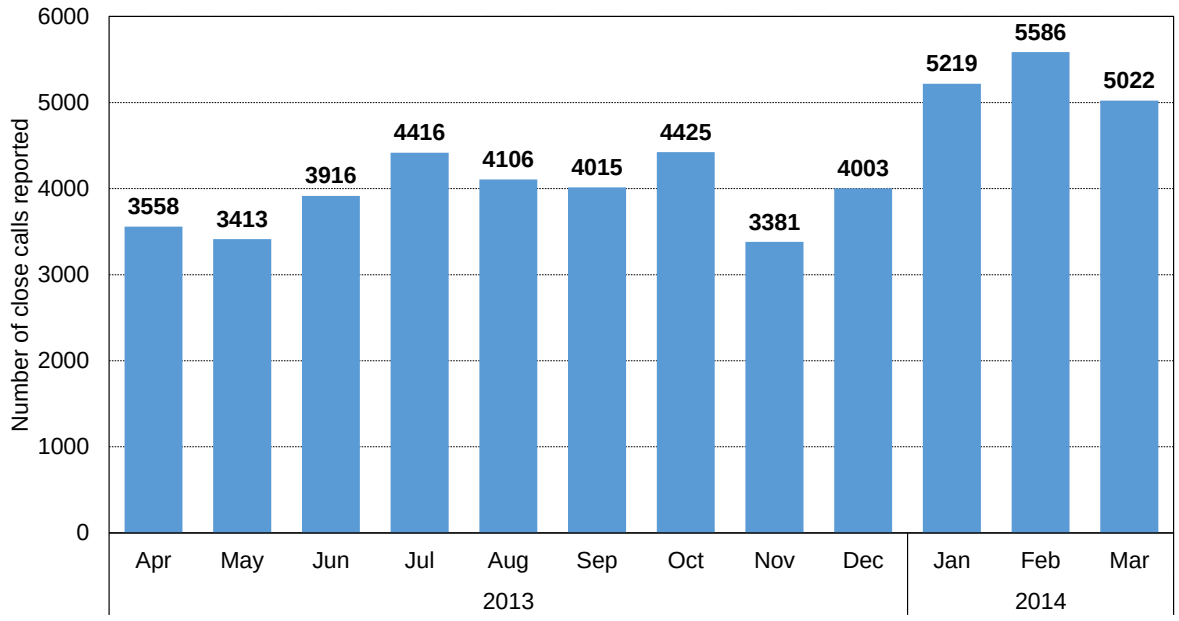
In parallel with this, the rail industry Close Call System (CCS) has been developed. This is an online, web-based system that allows rail organisations to record and manage events or situations considered to be *close calls*, ie ones with the potential to cause injury or damage. Because of the close links between SMIS operational incidents and CCS events, work is underway to harmonise these reporting categories and clarify the precise scope that these terms and systems should cover. This should facilitate the production of more accurate and meaningful safety performance data in future.

Chart 207. Relationship between SMIS and Close Call system



The enhanced Close Call system went live on 29 October 2012. Since then there has been a generally increasing number of close calls recorded each month, as more companies use the system. The monthly numbers for 2013/14 can be seen in Chart 208. Each close call entry is given a risk ranking. The risk rankings for all records recorded in 2013/14 are broken down as follows: High (6%), Medium (40%), Low (53%), and Negligible (1%).

Chart 208. Reported close calls in 2013/14



10.3 Different definitions of similar terms

Some terms have different meanings in differing contexts. The following table lists some of these terms and their definitions in European reporting, RIDDOR and GB safety statistics (as published by RSSB, ORR and DfT).

The European Railway Agency (ERA) is working to harmonise safety reporting across EU Member States and has defined a set of Common Safety Indicators to cover the most serious accidents and their precursors. See Section 3.3 for further information.

Table 38. 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 and contractors.
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. Passenger trespassers are classified as members of the public for the purposes of this report.	Same as RSSB definition except that those people who are fare evaders are classified as passenger trespassers.
Public	ERA groups those who are not passengers or workforce into three distinct categories: - LC users - unauthorised persons - others	Persons other than those who are passengers or members of the workforce. Members of the public may also be identified as trespassers (see below) or level crossing users.	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 who deliberately avoids fare payment, uses level crossings incorrectly, or who enters railway property from outside, through falls or road traffic accidents.

Table 39. 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. This excludes rail vehicles in possessions and some shunt moves.	Train includes locomotives, tramcars, trolley vehicles and other guided transport vehicles. This also includes the train carriages themselves. Rail vehicles working in possessions and being shunted are included in this definition.	
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 or shock/trauma 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 seven 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, in connection with work on the operational railway.

Appendix 1. Key safety facts

Safety overview

Overview	2009/10	2010/11	2011/12	2012/13	2013/14
Fatalities					
Passenger	5	7	5	4	4
Workforce	3	1	1	2	3
Public	60	33	47	42	29
Total	**68**	**41**	**53**	**48**	**36**
Major injuries					
Passenger	234	251	259	312	270
Workforce	123	122	128	114	126
Public	38	36	40	42	44
Total	**395**	**409**	**427**	**468**	**440**
Minor injuries					
Passenger	5308	5600	5954	6382	6307
Workforce	5327	5379	5432	4757	4913
Public	190	186	186	176	162
Total	**10825**	**11165**	**11572**	**11315**	**11382**
Shock/trauma					
Passenger	207	226	262	238	235
Workforce	1169	1156	1239	964	1001
Public	4	4	3	6	2
Total	**1380**	**1386**	**1504**	**1208**	**1238**
Fatalities and weighted injuries					
Passenger	38.76	42.95	42.64	47.44	43.10
Workforce	25.19	23.28	24.41	22.81	25.16
Public	64.26	37.11	51.49	46.69	33.85
Total	**128.21**	**103.34**	**118.54**	**116.94**	**102.10**
Suicide and attempted suicide					
Suicides	238	207	249	246	279
FWI	240.7	210.7	251.4	249.5	284.5

Passengers

Passengers	2009/10	2010/11	2011/12	2012/13	2013/14
Fatalities	**5**	**7**	**5**	**4**	**4**
Train accidents	0	0	0	0	0
Slips, trips, and falls	1	1	2	1	0
Platform-train interface	4	5	3	2	4
Assault and abuse	0	1	0	1	0
On-board injuries	0	0	0	0	0
Contact with object or person	0	0	0	0	0
Struck by train on station crossing	0	0	0	0	0
Other type of passenger injury	0	0	0	0	0
Major injuries	**234**	**251**	**259**	**312**	**270**
Train accidents	3	6	1	0	1
Slips, trips, and falls	145	158	172	203	181
Platform-train interface	43	45	48	64	49
Assault and abuse	9	10	11	10	5
On-board injuries	26	25	21	26	28
Contact with object or person	7	5	6	6	6
Struck by train on station crossing	0	0	0	1	0
Other type of passenger injury	1	2	0	2	0
Minor injuries	**5308**	**5600**	**5954**	**6382**	**6307**
Class 1	1209	1250	1375	1403	1382
Class 2	4099	4350	4579	4979	4925
Incidents of shock	**207**	**226**	**262**	**238**	**235**
Class 1	2	5	5	3	7
Class 2	205	221	257	235	228
Fatalities and weighted injuries	**38.76**	**42.95**	**42.64**	**47.44**	**43.10**
Train accidents	0.39	0.71	0.16	0.05	0.22
Slips, trips, and falls	21.23	22.71	25.75	28.58	25.05
Platform-train interface	10.48	11.82	10.28	10.71	11.31
Assault and abuse	1.34	2.49	1.58	2.38	0.95
On-board injuries	3.84	3.71	3.42	3.99	4.13
Contact with object or person	1.35	1.24	1.40	1.36	1.36
Struck by train on station crossing	0.00	0.01	0.00	0.10	0.00
Other type of passenger injury	0.12	0.26	0.05	0.27	0.07
Passenger kms (billions)	**51.42**	**54.48**	**57.31**	**58.41**	**60.14**
Passenger journeys (millions)	**1259**	**1356**	**1462**	**1503**	**1590**

BTP Passenger & public assaults	2009/10	2010/11	2011/12	2012/13	2013/14
Total	**3274**	**3410**	**3438**	**3452**	**3536**
Actual bodily harm	1207	1186	1217	1094	1065
Common assault	1451	1511	1579	1657	1691
GBH and more serious cases of violence	111	131	108	115	119
Other violence	58	55	40	41	29
Racially aggravated harassment	447	527	494	545	632

Incidents of passenger trespass, suspected and attempted suicide are analysed under public risk and counted in the key safety facts sheet for members of the public.

Workforce

Workforce	2009/10	2010/11	2011/12	2012/13	2013/14
Fatalities	**3**	**1**	**1**	**2**	**3**
Infrastructure worker	3	1	1	2	3
Train driver	0	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	0	0	0	0	0
Major injuries	**123**	**122**	**128**	**114**	**126**
Infrastructure worker	74	75	67	68	79
Train driver	10	11	12	16	9
Other on-board train crew	18	12	18	14	8
Station staff	8	8	10	7	11
Revenue protection	4	4	5	4	5
Other workforce	9	12	16	5	14
Minor injuries	**5327**	**5379**	**5432**	**4757**	**4913**
Class 1	557	585	662	597	560
Class 2	4770	4794	4770	4160	4353
Incidents of shock	**1169**	**1156**	**1239**	**964**	**1001**
Class 1	291	302	323	325	351
Class 2	878	854	916	639	650
Total FWI	**25.19**	**23.28**	**24.41**	**22.81**	**25.16**
Infrastructure worker	12.05	10.36	10.06	11.04	13.48
Train driver	3.07	3.32	3.55	3.77	3.18
Other on-board train crew	5.42	4.79	5.28	4.22	3.37
Station staff	2.20	2.1	2.3	1.9	2.2
Revenue protection	1.07	1.03	1.14	0.88	0.96
Other workforce	1.38	1.65	2.12	1.04	1.94

Members of the public

Public	2009/10	2010/11	2011/12	2012/13	2013/14
Trespass					
Fatalities	46	25	40	32	21
Major injuries	19	18	15	28	26
Minor injuries	36	30	26	30	23
Shock/trauma	1	1	1	1	1
Total trespass FWI	**48.04**	**26.92**	**41.60**	**34.92**	**23.68**
Level crossings					
Fatalities	13	6	4	9	8
Major injuries	7	5	8	5	4
Minor injuries	24	20	25	28	15
Shock/trauma	2	1	1	4	0
Total level crossings FWI	**13.75**	**6.56**	**4.87**	**9.58**	**8.44**
Non-trespass non-LX					
Fatalities	1	2	3	1	0
Major injuries	12	13	17	9	14
Minor injuries	130	136	135	118	124
Shock/trauma	1	2	1	1	1
Total non-trespass non-LX FWI	**2.47**	**3.63**	**5.02**	**2.19**	**1.73**
Total public accidental FWI					
Fatalities	60	33	47	42	29
Major injuries	3.80	3.60	4.00	4.20	4.40
Minor injuries	0.45	0.49	0.49	0.47	0.44
Shock/trauma	0.02	0.01	0.01	0.02	0.01
Total accidental FWI	**64.26**	**37.11**	**51.49**	**46.69**	**33.85**
Suicide					
Fatalities	238	207	249	246	279
Major injuries	26	36	23	34	54
Minor injuries	15	17	21	16	25
Shock/trauma	1	0	1	0	3
Total suicide FWI	**240.67**	**210.67**	**251.39**	**249.47**	**284.52**

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

Train accidents

Train accidents	2009/10	2010/11	2011/12	2012/13	2013/14
Fatalities (excluding suicides)	**7**	**0**	**1**	**6**	**2**
Passengers	0	0	0	0	0
Workforce	0	0	0	0	0
Members of the public	7	0	1	6	2
Weighted injuries (excluding suicides)	**1.18**	**1.40**	**0.83**	**0.40**	**0.55**
Passengers	0.39	0.71	0.16	0.05	0.22
Workforce	0.57	0.50	0.35	0.22	0.32
Members of the public	0.21	0.20	0.32	0.12	0.01
Total train accidents	**577**	**520**	**545**	**695**	**636**
PHRTAs	**42**	**18**	**33**	**35**	**32**
Involving passenger trains	26	14	18	21	17
Collisions between trains	4	1	5	5	5
Derailments	8	5	0	7	0
Collisions with road vehicles not at LC	2	0	2	2	1
Collisions with road vehicles at LC (not derailed)	12	4	7	7	8
Collisions with road vehicles at LC (derailed)	0	1	2	0	0
Striking buffer stops	0	2	2	0	3
Struck by large falling object	0	1	0	0	0
Not involving passenger trains	16	4	15	14	15
Collisions between trains	0	1	1	1	1
Derailments	12	3	13	9	11
Collisions with road vehicles not at LC	2	0	0	1	0
Collisions with road vehicles at LC (not derailed)	2	0	0	3	2
Collisions with road vehicles at LC (derailed)	0	0	0	0	0
Striking buffer stops	0	0	1	0	1
Struck by large falling object	0	0	0	0	0
Non-PHRTA train accidents	**535**	**502**	**512**	**660**	**604**
Involving passenger trains	469	440	432	562	524
Open door collisions	1	0	0	0	0
Roll back collisions	3	6	1	5	0
Striking animals	144	168	169	324	268
Struck by missiles	141	90	57	66	52
Train fires	68	53	43	40	31
Striking level crossing gates/barriers	2	7	2	1	5
Striking other objects	110	116	160	126	168
Not involving passenger trains	66	62	80	98	80
Open door collisions	1	0	0	0	0
Roll back collisions	0	2	0	0	0
Striking animals	16	19	21	22	26
Struck by missiles	22	8	10	6	3
Train fires	6	9	8	11	5
Striking level crossing gates/barriers	4	1	2	1	0
Striking other objects	17	23	39	58	46
PIM risk estimate (FWI per year)	**7.40**	**8.13**	**7.24**	**7.90**	**7.52**
Public behaviour	3.20	3.31	3.35	3.54	3.17
SPAD	0.90	0.98	0.70	0.68	0.81
Trains and rolling stock	0.30	0.35	0.42	0.45	0.25
Operational incidents	0.90	1.28	1.12	1.06	1.27
Environmental	0.80	0.94	0.68	0.57	0.39
Infrastructure	1.30	1.26	0.97	1.60	1.63

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*.

PIM precursors

PIM precursors	2010/11	2011/12	2012/13	2013/14
Public behaviour				
Bridge strikes	1598	1541	1507	1634
Non Rail vehicles on the line	59	65	57	47
Non-Passenger trains striking objects due to vandalism	4	7	7	3
Passenger trains striking objects due to vandalism	43	38	20	33
Public behaviour (Active automatic level crossings)	43	40	48	40
Public behaviour (Active manual level crossings)	12	6	19	7
Public behaviour (Passive level crossings)	83	85	67	65
SPADs				
SPADs	299	277	250	293
Trains and rolling stock				
Non-Passenger defects (other than brake/control)	6	7	10	5
Passenger defects (other than brake/control)	51	42	51	32
Brake/control defects	23	33	19	6
Operational incidents				
Displaced or insecure loads	27	29	19	27
Objects foul of the line	366	332	307	272
Other issues	365	366	365	365
Routing	2110	2073	2057	1987
Signaller errors other than routing	23	21	19	18
Track issues	136	172	157	129
Affecting level crossings	83	81	74	87
Runaway trains	6	6	2	5
Train Speeding (approaching bufferstops)	11	10	12	14
Train Speeding (non-passenger)	55	60	42	41
Train Speeding (passenger)	79	73	81	104
Environmental				
Adhesion	206	82	155	280
LC incidents due to weather (Active automatic)	4	2	3	1
LC incidents due to weather (Active manual)	4	4	4	5
LC incidents due to weather (Passive)	3	0	0	1
Non-Passenger trains running into other obstructions	11	19	21	17
Non-Passenger trains running into trees	17	30	39	125
Passenger trains running into other obstructions	61	84	97	129
Passenger trains running into trees	62	242	232	551
Infrastructure				
Animals on the line	1529	1543	1667	1622
Broken fishplates	402	362	431	327
Broken rails	199	129	180	121
Buckled rails	41	12	10	19
Culvert failures	4	3	6	25
Cutting failures	39	30	150	137
Embankment failures	10	3	49	45
Flooding	39	31	223	121
Gauge faults	2	3	4	3
LC failures (Active automatic)	863	729	977	837
LC failures (Passive)	578	612	985	924
Overline bridge failures	9	10	14	28
Rail bridge failures	12	21	33	61
Retaining wall failures	2	4	5	6
S&C faults	646	570	408	386
Tunnel failures	9	5	8	11
Twist and geometry faults	19	8	8	12
Wrongside signalling failures	10115	9442	8842	9049

The PIM uses risk ranked operational incidents, but events in 2013/14 which would have been given zero risk are no longer ranked. Zero-ranked events from prior years are still shown in this table but do not contribute to the PIM.
Only those operational incidents judged to have had the potential to cause a train accident are featured in the table.
The train striking objects measures include all incidents of trains striking objects and not just the RIDDOR-reportable ones shown in the train accident key safety facts sheet.

Road-rail interface

Road-rail interface	2009/10	2010/11	2011/12	2012/13	2013/14
Fatalities at LC (level crossings)	**13**	**6**	**4**	**9**	**8**
Pedestrians	**8**	**6**	**3**	**4**	**6**
Passenger on station crossing	0	0	0	0	0
Member of public	8	6	3	4	6
Road vehicle occupants	**5**	**0**	**1**	**5**	**2**
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	**1.02**	**1.20**	**1.16**	**0.90**	**0.66**
Pedestrians	**0.69**	**0.48**	**0.57**	**0.70**	**0.55**
Road vehicle occupants	**0.21**	**0.10**	**0.32**	**0.12**	**0.01**
Train occupants	**0.12**	**0.62**	**0.27**	**0.08**	**0.10**
Suicide and attempted suicide					
Suicide	**33**	**26**	**25**	**25**	**37**
Attempted suicide	**0.11**	**0.20**	**0.11**	**0.21**	**0.22**
Collisions with road vehicles at LC	**14**	**5**	**9**	**10**	**10**
Resulting in derailment	0	1	2	0	0
Collisions with gates or barriers at LC	**6**	**8**	**4**	**2**	**5**
Gates	6	6	3	2	2
Barriers	0	2	1	0	3
Reported near misses	**405**	**454**	**470**	**439**	**409**
With pedestrians	247	306	322	294	279
With road vehicles	158	148	148	145	130
Reported incidents of crossing events	**2523**	**2936**	**3828**	**3514**	**3989**
With pedestrians	899	1365	1807	1798	2104
With road vehicles	1624	1571	2021	1716	1885
Vehicle incursions	**50**	**59**	**65**	**57**	**48**
Via fences	27	30	30	25	24
Via bridges	1	2	1	0	1
Via level crossings	17	23	28	22	15
Via access points	5	4	6	10	8
Number foul of the track	31	33	38	34	22
Number struck by trains	5	0	2	4	1
Train struck by falling vehicle	0	1	0	0	0

Appendix 2. Fatalities in 2013/14

Passenger				4
Date	**Location**	**Territory**	**Event type**	**Description**
04/04/2013	Queen's Road, Peckham.	South East	Platform -train interface	An elderly female passenger slipped and fell onto the tracks at Queen's Road station into the path of an approaching train. The train went over the top of her but caused only minor injuries, however the victim suffered a heart attack at the scene.
06/11/2013	East Croydon	South East	Platform -train interface	An elderly male passenger was seen to stumble and fall backwards onto the tracks at East Croydon station. He was recovered and conveyed to hospital with suspected spinal injuries and later died. Alcohol was confirmed as a potential factor.
21/12/2013	Mansfield Viaduct	London North Eastern	Platform -train interface	A male passenger fell into the four foot attempted to get back onto the platfor and was struck. The deceased is believed to have been intoxicated at the time of the incident.
01/03/2014	Shepherds Bush	South East	Platform -train interface	A train travelling through Shepherds Bush station reported striking a person. CCTV indicates that the passenger was intoxicated at the time of incident and fell onto the tracks by accident.

Workforce				3
Date	**Location**	**Territory**	**Event type**	**Description**
19/06/2013 (two fatalities)	Claypole	London North Eastern	Road traffic accident	Two contracted Network Rail employees were fatally injured in a car accident whilst on duty. The two members of staff had been welding on site at Langley Junction, and whilst returning to their depot the car was reported to have left the main carrigeway and collided with the rear of a parked lorry near the town of Claypole.
22/01/2014	Newark North Gate	London North Eastern	Struck /crushed by train	An infrastructure worker was fatally injured when struck by a passenger train whilst on the line at Newark North Gate Station. All lines were blocked and the injured party was taken to hopital by air ambulance, but later died in hospital.

Public (not including suicide or trespass)				8
Level crossing users (pedestrians)				6
Date	**Location**	**Territory**	**LC type**	**Description**
07/04/2013	Blackhills Farm UWC	London North Eastern	UWC-T	A pedestrian was struck by a train on level crossing. The deceased was chasing their dog at the time of the accident.
27/06/2013	Marlow	Western	Footpath	A pedestrian was struck by a train on a level crossing.
11/07/2013	Springfield Road footpath crossing	Western	Footpath	A male pedestrian was struck by a train on a level crossing. The train driver sounded their horn and applied the emergency brake, but could not prevent the accident.
03/10/2013	Dernford R/G UWG crossing	South East	Footpath	A male pedestrian was struck by a train on a level crossing. The crossing lights were working correctly at the time of the incident. The train involved was the second over the crossing in a short period.
26/10/2013	Attenborough	London North Eastern	Footpath	A pedestrian was struck by a train on a level crossing. The train involved was the second over the crossing in a short period of time.
24/03/2014	Cattishall footpath crossing	South East	Footpath	A cyclist was struck by a train on a level crossing. The train driver sounded their horn, but could not prevent the accident. It appeared the deceased was wearing headphones.
Level crossing users (road vehicle occupants)				2
Date	**Location**	**Territory**	**LC type**	**Description**
09/04/2013 (two fatalities)	Station Road AHBC LC, Great Coates	London North Eastern	AHB	A passenger train struck a car at the AHB crossing at Great Coates station. The train was not derailed by the impact. There were two fatalities in the car, which appears to have been driven around the barriers.

Trespass	22
In station	4
Not in stations	18

Suicide	278
Coroner's confirmed verdict	34
Application of Ovenstone criteria	244

Appendix 3. Scope of RSSB safety performance reporting and risk modelling

Railway Group Standard GE/RT8047: Reporting of Safety Related Information lays out the requirements on mainline infrastructure managers and railway undertakings for reporting safety related information via the Safety Management Information System (SMIS). It covers requirements related to injuries and events such as train accidents, irregular working and SPADs.

This appendix describes the scope of RSSB's safety performance reporting and safety risk modelling, based on the information reported to SMIS, and other sources.

General:

All events listed in Table A of GE/RT8047, occurring at **sites within scope**, with the exception of:

- incidents due to occupational health issues and terrorist actions.

Injuries and incidents of shock/trauma:

Workforce:

All injuries and incidents of shock/trauma to members of the workforce whilst on duty and:

- involved in the operation or maintenance of the railway at **sites within scope**, or
- travelling to or from **sites within scope** while involved in the operation or maintenance of the railway, or
- directly affected by incidents occurring at **sites within scope**.

Fatalities to members of the workforce whilst on duty and:

- involved in the operation or maintenance of yards, depots and sidings not on NRMI, or
- travelling to or from yards, depots and sidings not on NRMI while involved in the operation or maintenance of the railway**.**

Passengers and public:

All injuries and incidents of shock/trauma to passengers and public who are:

- at a site within scope, or
- directly affected by incidents occurring at **sites within scope**.

Sites within scope for safety performance reporting:

Sites within and outside scope for all person types comprise:

Within scope	Outside scope
Railway infrastructure and trains on sections of operational railway under the management of Network Rail, or where Network Rail is responsible for the operation of the signalling. The operational railway comprises all lines for which the infrastructure manager and railway undertaking have been granted a safety authorisation and safety certificate (respectively) by the ORR (under Railway Safety Directive 2004/49/EC). The table on page 225 details which railway lines this applies to. Railway infrastructure includes all associated railway assets, structures and public areas at stations.	• Station car parks • Offices (except areas normally accessible by members of the public) • Mess rooms • Training centres • Integrated Electronic Control Centres and Signalling Control Centres • Outside the entrance to stations • Station toilets • Retail units and concessions in stations • Construction sites at stations which are completely segregated from the public areas • Track sections closed for long-term construction, maintenance, renewal or upgrade • Public areas away from the platform-train interface (PTI) at non-Network Rail stations[75]

Additional sites within and outside scope for the workforce comprise:

Within scope	Outside scope
Yards, depots and sidings that are managed by Network Rail.	Yards, depots and sidings[76] that are managed by third parties, **unless the injury sustained is fatal**.

Note regarding injuries within yards, depots and sidings owned by third parties:

Although not within the current normal scope of reporting, the ASPR provides information on workforce injuries within these areas in Appendix 4, and the Safety Risk Model provides risk estimates for these areas (the risk is in addition to the total system risk estimate of 143.4 FWI).

In future, it will be the case that injuries and risk within third party YD&S will be brought within the normal reporting and modelling scope.

[75] The platform-train interface is in scope at non-Network Rail stations on NRMI lines, for example on London Underground and Nexus. See the following page for details.
[76] The reporting of injuries and incidents in third party yards, depots and sidings is non-mandatory in GE/RT8047. See Appendix 4 for more information.

Railway lines in scope:

Line / Section	Notes	Criteria		In / Out of Scope	
		Owned by NR?	NR operate the signalling?	In stations	On or about the track/at PTI
High Speed 1[77]	The entire line, including St Pancras, is managed, operated and maintained by NR.	✓	✓	In	In
Heathrow Express: Paddington to Heathrow Central	NR-owned infrastructure.	✓	✓	In	In
Heathrow Express: Heathrow Central to Terminals 4 and 5	Owned by BAA but maintained on their behalf by NR.	✓	✓	In	In
Nexus – Tyne and Wear Metro: Fellgate to South Hylton	Owned and managed by NR, but stations served only by metro trains.	✓	✓	Out	In
Nexus – Tyne and Wear Metro: All sections apart from Fellgate to South Hylton	Neither managed by NR, nor is the signalling controlled by NR.	×	×	Out	Out
LUL Metropolitan Line: Chiltern services between Harrow-on-the-Hill and Amersham	This section is owned and operated by LUL and its subsidiaries / operators.	×	×	Out	Out[78]
LUL District Line: Gunnersbury to Richmond	This section was a joint operation with Silverlink Metro, for which NR is now responsible.	✓	✓	Out	In
LUL District Line: East Putney to Southfields	LUL owns the infrastructure. NR owns the signals, but the signalling is operated by LUL.	×	×	Out	Out
LUL Bakerloo Line: Services north of Queens Park	Track managed by NR, who also operates the signalling.	✓	✓	Out	In
Island Line on the Isle of Wight	The service is wholly operated and managed under a franchise to South West Trains.	×	×	Out	Out
East London Line	TfL owns and maintains the track, but NR operates the signalling.	×	✓	In	In
All other NR owned stations		✓	✓	In	In

[77] The risk from High Speed 1 train operations is modelled in the same way as all other lines, ie as an average railway, rather than explicit modelling of High Speed 1 characteristics. The contribution of Eurostar services to HEM/HEN risk is included.

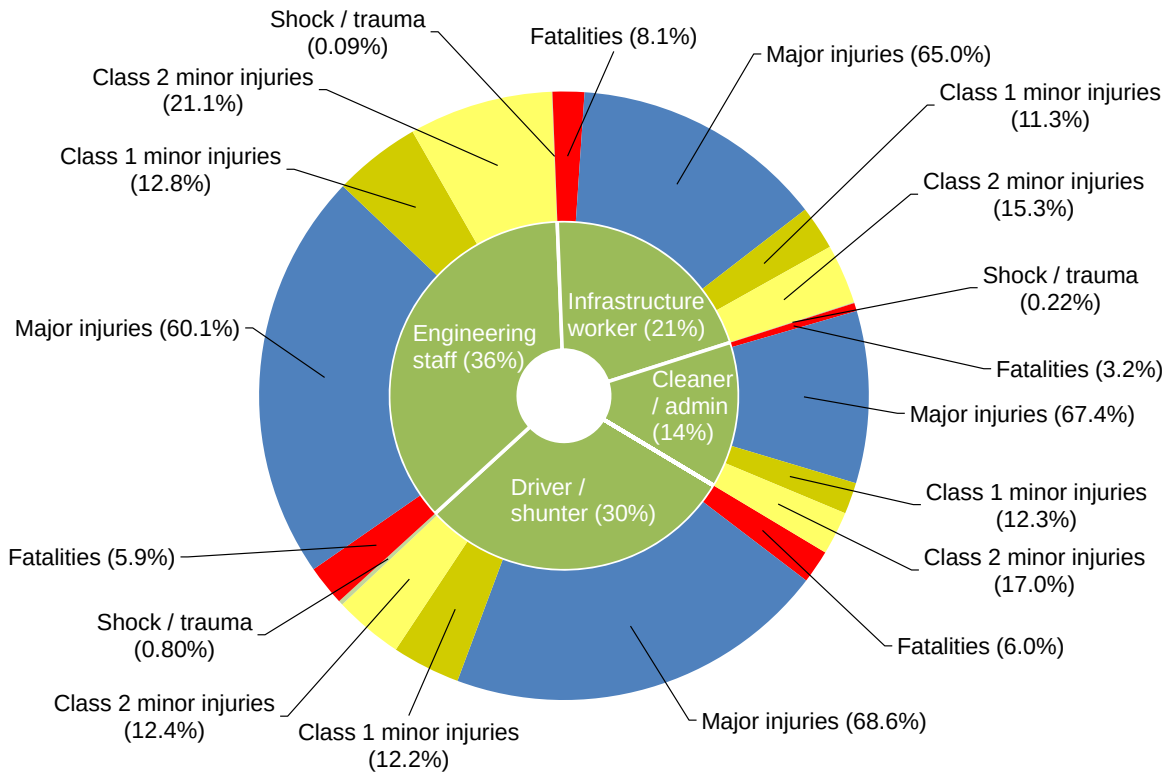
[78] PTI and on-board injuries on these Chiltern services are in scope, injuries on or about the track are out of scope.

Appendix 4. Yards, depots and sidings

Railway companies are required to manage risk and carry out risk assessments on areas away from the operational railway, such as yards, depots and sidings (YD&S) although there is no mandatory requirement to report any injuries or incidents occurring in YD&S sites into SMIS. Through the agreement of the industry, the collection of data to support the YD&S initiative was made a non-mandatory requirement, which was included as an appendix to the Standard for Safety Information Reporting (GE/RT8047). Data collection began on April 1st 2010 and has now provided over 4 years of data.

The provision of this data has allowed RSSB to develop an extension to the SRM to cover YD&S sites. This was first published as version 7.2 of the Safety Risk Model (SRM) and is now fully incorporated into the SRM from SRMv8 onwards. The project has achieved a detailed analysis of the nature of risk on YD&S sites. Four worker types have been considered in the YD&S model. Based on the data collected, the modelled risk in YD&S to these four groups as a whole is estimated to be 7.28 FWI per year. When the small amount of risk to other person types (ie passengers and public) is taken into account, the total modelled YD&S risk based on the participating companies is estimated to be 7.61 FWI per year (these figures are from SRMv8 and exclude direct suicide risk).

Chart 209. Breakdown of YD&S risk to the workforce: 7.28 FWI (SRM v8)



- Major injuries are the dominant component of the risk to all workforce types. In each case, the fatality component is relatively low. Engineering staff make up the greatest proportion of absolute risk across the workforce types, followed by drivers/shunters and infrastructure workers.

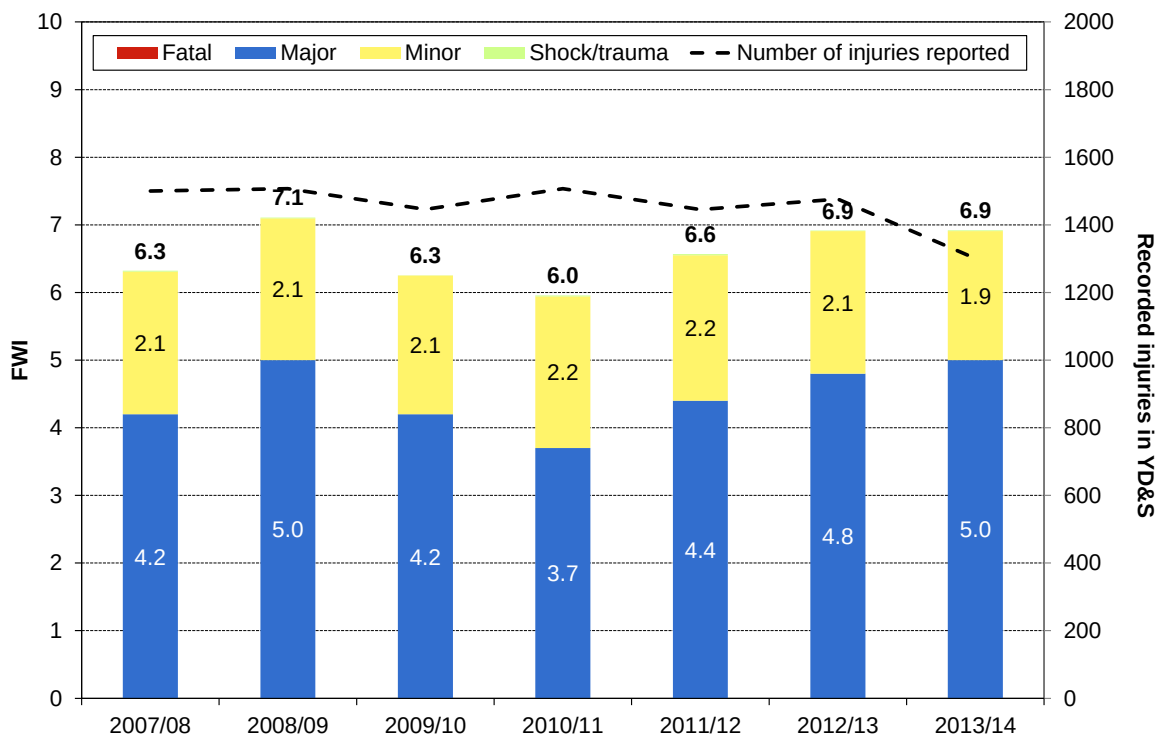
Analysis of trends at YD&S - based on currently reported data

The following sections provide some analysis of the types of events recorded in SMIS on YD&S sites over the last five years, illustrating the main hazardous event contributors to safety performance at these locations.

The majority of injuries recorded on YD&S sites are those suffered by members of the workforce. There have been two workforce fatalities on YD&S sites since 2004/05, but none since 2007/08.

Injuries to passengers and members of the public also occur in YD&S sites, albeit with a much lower frequency. Since 2007/08, there have been three injuries involving over-carried passengers (two minor and one case of shock). There have also been 19 accidental injuries to members of the public at YD&S sites, one of which was a trespass fatality. In addition, there have been two suicides in yards, depots and sidings. None of these events is included in Chart 210, which shows only harm to the workforce.

Chart 210. Recorded workforce harm at YD&S locations since 2007/08

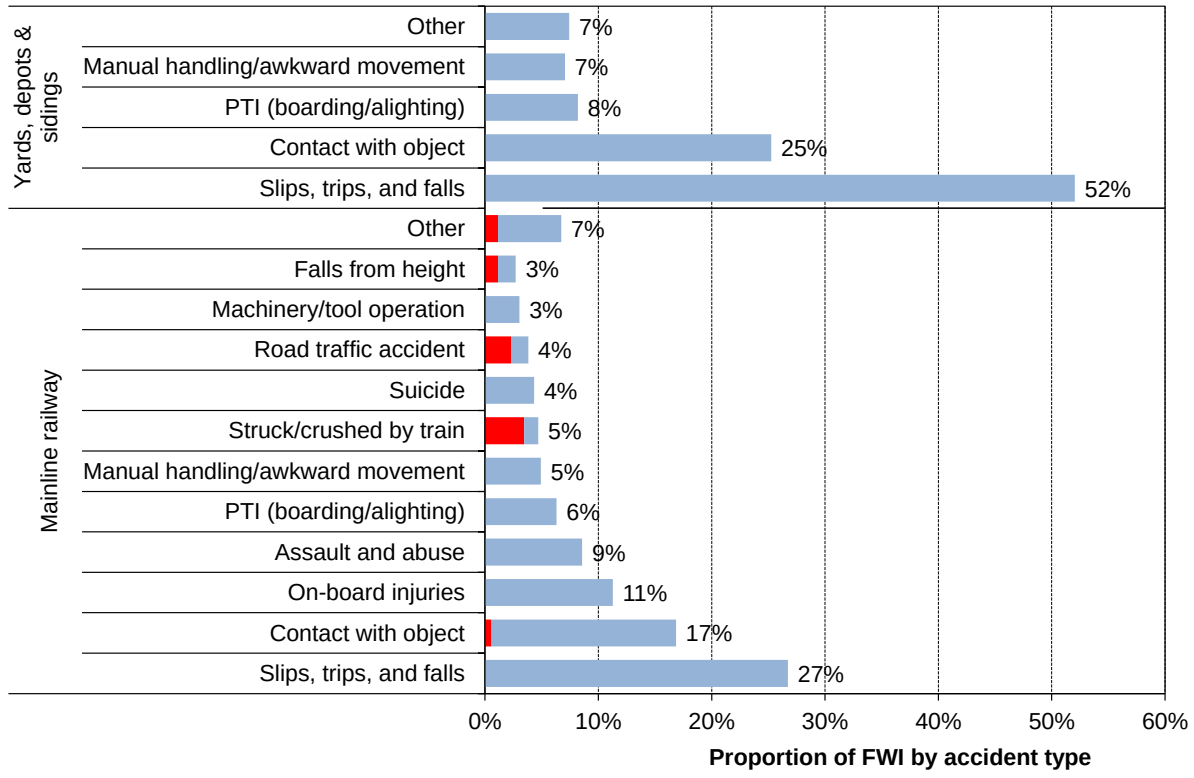


- The overall level of harm remained unchanged in 2013/14, while the number of recorded injuries reached its lowest point over the period shown. Major injuries generally dominate the FWI profile, so fluctuations in these injury numbers affect the total level of harm recorded.

Comparison of accident profiles between YD&S and the mainline railway

The chart below reviews the proportion of harm broken down by the types of accidents occurring on the mainline railway and in YD&S.

Chart 211. Proportion of harm by accident type, for YD&S compared with the mainline railway (2007/08 to 2013/14)



- The main contributor to the injury profile on YD&S sites are workforce slips, trips and falls, with more than half of all harm suffered on YD&S sites due to this hazardous event.
- Harm due to workforce contact with object injuries accounts for one quarter of the total harm recorded in YD&S.
- Workforce manual handling injuries, and injuries sustained when members of the workforce are getting on and off trains, each account for under 10% of the total harm in the period.
- Although the top two hazardous events are the same when comparing site types, it is clear that members of the workforce who are injured due to slips, trips and falls on YD&S sites account for a significantly higher proportion of the harm than the same event type on the mainline.
- Reflecting the wider range of environments faced by mainline workers, the accident profile comprises a larger number of accident types.

Appendix 5. Modelling the risk from train accidents

The SRM models train accident risk based on fault trees and event trees. Prof. Andrew Evans, of Imperial College, publishes an annual analysis of fatal train accidents.[79] Prof. Evans models risk by:

(1) Estimating the mean accident rate (accidents per year or per billion train kilometres), and the trend in that rate, from data on accident frequencies;

(2) Estimating the mean accident consequence (fatalities per accident), from data on accident consequences; and

(3) Multiplying these estimates to generate a modelled fatality risk (fatalities per year).

Although both the SRM and the Evans model produce estimates of train accident risk, they serve different purposes and use different methods.

The Safety Risk Model

The SRM helps the industry manage safety. It provides a detailed representation of accident causes and consequences, breaking the risk down into over 2,000 precursors. This allows key risk drivers to be identified and provides a basis for quantified risk assessments and cost-benefit analyses.

It is an aggregation of many different but related models, which are informed by data and expert judgement. Factors that affect the risk, such as the improved crashworthiness of modern rolling stock or changes in train loading, can be modelled explicitly. The model incorporates events that have the potential to occur, but have not occurred in the past, or would not be expected to occur in the time span covered by the data. The occurrence of a rare event (for example one that resulted in a large number of fatalities) would not affect the SRM estimate unless it led to any of the assumptions behind the model being re-evaluated. The SRM also uses non-fatal accidents as a source of data for both frequency and consequence estimates.

The SRM is a complex model that is based on sophisticated analysis and expert judgement. Uncertainty in the estimates derived from the model is therefore difficult to quantify, although work is currently underway in this area.

Andrew Evans model

Andrew Evans' model provides a high-level estimate of current risk that is based on historic risk and the long-term rate of risk reduction.

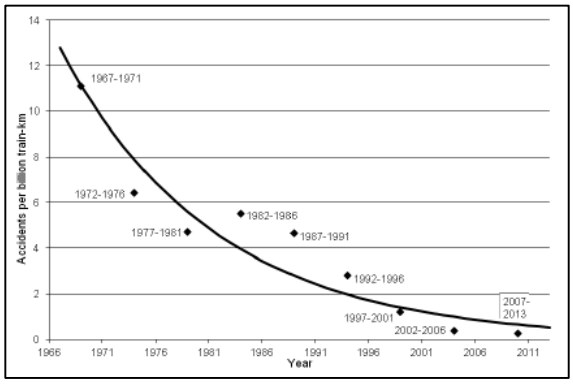
The accident rates and accident consequences are based purely on the observed data from past accidents. The model fits an exponential trend to the occurrence of fatal accidents, which gives an estimate of the rate of reduction over the last fifty years or so. Accident consequences are assumed to be static over the period, in the absence of significant statistical evidence to suggest otherwise.

Whilst useful for quantifying the long-term trend, this single rate is not suited to detecting changes in the rate over a shorter period, because historic data continues to influence the process for estimating current levels of accident frequency. The occurrence of a rare event

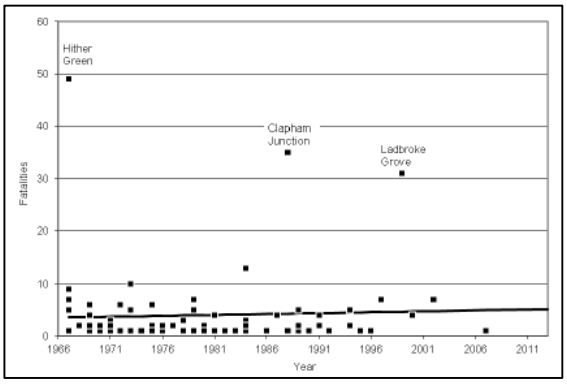
[79] *Fatal train accidents on Britain's main line railways: end of 2012 analysis*. A W Evans, Emeritus Professor, Imperial College London, February 2013

(such as a high consequence accident) would automatically impact on the model, for example by increasing the average consequence figure.

The Evans model is based on fitting a single exponential curve so it is possible to quantify some elements of the uncertainty in the estimate. The estimate is dependent on the model structure, for example the start date (starting in 1967 incorporates the accident at Hither Green, which killed 49 passengers that year) and the selection of five-year periods for curve-fitting.



Fatal train accidents per billion train-km
Source: Prof A Evans, 2014



Fatalities in train accidents
Source: Prof A Evans, 2014

Comparing results from the two models

The Evans approach models a single trend for train collisions, derailments and buffer stop collisions as a group, and models train collisions with road vehicles separately, because they tend to have a markedly different average outcome when compared with other train accidents. In contrast, and because accidents such as collisions and derailments have a wide-ranging set of precursors and likely severities of outcome, the SRM models over 1,700 detailed train accident scenarios separately before combining them into the overall model. The following table shows the difference in predictions made by the two approaches:

Train accident grouping	Average number of fatalities per year	
	Evans approach	SRM (v8)
Train collisions with road vehicles	3.12	3.68
Derailments, train collisions, and buffer stop collisions	1.22	2.12

- Train accidents involving collisions with road vehicles are relatively frequent and their consequences do not tend to vary widely. The observed set of events therefore provides a good indicator of the underlying level of risk, and thus there is similarity between the SRM estimate and the Evans estimate.

- Collisions between trains, derailments and overruns occur less frequently, and have a much wider range of potential outcomes. In this case, the observed set of events is not guaranteed to reflect the underlying level of risk and modelling assumptions assume more importance. Consequently, the SRM estimate and the Evans estimate – although of the same order of magnitude – differ by a proportionately larger amount.

Summary

The Evans model is useful for reviewing how the long-term trend in fatal train accidents has progressed. The SRM provides a rich source of information on the relationship between train accident precursors and train accident risk levels.

Appendix 6. Ovenstone criteria adapted for the railways

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

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

The classification of suspected suicide is only used when a coroner's report into the fatality has not recorded a confirmed verdict of the cause of death. It is a managerial assessment of whether the cause of death was more likely to be intentional or non-intentional, based on applying the Ovenstone criteria adapted for the railways, and requires objective evidence of intentional self-harm for the fatality to be classified as suspected suicide rather than accidental.

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 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 criteria for suspected suicide

Each of the following, on its own, may be treated as sufficient evidence of suspected suicide, in the case where the coroner has returned an open or narrative verdict, or has yet to return a verdict.

- Suicide note
- Clear statement of suicidal intent to an informant
- Behaviour demonstrates suicidal intent
- Previous suicide attempts
- Prolonged depression
- Instability; that is, a marked emotional reaction to recent stress or evidence of failure to cope (such as a breakdown)

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 7. Level crossing types

Active crossings: Manual

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 with obstacle detection (MCB-OD): MCB-OD are full barrier crossings equipped with an obstacle detection system as a means of detecting any obstacles on the crossing prior to signalling train movements. The obstacle detection system comprises of RADAR and scanning laser obstacle detectors. The lowering sequence is instigated automatically upon detection of an approaching train. MCB-ODs are equipped with road traffic lights and audible alarms. The barriers, road traffic signals and audible warnings for pedestrians are interlocked with the signalling system. The signaller no longer normally participates in operation of the crossing and does not have a view of it. Indications on the state of the crossing warning lights, barriers and obstacle detection system are provided to the signaller and the barriers can be lowered and raised manually if required.

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.

Active crossings: Automatic

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. A physical difference apparent to the user is that no telephone is provided. An indication is provided to the train drivers to show that the crossing is working correctly, they 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.

Automatic open crossing locally monitored with barriers (AOCL-B): AOCL-B is a simple half barrier overlay to previously commissioned AOCL crossings.

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 (which extinguishes when a train is approaching) and are generally only used by railway staff. All these crossing types, some of which 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 8. 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 injuries 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 first-party injuries arising from suicide, suspected suicide and attempted suicide.
Trespass	First-party injuries resulting from people engaging in behaviour involving access of prohibited areas of the railway, where that access was the result of deliberate or risk-taking behaviour. This includes actions such as deliberately alighting a train in running (other than as part of a controlled evacuation procedure), accessing the track at stations to retrieve items, or climbing on the outside of overbridges etc. Errors and violations at level crossings are not included in this category.
Witnessing suicide or trespass	Shock/trauma or other third party injuries arising from witnessing or otherwise being affected by suicide and trespass fatalities.
Workforce electric shock	Electric shock involving third rail, OLE, 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 9. Definitions

Term	Definition
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. For the majority of RSSBs work, BTP crime codes are been grouped into higher level categories to facilitate analyses and comparisons with SMIS records.
Child	A person under 16 years of age.
Fatalities and weighted injuries (FWI)	The aggregate amount of safety harm. One **FWI** is equivalent to: • one **fatality**, or • 10 **major injuries**, or • 200 Class 1 **minor injuries**, or • 200 Class 1 **shock/trauma** events, or • 1,000 Class 2 **minor injuries**, or • 1,000 Class 2 **shock/trauma** events.
Fatality	Death within one year of the causal accident. This includes subsequent death from the causes of a railway accident. All are RIDDOR reportable.
Hazardous event	An incident that has the potential to be the direct cause of safety harm.
HLOS	A key feature of an access charges review. Under Schedule 4 of the 2005 Railways Act, the Secretary of State for Transport (for England and Wales) and Scottish Ministers (for Scotland) are obliged to send to ORR a high level output specification (HLOS) and a statement of funds available (SoFA), to ensure the railway industry has clear and timely information about the strategic outputs that Governments want the railway to deliver for the public funds they are prepared to make available. ORR must then determine the outputs that Network Rail must deliver to achieve the HLOS, the cost of delivering them in the most efficient way, and the implications for the charges payable by train operators to Network Rail for using the railway network.
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 operative.
Level crossing	A ground-level interface between a road and the railway. It provides a means of access over the railway line and has various forms of protection including two main categories: Active crossings– where the road vehicle user or pedestrian is given warning of a train's approach (either manually by railway staff, ie manual crossings or automatically, ie automatic crossings) Passive crossings – where no warning system is provided, the onus being on the road user or pedestrian to determine if it is safe to cross the line. This includes using a telephone to call the signaller. The different types of crossing are defined in Appendix 7.
Major injury	Injuries to passengers, staff or members of the public as defined in schedule 1 to RIDDOR 1995 amended April 2012. This includes losing consciousness, most fractures, major dislocations, loss of sight (temporary or permanent) and other injuries that resulted in hospital attendance for more than 24 hours.

Term	Definition
Minor injury	**Class 1** Injuries to passengers, staff or members of the public, which are neither fatalities nor major injuries, and: - for passengers or public, result in the injured person being taken to hospital from the scene of the accident (as defined as reportable in RIDDOR 1995 amended April 2012). - for workforce, result in the injured person being incapacitated for their normal duties for more than three consecutive calendar days, not including the day of the injury. **Class 2** All other physical injuries.
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.
Operational incident	An irregularity affecting, or with the potential to affect, the safe operation of trains or the safety and health of persons. The term operational incident applies to a disparate set of human actions involving an infringement of relevant rules, regulations or instructions.
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 6.
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.

Term	Definition
Precursor Indicator Model (PIM)	An RSSB-devised model that measures the underlying risk from train accidents by tracking changes in the occurrence of accident precursors. See Section 8.7.1 for further information.
Public (members of)	Persons other than passengers or workforce members. 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)*	RIDDOR refers to the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations, a set of health and safety regulations that mandate the reporting of, inter alia, work-related accidents. These regulations were first published in 1985, and have been amended and updated several times. In 2012, there was an amendment to the RIDDOR 1995 criteria for RIDDOR-reportable workforce minor injuries from three days to seven days. For the purposes of the industry's safety performance analysis, the more-than-three-days criterion has been maintained, and the category termed Class 1 minor injury. In the latest version of RIDDOR, published 2013, the term 'major injury' was dropped; the regulation now uses the term 'specified injuries' to refer to a slightly different scope of injuries than those that were classed as major. Again, for consistency in industry safety performance analysis, the term major injury has been maintained, along with the associated definition from RIDDOR 1995.
Risk	Risk is the potential for a known hazard or incident to cause loss or harm; it is a combination of the probability and the consequences of that event.
Running line	A line shown in Table A of the Sectional Appendix as a passenger line or as a non-passenger line.
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.
Shock/trauma	Shock or traumatic stress affecting any person who has been involved in, or a witness to, an event, and not suffered any physical injury. Shock and trauma is measured by the SRM and reported on in safety performance reporting; it is within the scope of what must be reported into SMIS. However, it is never RIDDOR-reportable. • Class 1 Shock/trauma events relate to witnessing a fatality, incidents and train accidents (collisions, derailments and fires). • Class 2 Shock/trauma events relate to all other causes of shock/trauma such as verbal assaults, witnessing physical assaults, witnessing non-fatality incidents and near misses.
Signal passed at danger (SPAD)	An incident when any part of a train has passed a stop signal at danger without authority or where an in-cab signalled movement authority has been exceeded without authority. A 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.

Term	Definition
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.
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. In the Plan, trajectories have been developed which describe the industry's ambitions in nine identified key risk areas and identify actions that are being undertaken to achieve them.
Suicide	A fatality is classified as a suicide where a coroner's verdict has returned a verdict of suicide.
Suspected suicide	The classification used for fatalities believed to be a suicide and which have not yet been confirmed by a verdict from a coroner.
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.
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.
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.*

Term	Definition
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.*
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.
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.

Term	Definition
Trespass/Trespasser	Trespass occurs when people intentionally go where they are never authorised to be. This includes: • Passengers crossing tracks at a station, other than at a defined crossing. • Public using the railway as a short cut. • Passengers accessing track area at station to retrieve dropped items. • Public using the running lines as a playground. • Public committing acts of vandalism / crime on the lineside. • Passenger / public accessing the tracks via station ramps. • Public inappropriate behaviour on other infrastructure resulting in a fall onto the railway. • Public jumping onto railway infrastructure. • On train passengers accessing unauthorised areas of the train (interior or exterior). Note: Level crossing users are never counted as trespassers, providing they are not using the crossing as an access point into a permanently unauthorised area, such as the trackside.
Workforce	Persons working for the industry on railway operations (either as direct employees or under contract). Notes: • 'Under contract' relates to workforce working as contractors to (for example) a railway undertaking or infrastructure manager (either as a direct employee or a contractor to such organisations). • Staff travelling on duty, including drivers travelling as passengers, are to be regarded as workforce. When travelling before or after a turn of duty, they are to be treated as passengers. • British Transport Police (BTP) employees working directly for a railway undertaking or infrastructure manager on railway operations should be treated as workforce. • On-board catering staff (persons on business, franchisees' staff etc) and any persons under contract to them on a train (for example, providing catering services) should be treated as workforce.

Appendix 10. Glossary

Acronym	Expansion
ABCL	automatic barrier crossing locally monitored
AHB	automatic half-barrier crossing
ALCRM	All Level Crossing Risk Model
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
BAA	British Airports Authority
BTP	British Transport Police
CCS	contract conditions - safety
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
EC	European Commission
ECS	empty coaching stock
EIT	Enabling Innovation Team
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
GBH	Grievous bodily harm
GE	General Electric
GIS	geographic information system
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HABD	Hot Axle Box Detector
HEM	hazardous event movement
HEN	hazardous event non-movement
HET	hazardous event train accident
HGV	heavy goods vehicle
HLOS	High Level Output Specification
HSE	Health and Safety Executive
ILCAD	International Level Crossing Awareness Day
ISLG	Infrastructure Safety Liaison Group
LC	level crossing
LCRIM	Level Crossing Risk Indicator Model
LENNON	Latest Earnings Networked Nationally Overnight (system)
LIDAR	light detection and ranging
LOEAR	Learning from Operational Experience Annual Report
LUL	London underground
LX	level crossing

Acronym	Expansion
MCB	manually controlled barrier crossing
MCG	manually controlled gate crossing
MWA	moving weighted average
MWL	miniature warning lights
NHS	National Health Service
NMT	New measurement train
NPS	National Passenger Survey
NR	Network Rail
NRMI	Network Rail managed infrastructure
NRT	National Rail Trends
NRV	national reference value
NSA	National Safety Authority
NTS	National Travel Survey
OC	open crossing
OD	obstacle detection
OFG	Operations Focus Group
OLE	Overhead line equipment
ONS	Office for National Statistics
ORBIS	Offering Rail Better Information Services
ORCATS	Operational Research Computerised Allocation of Tickets to Services (system)
ORR	Office of Rail Regulation
OTP	on-track plant
PHRTA	potentially higher-risk train accident
PIM	Precursor Indicator Model
PLPR	Plain Line Pattern Recognition
PTI	platform-train interface
RAIB	Rail Accident Investigation Branch
RDG	Rail Delivery Group
RID	Regulations concerning the International Carriage of Dangerous Goods by Rail
RIDDOR	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995
ROGS	The Railways and Other Guided Transport Systems
RRUKA	Rail Research UK Association
RSSB	Rail Safety and Standards Board
RTS	Rail Transport Service
SMIS	Safety Management Information System
SMS	safety management system
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
SSRG	System Safety Risk Group
TOC	train operating company
TPWS	Train Protection and Warning System
TSI	Technical Specification for Interoperability
TSLG	Technical Strategy Leadership Group

Acronym	Expansion
UK	United Kingdom
UWC	user-worked crossing

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