Learning from Operational Experience Annual Report 2010

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Data is obtained from incident reports, confidential reporting, research activity, and other sources as necessary. It is compiled in the Safety Management Information System (SMIS), other information systems, and research outputs.

Changes are made by the industry through the planning process, through implementing revised standards, or by other operational or engineering measures.

RSSB publications, based on data collected, provide a wide range of information. They include regular reports on safety performance and other topical issues, as well as research reports.

Decisions are taken by recognised industry decision-making bodies, such as standards committees. RSSB provides governance for these industry bodies and owns the outputs (such as standards) on behalf of the industry. Through this route, decisions can be traced back through knowledge to information to valid data.

Data and information are used in modelling and other analytical work conducted by RSSB’s analysts. For example, SMIS data is used in the Safety Risk Model (SRM) and Precursor Indicator Model (PIM), and research results and operational experience are used to populate the Vehicle Track Interaction Strategic Model (VTISM).
Executive summary

Statistics show that the rail industry’s safety performance has steadily improved over time. However, we know that with good performance can come complacency; we also recognise that there will always be some residual risk associated with the transportation of people and goods. This is why the rail industry continues to strive to reduce the frequency of events that can cause harm, and to minimise the impact on passengers, staff and the public when they do occur.

One of the main contributors to the improvement of safety is the learning that flows from near misses and accidents. We call this Learning from Operational Experience (LOE). LOE is defined as the process by which knowledge from the operation of systems is gained, exchanged and used, leading to continuous improvement in both business performance and safety.

In support of LOE, RSSB provides many outputs to its members, the GB rail industry. These include annual and periodic safety reports, RSSB Board strategic items on specific areas of risk, the regular publication of information about incidents within the railways or other sectors, and the analysis and support we provide to the national stakeholder groups, which were established by the RSSB Board and which focus on particular risk areas.

The Learning from Operational Experience Annual Report looks at some of the ways LOE is achieved, be it via accident investigation reports and recommendations, statistical trend analysis or cross-industry group initiatives. It also fulfils the recommendations tracking function of previous RSSB documents.

LOE in action

The diagram opposite shows how RSSB works on the ‘plan, do, review’ principle, taking our expertise of data capture and analysis, and processing the resultant knowledge via the many industry bodies that we facilitate, in order to effect positive change.

An example of this learning loop in action may be seen in the work the industry has done on improving train crashworthiness. This issue was raised by the train accident at Ladbroke Grove (1999), among others, in which a number of fatalities were directly attributed to a loss of survival space resulting from the crushing of the passenger compartment, or ejection from the vehicle through broken windows or tears in the body structure.

Lord Cullen’s resulting inquiry recommended that the (then) current standard for rolling stock crashworthiness be reassessed. As a consequence, and on behalf of the industry’s Rolling Stock Research and Development Group, RSSB led a research project1 to investigate improvements to passenger survivability by establishing how crash energy could be better absorbed by improving the ability of vehicles to remain upright and in-line during collisions.

1 T118: Whole train dynamic behaviour in collisions and improving crashworthiness.
The project took into account the evolution of train design since 2000 and concluded that the contents of the relevant Euronorm\(^2\) embodied the best available framework for developing and designing future vehicle bodies. As a result, the Euronorm has been adopted as a mandatory requirement by Railway Group Standard GM/RT2100 (*Requirements for rail vehicle structures*), issue 4 of which includes standards for cab interiors, doors and windscreens. Having been put out to industry consultation, GM/RT2100 was published in December 2010 and came into force on 5 March 2011.

**Key themes**

Throughout 2010, RSSB has also monitored various other aspects of LOE, as detailed below.

**Corporate memory retention**

Most of the rail safety improvements seen over the last 60 years have resulted from technological advancement, some of which has arisen from official accident investigations. Since 2005, investigations have been carried out by the independent Rail Accident Investigation Branch (RAIB), in addition to the industry’s own investigations. The cycle of ‘investigate, report, recommend, consider, track agreed recommendations’ is working increasingly well and goes some way to creating something that the industry can ‘remember’.

But what if it forgets, and long-recognised practices and standards fall aside during a reorganisation or change in the rail employee demographic, or – as is so often the case – a series of such changes? On page 18, we show how this problem led to the collapse of the Malahide Viaduct in Ireland, an accident which occurred as a passenger train was passing over it, and whose effects were limited only by the skill of the driver.

We also suggest ways of dealing with the difficulties of corporate memory retention, and provide information on RSSB’s research into leading and lagging indicators\(^3\), along with the links we are forging between different sources of data and qualitative information in a move to facilitate cross-modal learning.

**Safety Management Systems**

Harmonising certain Safety Management System (SMS) elements can deliver operating efficiencies and assist duty holders with the practicalities of their duties of co-operation.

A significant proportion of rail safety system risk is controlled through the combined efforts of transport operators, thus necessitating the clarity of roles, responsibilities and processes at the interfaces between them.

\(^2\) EN15227: *Railway applications – crashworthiness requirements for railway vehicle bodies.*

\(^3\) T852: *The application of leading and lagging indicators to the rail industry.*
Executive summary

RSSB’s SMS function works closely with industry stakeholders to build on existing processes and strive for continuous improvement.

To this end, we responded to the industry’s request for guidance on conducting accident investigations. The resulting document extends beyond the requirements of Railway Group Standard GO/RT3119 (Accident and Incident Investigation), which is largely focussed on trains. Further details may be found on page 22.

Safety culture

A strong or ‘positive’ safety culture is fundamental to continuous improvement. This is reflected in employee (frontline and management) attitudes towards safety, the frequency of key day-to-day behaviours and the quality and effectiveness of the underlying SMS.

RSSB’s web-based Safety Culture Toolkit helps rail companies measure their own safety culture, and determine the actions that they could take to tackle any issues without the need for extensive external support. This is one of the support tools that can help companies to work with the ORR and its Rail Management Maturity Model (RM3). More information may be found on page 23.

Mobile phones

Within a safety critical environment like the railway, it is not always safe to yield to the natural reflex to answer a ringing phone or to read (and maybe reply to) a text. This was illustrated in the USA on 12 September 2008, when a commuter service passed a protecting signal at danger and collided head-on with a freight train in Chatsworth, California, at a closing speed of around 85mph. Twenty-five people lost their lives, including the train driver himself. On the day of the accident, he had sent and received several text messages while on duty, the last of which occurred just 22 seconds before the collision.

All private use of mobile phones while working on safety critical activities is now banned by GB rail operators. Further controls have also been reinforced to minimise the risk associated with the use of company-issued phones.

To support this stance, in December 2009 RSSB published a Railway Industry Standard, which provides duty holders with a framework for producing a comprehensive company policy on the use of mobiles in driving cabs and setting minimum requirements to be mandated in that policy. In addition, we have recently completed a research project designed to help reduce inappropriate mobile use. We have also undertaken research on the key distinctions between car driving and train driving. See pages 23-24.

Platform-train interface

Mindful of rising levels of risk, the Operations Focus Group (OFG) has requested that RSSB undertake research into accidents occurring to passengers at the platform-train interface.

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4 T904: Development of a train driver education programme on mobile phone risk.
Executive summary

(PTI). Details of RSSB’s analysis may be found on page 25, but in brief we have found that that:

- Slips, trips and falls in stations account for the largest proportion of passenger FWI risk, at 46%. Passenger PTI accounts for the next largest proportion, at 20%. Of this, 12% occurs while getting on or off trains.

- Accidents during boarding or alighting account for 9% of fatality risk, while other accidents at the platform train interface account for 29%; this is biggest single contributor to passenger fatality risk.

RSSB’s research continues in this area; the final results will be presented to the OFG during 2011. The rail industry is also taking steps to deal with these issues, by improving platform markings, implementing a slip, trip and fall toolkit, producing a Rail Industry Standard for train dispatch, risk-assessing train dispatch plans, and by fixing reflective strips to door edges and handles to increase visibility.

In addition, the RED 28 DVD focuses on the PTI issue, by featuring a dramatisation of an incident and suggestions on how to minimise the hazards.

Level crossings

In April 2010, RSSB released an updated edition of its Road-rail interface special topic report. With respect to level crossings, the report notes that:

- Approximately 77% of the total risk at level crossings is to pedestrians. Most of pedestrian risk involves members of the public (62%) and passengers being struck by trains (8%) on level crossings.

- Approximately 4% of the total risk at level crossings is to passengers and members of the workforce on board the train.

The rail industry has focussed on mitigating the risk at the road-rail interface through the combined actions of the Road-Rail Interface Safety Group (R-RISG) and the specific actions of Network Rail and the law enforcement agencies. The R-RISG monitors the situation via the high-level analysis produced by RSSB and Network Rail’s management actions and specific local supervision and maintenance regimes, which includes the use of the All Level Crossing Risk Model. See page 26 for further information. At the time of publication (March 2011), Network Rail is reviewing its strategy for level crossings and RSSB is working in support of this.

Winterisation

The snow experienced at the start of December 2010 had an inevitable effect on the railway. Parts of Scotland, the North East and the South East suffered most acutely, with widespread disruption to services.

We note the effects these conditions had on passengers and train operators, with particular emphasis on freezing brakes. RAIB has since published two investigation reports into incidents in which this issue was causal, but on page 27 we also record other actions that the
rail industry has taken, including the publication by the Rail Freight Operators’ Group of an approved code of practice, which offers guidance on testing brakes in snowy conditions and suggests various ways of minimising the risks associated with winter weather operations.

**Role of investigations in the learning process**

Though the cycle of safety planning and performance reporting is essential to ensuring that safety continues to improve, much of the industry’s learning comes from investigations into accidents and incidents.

**RAIB investigations**

RAIB published 21 accident reports in 2010 (see right). The 15 covering incidents on NRMI led to 76 recommendations. RSSB’s analysis shows that, in 2010, most recommendations related to *Infrastructure asset management* (41%). This tallies with RSSB’s Precursor Indicator Model (see page 15).

During the year, RSSB and RAIB worked increasingly closely to facilitate the learning from accidents and incidents, including facilitating RAIB attendance at cross-industry groups, jointly reviewing findings from investigations that may impact on standards or research needs, and demonstrating more fully the decision-making process in the few cases where recommendations are not adopted.

**Progress against Formal Inquiry recommendations**

Between 2002 and 2006, RSSB and its predecessor Railway Safety, was responsible for extracting lessons from accidents by investigating their causes. The company produced 49 Formal Inquiry reports during this period, which produced a total of 533 recommendations. Of these, 532 had been closed by 1 January 2010.

The remaining recommendation relates to the accident at Blake Street on 7 August 2005, in which a Class 66 locomotive ran away from a worksite and derailed at Alrewas. RSSB will track its progress; once complete, we will close our Formal Inquiry tracking function for good.

**Incident Causal Classification System analysis**

RSSB receives investigation reports from all railway organisations. Currently, around 4,500 have been stored, dating back to the late 1990s. Although the conclusions in these reports hold much valuable information about event causes, once the recommendations therein have been acted upon, there is a danger that some of their learning points will be lost or will not reach other parties who could benefit from them.

RSSB is developing an Incident Causal Classification System (ICCS), which uses a taxonomy based on the one created by RAIB. The ICCS holds all RAIB reports, along with a number of Formal Investigations and rail accident investigations from outside Great Britain. RSSB also recognises the need beyond rail, as lessons learned by other industries may be transferrable, and may even reveal a gap in knowledge. The ICCS is thus being augmented with reports from the oil, marine and aircraft industries.
Executive summary

Our full ICCS analysis for 2010 may be found in Chapter 5 and includes information on SPADs, and derailments and their causes (including infrastructure and wagon maintenance issues).

In order to demonstrate the ICCS’s capability to draw parallels between learning points raised by accidents on the main line GB network and other railways and industries, we have also focussed on collisions with third parties and collisions in which competence and compliance issues were found to have been causal. This has allowed us to compile a digest of related incidents which occurred on GB Heritage lines, on the Croydon Tramlink, and in Australia, along with a collision during a race at the Dover Regatta and a fatal air crash near North Caicos Airport, in the British West Indies.

Confidential Incident Reporting and Analysis System

Learning does not only occur after an accident; many valuable lessons are revealed by what might be termed ‘accidents waiting to happen’.

Reports to the industry’s Confidential Incident Reporting and Analysis System (CIRAS) focus mainly on ‘near miss’ events or perceived deficiencies in safety systems and arrangements. Of the 264 reports raised in 2010, most were made by drivers (46) and track workers (43). CIRAS monitors the outcomes from the reporting process to ascertain the value and benefits delivered to the railway industry. Positive outcomes are recorded where the CIRAS report prompted an investigation, briefing, review or change. The issues highlighted in Chapter 6 include the following:

- Problems with electric couplings on Class 170 units.
- Machine Controller competencies lacking.
- AWS equipment not set up as per the Rule Book.
- Inadequate rest periods due to rostering.

* * * * * *

This report is an attempt to capture some of the learning we have facilitated on behalf of the GB rail industry in 2010. Throughout, we pose questions about corporate memory retention, the need for a just safety culture, mobile phone policies, winterisation procedures and competence and compliance systems.

We are also mindful of the need to look beyond our own operations for insights or initiatives. As we have demonstrated in the past, the Baker Panel review into the Texas City oil refinery disaster of 2005 and the Haddon-Cave report on the Nimrod accident of 2006 contain lessons from which the rail industry would benefit. By recommending RSSB’s National Incident Reporting System (NIR-Online) as a model for sharing lessons and best practice, the report on the Buncefield oil depot explosion of 2005 showed that other industries can also learn from rail.
Executive summary

LOE is universal, and we would welcome your feedback on how to shape future editions of this document.
1 Introduction

One of RSSB’s constitutional functions is to report on progress against recommendations from Formal Inquiries. Until 2006, this was published in a separate report, which from 2007 was integrated into the Annual Safety Performance Report (ASPR) following the cessation of RSSB’s involvement in conducting accident inquiries after 2005.

In the 2008 edition of the ASPR, the recommendations chapter evolved to cover the wider aspects of Learning from Operational Experience (LOE).

Throughout 2009 and 2010, RSSB has worked with industry groups to shape the definition and objectives of LOE to meet industry requirements. At the same time, the reporting solely on Formal Inquiries conducted by RSSB up to 2006 is virtually complete, while opportunities for learning from wider sources of information are developing.

In producing this report, which describes the LOE processes and their evolution, RSSB is retaining the recommendations tracking function of previous documents. As learning is also a two-way process, some of the learning points raised in 2010 are repeated.

1.1 Aims and scope of document

The LOE Annual Report covers the calendar year 2010. It has been written to provide railway managers with:

- An overview of the railway risk profile.
- Recent general developments in sharing learning from operational experience.
- Specific learning points arising in 2010.
- A clear picture of rail industry progress against recommendations from accident investigations.
- A summary of related RSSB deliverables.

Note that hyperlinks (underlined blue text) have been used throughout this document to aid navigation and for access to relevant documents and websites.

Green boxes have also been provided to highlight lessons learnt by our industry in the past, along with learning points that readers might like to consider for the future.

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5 Clause 2.3, part a).iii of RSSB’s Constitution Agreement (01/04/03) states that the company shall ‘maintain a current record of’: a) ‘recommendations of accident investigations and formal inquiries’; b) the responses of all the organisations to which the respective recommendations are directed; and c) the state of progress towards implementation within timescales recommended or prescribed by such investigations or formal inquiries’.

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Overview

2 Overview of main line risk profile

Statistics show that the rail industry’s safety performance has steadily improved over time. Over the last eleven years in particular, it has seen institutional changes, significant growth and further investment. Sustained improvements in safety performance and risk have resulted from many of these changes, together with the efforts of railway managers and staff to continuously improve. Some improvements have been formed from the learning that comes with operational experience.

To provide a picture of the recent situation, Chart 1 shows how accidental fatalities and weighted injuries recorded on GB rail have fallen between 2000/01 and 2009/10.

- There were no passenger or workforce fatalities in train accidents during 2009/10. The overall harm to members of the workforce is at an historic low, with low levels also being maintained for passengers.

- Seventy people died accidentally on the railway in 2009/10. Five were passengers, three were members of the workforce and the remaining 62 were members of the public, 49 of whom were engaged in acts of trespass. When non-fatal injuries are taken into account, the total harm occurring during the year was 129.7 fatalities and weighted injuries (FWI).

- A further 236 people died as a result of suicide or suspected suicide.

Furthermore, the fatality risk to passengers from train accidents has decreased from 2.45 per ten billion passenger kilometres in 2001 to 0.45 per ten billion passenger kilometres. For

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staff, the train accident fatality risk per one billion train kilometres has fallen from 5.21 to 1.14.\(^7\)

Appendix 2 lists fatal rail accidents which have occurred since 1997 (including the Ladbroke Grove accident of 1999\(^8\), in which 31 people died, and Hatfield – see opposite). The causes that led to them include infrastructure failure (points, track), signals passed at danger (SPADs) and road vehicle incursion. Many steps have been taken to reduce the risk from each of these event types and the likelihood of their reoccurrence, including:

- The application of better technology, such as TPWS.
- The withdrawal of Mark I coaching stock from the main line network.
- Smarter appreciation of operational safety issues, including a broader understanding of the human factors that relate to driver and signaller behaviour in relation to SPADs.
- Non-rail stakeholders playing their part to protect the impact their activities have on the railway at relevant interfaces, such as the Highways Agency putting in flank protection on road bridges.
  (Following the Great Heck accident in February 2001, a number of working groups from all interested parties produced Managing the obstruction of the railway by road vehicles (DfT, 2003). This offers guidance on how highway and rail authorities can show that they have ranked sites where roads cross or run alongside railways according to their relative risk and that they have considered how to manage that risk.\(^9\))
- A broader execution of a risk-based approach to safety, such as Network Rail’s management of level crossings.

The combined effect of all the actions to manage the risk is to reduce the frequency and consequence(s) of accidents. In order to reduce both frequency and consequences, the

\(^{7}\) These figures are derived from the RSSB Safety Risk Model (SRM), which is compiled using pan-industry data, collected through the Safety Management Information System (SMIS) over the last 11 years. Normalisers for these figures have been chosen to best reflect the exposure to risk for each person type.

\(^{8}\) On 5 October 1999, a suburban train departing from Paddington station passed a signal at danger and collided with an incoming inter-city service at Ladbroke Grove.

\(^{9}\) The Road-Rail Interface Safety Group (R-RISG) also monitors these issues. The R-RISG includes Network Rail, RSSB, the ORR, BTP, ATOC and the Association of Directors of Environment, Economy, Planning and Transport. The DfT also attends to inform the group about legislative and policy issues.
industry’s research programme has undertaken work that includes a review of lifeguards and deflectors, which may provide protection against obstacles on the line, the structural and interior crashworthiness research, passenger and traincrew containment issues, and evacuation and escape strategies.

More information may be found in RSSB’s Report on improvements in the safety of passengers and staff involved in train accidents.

2.1 Review of train accident risk

Train accidents involving loss of life to passengers or members of the workforce are thankfully rare. Indeed, as Chart 2 shows, their frequency has fallen significantly over the last 60 years.

Yet with good performance can come complacency – a subject which has been the emphasis of many recent Public Inquiries. To quote the Baker Panel report into the BP Texas City oil refinery accident of 2005:

‘The passing of time without a process accident is not necessarily an indication that all is well.’

The Independent Inquiry into the Mid-Staffordshire NHS Foundation Trust also reminded us of the dangers of becoming ‘disconnected from what was actually happening [and choosing instead to] rely on apparently favourable performance reports by outside bodies […], rather than effective internal assessment and feedback’.

10 This is a metal bracket fitted in front of each of the leading wheels of a train in order to deflect small objects from the wheels to reduce the risk from derailment.

11 Chart source: RSSB.
The rail industry attempts to combat complacency by analysing safety performance and risk data in as many different ways as possible (see, for example, RSSB’s Annual Safety Performance Report). But the rarity of train accidents means a small dataset, so RSSB also tracks six types of accident precursor in order to assess underlying risk more effectively. The current output of this work – the Precursor Indicator Model (PIM) – is shown in Chart 3.12

Chart 3. Trends in train accident risk per the Precursor Indicator Model13

![Chart 3: Trends in train accident risk per the Precursor Indicator Model](image)

The PIM indicator has decreased significantly over the past 10 years. The most notable reduction has been in the risk from SPADs.

Ten years ago, SPADs contributed the largest element of the PIM indicator value; the most significant contributor to passenger risk now arises from infrastructure.14 More information on this issue may be found elsewhere in this document: Infrastructure maintenance.

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12 See RSSB, Annual Safety Performance Report 2009/10 (RSSB, 2010), pp. 148–150 for more information on the PIM.
14 Note that the PIM includes the risk to road vehicle occupants who are involved in collisions with trains (for example, at level crossings).
3 Rail industry learning

The rail industry’s primary safety objective is to avoid harm to people and property. However, there is always some residual risk associated with the transportation of people and goods. The industry seeks to reduce the frequency of events that can cause harm; but for those that do occur, it seeks to minimise the impact on passengers, staff and the public. One of the main contributors to the improvement of safety is the learning that flows from operational experience, near misses and accidents.

In fact, the industry – and whichever regulatory body oversees it – has been learning lessons from accidents and incidents since its inception. Early incidents like the death of William Huskisson MP at the opening of the Liverpool & Manchester Railway in 1830, for example, led to the first Railway Regulation Act (1840), which required all injurious accidents to be reported to the Board of Trade. Within 50 years, block signalling, interlocking and continuous braking on passenger trains had been made mandatory. The twentieth century saw further advances, ranging from continuous welded rails and multi-aspect signalling, through to automatic train protection systems.

3.1 The development of LOE

One way in which the rail industry seeks to avoid complacency is to focus on Learning from Operational Experience (LOE) – a function in which RSSB provides analysis and support to the rail industry under the supervision of the Safety Policy Group (SPG).\(^\text{15}\) After consultation with a wide range of industry representatives, LOE has been defined as the process by which knowledge from the operation of systems is gained, exchange and used, leading to continuous improvement and the development of a positive safety culture.

There are five high-level principles which support this vision for the railway industry in Britain:

- Industry decision makers should have access to good quality intelligence in a way that meets their needs.
- Accidents and incidents should be investigated promptly and proportionately with relevant learning points effectively identified and acted upon.
- Good practice should be proactively identified, shared and used among industry partners.
- Organisations should have processes to understand, interpret and embed lessons so as to prevent recurrence of similar/repeat events.

\(^\text{15}\) The Safety Policy Group is a senior cross-industry body, consisting of RSSB members, who supervise and advise on the delivery of RSSB’s functions that support the industry in managing safety. The Safety Regulator (the ORR) and Department for Transport are observers on the group.
Rail industry learning

- Industry processes should support the retention and communication of knowledge and experience.

LOE is discharged through the rail industry’s national stakeholder groups, all of which have been established by the RSSB Board. The industry-wide SPG has overall stewardship.

CTRL+click on the graphic below to link to relevant web content for each group:

The groups review the outputs from a number of RSSB activities, including:

- **Safety performance reporting** – information on the latest trends, updated on a regular basis.
- **Operational Feedback** – RSSB’s arrangement for analysing and disseminating lessons from rail and other industry accidents.
- **CIRAS** – the rail industry’s Confidential Incident Reporting and Analysis System.
- **Human Factors**
- **Safety Management Systems programme**
- **R&D** – RSSB’s management of research and development on behalf of government and the railway industry.

### 3.2 LOE in action

Changes are made by the industry through the planning process, through implementing revised standards, or by other operational or engineering measures.

Data is obtained from incident reports, confidential reporting, research activity, and other sources as necessary. It is compiled in the Safety Management Information System (SMIS), other information systems, and research outputs.

Data is provided to decision-making bodies, such as standards committees. RSSB provides governance for these industry bodies and owns the outputs (such as standards) on behalf of the industry. Through this route, decisions can be traced back through knowledge to information to valid data.

Data and information are used in modelling and other analytical work conducted by RSSB’s analysts. For example, SMIS data is used in the Safety Risk Model (SRM) and Pre-cursor Indicator Model (PIM), and research results and operational experience are used to populate the Vehicle Track Interaction Strategic Model (VTISM).
The above diagram (which appears in our Guide to RSSB), shows how we work on the ‘plan, do, review’ principle, taking our expertise of data capture and analysis and processing the resultant knowledge via the many industry bodies that we facilitate, in order to effect positive change.

An example of this learning loop in action may be seen in the work the industry has done on improving train crashworthiness. This issue was raised by the train accident at Ladbroke Grove (1999), among others, in which a number of fatalities were directly attributed to a loss of survival space resulting from crushing of the passenger compartment, or ejection from the vehicle through broken windows or tears in the body structure.

Lord Cullen’s resulting inquiry recommended that the (then) current standard for rolling stock crashworthiness be reassessed. As a consequence, and on behalf of the industry’s Rolling Stock Research and Development Group, RSSB led a research project (T118: Whole train dynamic behaviour in collisions and improving crashworthiness) to investigate improvements to passenger survivability by establishing how crash energy could be better absorbed by improving the ability of vehicles to remain upright and in-line during collisions.

T118 took into account the evolution of train design since 2000 and concluded that the contents of the relevant Euronorm embodied the best available framework for developing and designing future vehicle bodies. As a result, the Euronorm has now been adopted as a mandatory requirement by Railway Group Standard GM/RT2100 (Requirements for rail vehicle structures), issue 4 of which includes standards for cab interiors, doors and windscreens. Having been put out to industry consultation, GM/RT2100 was published in December 2010 and came into force on 5 March 2011.

3.3 Key LOE themes

Just as businesses have to work as one to make a profit, and football teams play as one to win championships, the rail industry needs to think and act as a cohesive unit, in order to maintain good levels of safety. This section shows how the industry has achieved such levels in a number of key areas.

3.3.1 The challenge of corporate memory

On the evening of 21 August 2009, Malahide Viaduct (on the Dublin to Belfast line in Ireland) collapsed into the sea as a passenger train passed over it. The driver noticed that the track was giving way on the northbound side and felt the ballast moving beneath him. By allowing the train to coast, he eased pressure on the trackbed and managed to avoid derailment – or worse.

In its subsequent report (published August 2010), the Rail Accident Investigation Unit (RAIU) found that the collapse occurred because staff conducting safety checks had not been provided with critical structural information. For more than 40 years, repair work had focused on the viaduct pillars, rather than the causeway on which

16 EN15227: Railway applications – crashworthiness requirements for railway vehicle bodies.
they were built. Significant grouting work to protect the superstructure took place in 1967, two metres below sea level. Investigators noted that, since that time, new engineers joining Iarnród Éireann (IÉ) did not know that there were two separate parts to the bridge, or that the piers were not embedded in the bedrock. The RAIU found an underlying factor to be that:

‘There was a loss of corporate memory when former Iarnród Éireann staff left the Division, which resulted in valuable information in the relation to the historic scouring and maintenance not being available to the staff in place at the time of the accident’.17

History is littered with instances – many of them military – where lessons have not been learned. On a personal level, we seem to be able to manage, but (as the Malahide Viaduct accident indicated) companies are vulnerable as they comprise a number of different and disparate memories, which do not necessarily link perfectly, and which are subject to change as staff retire, move on, or move in from elsewhere.

For the railway, the past is less of a foreign country than it is for some industries, as we still use Victorian infrastructure, along with vehicles designed and built from the 1960s to the present day. Thus, while a collision like that at Harrow & Wealdstone (1952) will probably not happen again (thanks to AWS and TPWS), human fallibility – responsible for the ‘read across’ SPAD and derailment at Norton Fitzwarren in 1940, for example – is still valid as human fallibility will always exist.18

Statistics suggest that the GB rail industry is performing well, although we are well aware that with good performance can come complacency. We combat complacency with continued vigilance. This is why RSSB (for example) analyses safety performance data in various ways, considers precursors via the Precursor Indicator Model (PIM) and supplies qualitative information to the various national stakeholder groups.19 The qualitative information from incidents and accident investigations across the globe are input to the Incident Causal Classification System (ICCS), in a move to assess lessons from other railways and other industries (see Chapter 5 for more information).

Such analysis helps the industry to formulate initiatives to help further combat recurrence and to help improve – because behind each statistic is a person with a family.20 Indeed, as

18 At Harrow & Wealdstone, a passenger service passed a signal at danger and struck the rear end of a train in the section ahead. A third train struck the wreckage soon after. There were 112 fatalities. The Norton Fitzwarren incident involved a late-running sleeper train which was rerouted to a loop by the signaller at Taunton West. The driver mistook the Main line signals, which were off, for his own, which were on. They were 350 yards away at the end of the loop – too late to brake in time. The locomotive was derailed by the trap points and the first six carriages were thrown across all four lines. Of the 900 passengers aboard, 27 were killed and 25 were injured.
20 As expressed in the TUC’s 2010 report, The Case for Health and Safety (p. 11).
the Nimrod Inquiry report reminded us, safety is about people as well as process and paper.\textsuperscript{21}

Qualitative information is also key to ‘storytelling’ – a recognised tool for sharing knowledge being considered by the NHS, among others (see the NHS ABC of Knowledge Management for further details).

Storytelling is a good way of communicating complicated concepts clearly. It also provides the context in which knowledge arises, as well as the knowledge itself. Hence it can increase the likelihood of accurate and meaningful knowledge transfer. Stories are memorable – their messages tend to ‘stick’; they also get passed on in day-to-day language and can nurture a sense of community and help to build relationships. This explains why books like L. T. C. Rolt’s Red for Danger and Stanley Hall’s Beyond Hidden Dangers remain popular – and relevant.

As noted in Chapter 2, most of the safety improvements seen over the last 60 years have resulted from technological advancement, much of which – such as the introduction of TPWS and improvements in train crashworthiness\textsuperscript{22} – has arisen from official accident investigations. These investigations lead to recommendations, and it is from here that learning points arise. The tracking process (overseen by the Office of Rail Regulation) represents the closing of the loop and demonstrates that a lesson has been ‘learnt’ – for the time being at least. Investigations are carried out by the independent Rail Accident Investigation Branch (RAIB) and, clearly, the cycle of ‘investigate, report, recommend, track’ works well and goes some way to creating something that the industry can ‘remember’.

But what if it forgets, and practices and standards long recognised fall aside during a reorganisation or change in the rail employee demographic, or – as is so often the case – a series of such changes?

System changes often result in a temporary rise in risk as ‘teething troubles’ occur – witness the increase in platform-train interface accidents after the widespread introduction of coaching stock with power doors and hussle alarms in the early years of this century\textsuperscript{23}, although this situation improved from the end of 2005, reflecting increasing passenger familiarisation with the equipment, it is important that effective change management processes are in place to minimise such rises in risk – temporary, or otherwise.

The RAIB report into the incident at Romford on 14 February 2010 provides a more recent illustration of the problems that can arise with inadequate change management procedures (with specific


\textsuperscript{22} See (for example) RSSB (2009) Report on improvements in the safety of passengers and staff involved in train accidents RSSB.

Moving together towards practical solutions

The problems of corporate memory retention can be dealt with by sharing lessons and good practice initiatives through the Learning from Operational Experience industry workstream, the various national stakeholder groups, conferences and publications like Red Alert. Changes in the employee demographic represent a more profound problem, however. Anecdotal evidence suggests that younger people tend to move jobs after three years or so, taking what knowledge they have managed to gain with them. This suggests the importance of encouraging younger staff members to make a time investment, for the question about railway safety is not ‘do we know this?’ but ‘will we still know it tomorrow?’

The Institution of Railway Operators (IRO) may be able to help here. The IRO exists ‘to advance and promote the safe, reliable and efficient operation of the railways by improving the technical and general skills, knowledge and competency of those involved in rail operations’. This may encourage students to stay with the industry.

It also helps them understand why things are the way they are – a key point for appreciating where various check functions come from.

RSSB’s R&D project T852: The application of leading and lagging indicators to the rail industry also suggests that – in order to form ‘safety performance indicators’ – a company needs to ask how it got to a particular safety situation. This involves asking why processes are carried out, why we have certain risk controls and how they might go wrong.

In the UK, the Health and Safety Executive (HSE) has also published guidance (Successful health and safety management, HSG254) on the development of process safety indicators for major hazardous industries. RSSB’s research is exploring the use of leading and lagging indicators in the rail industry and will deliver a guidance note on their application.

On the micro level, much insight can be gained by delving into old accident reports, such as those found on the Railways Archive website. But conceivably, it would be useful to devise a method of recording the knowledge of the older ranks, many of whom are retiring. The industry may benefit from encouraging them to record their knowledge and engage with

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24 At around 07:25 on Thursday 4 February 2010, a quantity of ballast fell from the bottom doors of a hopper wagon in a freight train as it passed through Romford station at about 59 mph. Stones bounced onto the station platform and struck three people, two of whom subsequently required treatment for minor injuries.

25 See http://www.rssb.co.uk/LEARNING/Pages/default.aspx.

26 A conversation with various European rail safety colleagues indicated that a similar problem is evident on the continent.

27 See www.railwayoperators.org.
those younger (and newer to the industry) in order to prevent any knowledge gap from becoming a chasm.

RSSB is also trying to forge a link between different sources of data and qualitative information in a move to facilitate cross-modal learning. This is being developed into the Sharing Portal for Access to Rail Knowledge (SPARK) project. At its core is a ‘knowledge library’ to capture and manage information and make it easily accessible. It will include text publications (journals, conference proceedings, stand-alone reports), newspaper or magazine articles, presentations, video clips, audio clips and so on, from research institutes or universities, test facilities and railway companies. SPARK is intended to go live during 2011.

Learning point: Does your company consider the problems of corporate memory retention?

3.3.2 Safety Management Systems

A Safety Management System (SMS) consists of the arrangements and processes used by an organisation to effectively manage Health and Safety to a level that is as low as reasonably practicable (ALARP). Its objective is to provide a framework around which good performance can be established and maintained, in order to shape a positive safety culture.

Harmonising certain SMS elements can deliver operating efficiencies and assist duty holders with the practicalities of their duties of co-operation. A significant proportion of rail safety system risk is controlled through the combined efforts of transport operators, thus necessitating the clarity of roles, responsibilities and processes at the interfaces between them.

In late 2009, RSSB responded to the industry’s request, via the SPG, for guidance on conducting accident investigations.

The resulting document, to be published in 2011, extends beyond the requirements of Railway Group Standard GO/RT3119 (Accident and Incident Investigation) and its associated Guidance Note (GO/GN3519), which are largely focussed on trains. The wider range of undesired events that are not mandated for investigation in these two Standards includes, for example, non-train related accidents and those off the main line, accidents involving only minor injuries, construction related accidents possibly in possessions and near misses.

The guidance covers the key aspects of investigation but also other important related issues of accident management, such as the provision of necessary systems and resources (including competencies, response management, reporting, recommendation management and the learning of lessons). For further information on RSSB’s SMS Programme, click here: LINK.
3.3.3 Safety culture

Commitment to the development of a strong or ‘positive’ safety culture is fundamental to continuous improvement. This is reflected in employee (frontline and management) attitudes towards safety, the frequency of key day-to-day behaviours and the quality and effectiveness of the underlying SMS.

Organisations with strong safety cultures use a number of sources, such as employee feedback and management reviews, to actively manage risk. An example of this approach may be seen at Wylfa Power Station, in North Wales. Here, there is an understanding that an effective learning culture is vital to tackling operator errors and repeat events. This was achieved through focusing its Operational Experience programme on several key elements:

- Senior management commitment to full and open incident reporting and response, based on a just culture of ‘no blame’.
- Encouraging and making it easier to report near misses/loss control and improving the screening of events (i.e. developing a learning culture).
- Proactive identification and communication of human factor risks.
- Integration of a new Operational Experience Communicator role within each department, whose responsibilities include identifying and analysing event trends, sharing lessons learned and best practice.

RSSB has developed a web-based Safety Culture Toolkit that will allow rail companies measure their own safety culture, and determine the actions that they could take to tackle any issues identified without the need for extensive external support. The Toolkit, which has been licensed to the Rail Industry Safety & Standards Board in Australia, will also facilitate the accumulation of this data in one place, in order to make it easier to establish a single industry view and benchmark individual companies’ cultures.

The Toolkit may be viewed here: http://rssb.info-exchange.com/. For further information, email safetyculturetoolkit-HF@rssb.co.uk.

In addition, the ORR has released details of its Railway Management Maturity Model, which it uses to help identify how well duty holders are meeting the requirements of their safety-management systems.

Learning point: Does your company encourage open reporting in a healthy and just safety culture?

3.3.4 Mobile phones

Within a safety critical environment like the railway, it is not always safe to yield to the natural reflex to answer a ringing phone or to read (and maybe reply to) a text.

This was illustrated in the USA on 12 September 2008, when a Metrolink commuter service passed a protecting signal at danger and collided head-on with a freight train in Chatsworth, California, at a closing speed of around 85mph. Twenty-five people lost their lives, including
the Metrolink driver himself. On the day of the accident, he had sent and received several text messages while on duty, the last of which occurred just 22 seconds before the collision.

The recommendations made by the National Transportation Safety Board (NTSB) included the requirement for driving cabs to be fitted with audio and image recorders to monitor drivers during the course of their duty. The full report may be downloaded here.

The GB situation

The RSSB Board considered the early reports of the accident in October 2008 and initiated steps, through the Operations Focus Group, to review the arrangements for controlling mobile communications in Great Britain. In November 2008, Red Alert 33 highlighted the consequences of the Chatsworth incident and raised a number of questions about the risk from using mobile phones when driving trains. It also referred to a recent road-based Transport Research Laboratory study, which revealed that texting while driving can extend the average reaction time for car drivers even more than the use of alcohol or drugs.

Two months later, RED 23 featured a reconstruction of a SPAD which occurred because the driver was distracted by talking on his mobile. This led him to read across to the wrong signal on a gantry.

The lessons learnt resulted in a focused communications campaign, the outputs of which were shared by Southern on Opsweb as industry good practice.

Whilst most GB train companies had already implemented mobile phone policies, all private use of mobile phones while working on safety critical activities is now banned by GB rail operators. Further controls have also been reinforced to minimise the risk associated with the use of company-issued phones.

To support this stance, in December 2009 RSSB published a Railway Industry Standard (RIS-3776-TOM: Rail Industry Standard on the Use of Mobile Telephonic Equipment in Driving Cabs). The RIS provides duty holders with a framework for producing a comprehensive company policy on the use of mobiles in driving cabs and setting minimum requirements to be mandated in that policy.

In addition, RSSB has recently completed a research project (T904: Development of a train driver education programme on mobile phone risk), on behalf of the Operations Focus Group. It is specifically designed to help reduce inappropriate mobile use.

RSSB’s human factors team has also undertaken research on the key distinctions between car driving and train driving. The two tasks have many common elements, but there are also key differences. For example, train driving obviously does not involve steering, but there is greater reliance on anticipation and decision making. Trains have a much longer
stopping distance from any particular speed, do not directly interact with other traffic and in some cases can travel much faster than cars. This means that train drivers need to think ahead and use the cues in the environment, such as signals, to make appropriate decisions about how to control the train to ensure they can stop in time for red signals and stations.

The work concluded that the use of mobile phones has a negative impact on train driver performance. The most significant effects are an increased rate of failures to detect signals, other important railway features and unexpected hazards. Train drivers are also likely to suffer reduced situational awareness; thus they would be less likely to anticipate emerging situations requiring a response and generally more likely to make errors, such as forgetting a previous signal indication or failing to slow down in response to a signal indication. The most likely outcome of such impairments would be a SPAD. Other possible negative outcomes include failure to stop at a booked station or derailment due to overspeeding.

Learning point: Does your company have a policy on mobile phone use?

3.3.5 Platform-train interface
Mindful of a rise in risk since 2005, the Operations Focus Group requested that RSSB undertake research into accidents occurring to passengers at the platform-train interface (PTI). PTI accidents are categorised in two distinct ways:

- Accidents occurring while boarding or alighting trains;
- Accidents occurring at the platform edge not during boarding or alighting.

The first category is essentially self-explanatory, and covers any injury to a passenger that happens while they are getting off or getting on a train. The second category covers all other events of passengers coming into contact with trains due to being too close to the platform edge, or falling from the platform. It includes incidents of persons falling onto the track and being subsequently struck by a train entering or leaving the station, and incidents where no train is present.

RSSB’s analysis has shown that:

- Slips, trips and falls in stations account for the largest proportion of passenger FWI risk, at 46%. Passenger PTI accounts for the next largest proportion, at 20%. Of this, 12% occurs while getting on or off trains, and 8% occurs while not boarding or alighting.
- PTI risk accounts for the largest proportion of passenger fatality risk. Accidents during boarding or alighting account for 9% of the fatality risk, while other accidents at the platform train interface account for 29%; this is biggest single contributor to passenger fatality risk.
- More females than males are involved in accidents at the PTI while boarding or alighting; around 64% of these accidents have occurred to females. Ladies’ footwear could be the reason for this difference. It is also possible that females are more likely to report this type of incident.
Far more males than females are involved in accidents at the PTI — not while boarding or alighting; around 79% of these accidents have occurred to males.

Intoxication accounts for a much larger proportion of this type of injury (44% compared with 6% of PTI accidents while boarding/alighting). As males account for the majority of intoxication-related injuries, it would be expected that more males would be involved in this type of accident.

Even when excluding intoxication, more males are involved in accidents at the PTI — not while boarding or alighting.

The number of accidents while boarding or alighting increases during the week, rising to a peak on Friday. This coincides with a peak in intoxication-related injuries.

The highest totals of boarding/alighting accidents are in summer. This could be due to the type of passengers travelling, for example, tourists who may be less frequent (and therefore less experienced) users of the railway.

The harm from alighting accidents is disproportionately high; they account for more than twice the harm of boarding accidents.

The type of rolling stock could also be a factor in the occurrence of these accidents.

RSSB’s research continues in this area; the final results will be presented to the Operations Focus Group during 2011. The rail industry is also taking steps to deal with these issues, including improving platform markings, implementing a slip, trip and fall toolkit, risk-assessing train dispatch plans, and fixing reflective strips to door edges and handles to increase visibility.

In addition, RED 28 focuses on the PTI issue, by featuring a dramatisation of an incident and suggestions on how to minimise the hazards. Click here to access the briefing notes: LINK

3.3.6 Level crossings

In April 2010, RSSB released an updated edition of its Road-rail interface special topic report. With respect to level crossings, the report notes that:

- Approximately 77% of the total risk at level crossings is to pedestrians. Most of pedestrian risk involves members of the public (62%) and passengers being struck by trains (8%) on level crossings.
- Approximately 4% of the total risk at level crossings is to passengers and members of the workforce on board the train.

There has not been a multi-fatality interface train accident since Ufton in 2004. The industry continues to monitor the risks via the high-level analysis produced by RSSB and Network Rail’s management actions and specific local supervision and maintenance regimes. The latter is described in Network Rail’s Safety Management System, which includes the use of the All Level Crossing Risk Model (ALCRM).

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28 The accident at Ufton occurred when a road vehicle driver deliberately parked his car on the automatic half-barrier level crossing. The vehicle was struck by a passenger train, which derailed, killing five passengers and the train driver.
The rail industry has focused on mitigating the risk at the road-rail interface through the combined actions of the Road-Rail Interface Safety Group (R-RISG) and the specific actions of Network Rail and the law enforcement agencies. Recognition has also been given to worldwide good practice, expressed through the 5 Es: ‘engineering, enforcement, education, engagement and evaluation’.

The R-RISG has input to the ORR review of Railway Safety Principles and Guidance and the Law Commission review of Level Crossing legislation. It also supports the Network Rail level crossing awareness campaigns.

RSSB monitors worldwide accidents and incidents, with a view to sharing lessons learnt with R-RISG and other stakeholder groups. Furthermore, we raised a safety alert with the international community, via the UIC’s Safety Platform, on the collision between a lorry and a passenger train at Sudbury on 17 August 2010. This accident is being investigated by RAIB.

In 2010 RSSB also participated in the European Commission’s workshop on level crossing safety, jointly organised with the European Level Crossing Forum (which RSSB currently chairs).

3.3.7 Winterisation

The snow experienced at the start of December 2010 had an inevitable effect on the railway. Parts of Scotland, the North East and the South East suffered most acutely, with widespread disruption to services.

Some passengers were stranded for prolonged periods as trains were held up for various reasons, including frozen third rails, freezing points and signal failures. Poor communication between train operators and passengers was a particular leit-motif, much of which was reported by members of the media (many of whom recalled the difficulties experienced by Eurostar in December 2009).29

The freezing of brakes was also a cause for concern. On 3 December 2010, for example, a freight train slipped backwards despite its brakes being fully applied after it had been brought to a stand at Holytown. A subsequent investigation revealed that the brake blocks and brake gear had completely iced up prior to the incident.

Similar problems were experienced at Carstairs on 22 December 2009 and Carrbridge on 4 January 2010. As the links show, RAIB has investigated both of these incidents, but the Operations Focus Group is also monitoring the situation. Other actions taken by the rail industry include the following:

- On 29 December 2009, Freightliner issued a notice to its drivers, reminding them of the Rule for carrying out running brake tests in snowy conditions.

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29 See (for example) RSSB’s summary of the Eurostar Independent Review on Opsweb, or go to http://www.eurostarindependentreview.org.
Rail industry learning

- On 4 January 2010, Network Rail issued an urgent operating advice via the Rail Notices website, requesting all train operators to remind drivers of the relevant part of the Rule Book. This resulted from the Carstairs and Carrbridge incidents noted above.

- In October 2010, the Rail Freight Operators’ Group (RFOG) issued an approved code of practice, which offers guidance on testing brakes in snowy conditions and suggests various ways of minimising the risks associated with winter weather operations.

Learning point: Is your company ready for next winter? Are your winterisation procedures up-to-date?

30 That is, Rule Book GE/RT8000, module TW1, section 18. See www.rgsonline.co.uk.
Role of investigations

4 Role of investigations in the learning process

Though the cycle of safety planning and performance reporting is essential to ensuring that safety continues to improve, much of the industry’s learning comes from investigations into accidents and incidents.

The principal investigation of any safety event is conducted by the party immediately responsible for the activity. To facilitate this, railway companies have their own arrangements for carrying out internal formal and local investigations, as defined in Railway Group Standard GO/RT3119 (Accident and incident investigation) and its associated Guidance Note (GO/GN3519). Possible action includes undertaking independently chaired investigations when appropriate. The outputs are managed by the companies concerned, with actions being picked up by their own tracking systems. The results of duty holder-led formal investigations are also summarised in SMIS to give others the chance to learn from the information.

The more significant accidents (involving loss of life or potentially significant consequences) are investigated by the Office of Rail Regulation (ORR) as safety authority, and the Rail Accident Investigation Branch (RAIB). RAIB was established in 2005, following which RSSB ceased its accident investigation role (2006).

RAIB was set up following a recommendation made by Lord Cullen’s inquiry into the accident at Ladbroke Grove (a subsequent European Directive on rail accident investigation also required Member States to create such bodies).

If an accident involves a derailment or collision which results in, or could result in, the death of at least one person, serious injury to five or more people or extensive damage to rolling stock, the infrastructure or the environment, then RAIB will lead an investigation, draw conclusions and make recommendations. 31

RAIB investigates incidents on UK railway infrastructure without apportioning blame or liability. It is independent of the rail industry and the ORR, with the Chief Inspector of Rail Accidents reporting directly to the Secretary of State for Transport. RAIB’s recommendations on the rail industry are addressed to the ORR 32, which must then ensure that they are considered and that, where appropriate, action is taken. More information on RAIB may be found on its website.

25 years ago: 1985

POLMONT

In February 1985, the Department of Transport published its report into the derailment at Polmont, Scotland, which had occurred the previous July.

A passenger train, being driven from a driving trailer (with the locomotive propelling from the rear), struck a cow which had gained access to the line. There were 13 fatalities in the resulting derailment.

The report noted that, while such ‘push-pull’ operation was safe, it could be made safer, particularly in view of the fact that the driving trailers in use on the line in question were of light axle loading.

Future designs of driving trailer (the Mark III and Mark IV DVTs) were equipped with weighted ‘nose ends’, in order to improve their resistance to derailment. This is something evident too in post-privatisation unit designs like the Voyager DEMUs and the Pendolino tilting EMUs.

31 RAIB may also investigate other incidents that have implications for railway safety, including those which, under slightly different circumstances, may have resulted in an accident.

32 RAIB can also address recommendations to other safety authorities and other public bodies, such as the police, the Department for Transport and so on.
4.1 RAIB investigations

RAIB published 21 accident reports in 2010, covering the following categories:

- Heavy rail – on NRMI (15)
- Channel Tunnel (1)
- Heritage railways (2)
- Light Rail (2)
- Metro (1)

Table 1 (overleaf) lists each of these investigation reports (with links to the reports in question). Note that:

- 76 recommendations were issued from 15 RAIB investigations involving incidents on NRMI. This compares to:
  - 167 recommendations from 27 RAIB investigation reports in 2009;
  - 127 recommendations from 18 RAIB investigation reports in 2008; and
  - 158 recommendations from 22 RAIB investigation reports in 2007.

Tables 1 – 4 contain hyperlinks aid navigation direct to RAIB’s investigation reports and bulletins.
Role of investigations

### Table 1. RAIB investigations published in 2010

<table>
<thead>
<tr>
<th>Pub. Date</th>
<th>Report Title</th>
<th>Infrastructure Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/12</td>
<td>Incident at Romford station 4 February 2010</td>
<td>NRMI</td>
</tr>
<tr>
<td>22/11</td>
<td>Fire on a freight shuttle train in the channel tunnel, 11 September 2008</td>
<td>Channel Tunnel</td>
</tr>
<tr>
<td>28/10</td>
<td>Derailment near Gillingham tunnel, Dorset 28 November 2009</td>
<td>NRMI</td>
</tr>
<tr>
<td>07/10</td>
<td>Near-miss on Victory level crossing, near Taunton, Somerset 19 December 2009</td>
<td>NRMI</td>
</tr>
<tr>
<td>23/09</td>
<td>Failure of Bridge RDG1 48 (River Crane) between Whilton and Feltham 14 November 2009</td>
<td>NRMI</td>
</tr>
<tr>
<td>23/09</td>
<td>Fatal accident at Halkirk level crossing, Caithness 29 September 2009</td>
<td>NRMI</td>
</tr>
<tr>
<td>02/08</td>
<td>Fatal accident at Whitehall West junction, Leeds 2 December 2009</td>
<td>NRMI</td>
</tr>
<tr>
<td>18/08</td>
<td>Derailment at Wigan North Western station 25 August 2009</td>
<td>NRMI</td>
</tr>
<tr>
<td>16/08</td>
<td>Collision on the Great Orme Tramway 15 September 2009</td>
<td>Heritage</td>
</tr>
<tr>
<td>05/08</td>
<td>Overhead line failure, St Pancras International 23 September 2009</td>
<td>NRMI</td>
</tr>
<tr>
<td>05/08</td>
<td>Derailment at Windsor and Eton Riverside station 11 October 2009</td>
<td>NRMI</td>
</tr>
<tr>
<td>21/06</td>
<td>Collision at Exeter St Davids station 4 January 2010</td>
<td>NRMI</td>
</tr>
<tr>
<td>03/06</td>
<td>Fatal accident at Norbreck, Blackpool 5 August 2009</td>
<td>Tramway</td>
</tr>
<tr>
<td>12/05</td>
<td>Fatal accident at Fairfield level crossing, Badwyn, 6 May 2009</td>
<td>NRMI</td>
</tr>
<tr>
<td>08/04</td>
<td>Derailment at Hampton Loade, Severn Valley Railway 28 September 2009</td>
<td>Heritage</td>
</tr>
<tr>
<td>25/03</td>
<td>Derailment of a passenger train near Cummersdale, Cumbria 1 June 2009</td>
<td>NRMI</td>
</tr>
<tr>
<td>22/03</td>
<td>Near-miss at Hanger Lane junction 27 March 2009</td>
<td>LUL</td>
</tr>
<tr>
<td>18/03</td>
<td>Incident at Greenhill Upper Junction, near Falkirk 22 March 2009</td>
<td>NRMI</td>
</tr>
<tr>
<td>04/03</td>
<td>Derailment of a Docklands Light Railway train, near West India Quay station, London 10 March 2009</td>
<td>DLR</td>
</tr>
<tr>
<td>03/02</td>
<td>Derailment of a freight train near Stewarton, Ayrshire 27 January 2009</td>
<td>NRMI</td>
</tr>
<tr>
<td>14/01</td>
<td>Derailment of a freight train at Marks Tey, Essex 12 June 2008</td>
<td>NRMI</td>
</tr>
</tbody>
</table>

**Key:**

- = Off-NRMI

At the end of 2010, RAIB also published a Special Investigation of the Formal Investigation (FI) into an irregular signal sequence incident at Milton Keynes on 29 December 2008. As part of the West Coast Route Modernisation project, new signalling was commissioned in the Milton Keynes area on 28 December 2008. At 23:01 on the 29th, the driver of the 20:48 Virgin Trains service from Liverpool to Euston (1A74) reported that he had observed an irregular signal sequence while the train was standing at TK9740 signal on the Reversible Fast line at Milton Keynes Central.

When 1A74 arrived at the station, TK9740 was showing a red aspect. Another train (1A75) then passed on the Up Fast. The points leading from the Reversible line to the Up Fast changed, routing 1A74 onto the Up Fast; TK9740 then changed to green while 1A75 was still visible on the line ahead. Shortly afterwards, TK9740 changed to single yellow. The driver of 1A74 reported this irregular sequence to the signaller at Rugby Signalling Control Centre. After recording the details, the signaller allowed the train to proceed, and then took the

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33 Source: RAIB website.
Role of investigations

Reversible Fast line out of use in the Up direction pending investigation of this apparent wrongside failure.

A Formal Investigation was launched. RAIB was later asked to review the results; its resulting report highlighted a number of learning points for the wider industry:

- The need for investigations to be challenged by a person(s) with sufficient independent and technical expertise.
- The need for rail industry investigations to consider the underlying factors that may have influenced the causes of an event or permitted an unsafe condition to arise.
- The importance of establishing investigation teams with the necessary technical expertise, independence and authority to press for consideration of underlying management issues and the suitability of existing standards.
- The need for investigations to consider the way the railway recovers from serious signalling irregularities involving newly installed interlockings.
- The need to correctly apply safety verification processes to the preparation of safety critical application data.
- The need for the clear specification of interfaces between computer-based systems.
- The need for signalling projects to give careful consideration to the way design modifications to software and safety critical application data will be executed, checked and tested.
- The need for assurance processes that address the particular risks associated with software and safety critical application data.
- The potential role of automated data entry and/or checking systems as a means of reducing the risk from human error leading to an unsafe outcome.

Learning point: Are your investigations conducted in accordance with industry best practice?

Table 2 provides information on all RAIB recommendations closed out prior to and during 2010.
Table 2. RAIB recommendations closed out (all years, incidents on NRM)\(^{34}\)

| Incident date | Recs issued | RAIB investigation | Total recs issued (2006 total) | Recs issued in 2010 | Total recs issued in 2010 | Recs issued in 2009 | Total recs issued in 2009 | Recs issued 2006 Total | Total recs issued 2006 | Recs issued 2007 Total | Total recs issued 2007 | Recs issued 2008 Total | Total recs issued 2008 | Recs issued 2009 Total | Total recs issued 2009 | Recs issued 2010 Total | Total recs issued 2010 | Recs issued 2011 Total | Total recs issued 2011 | Recs issued 2012 Total | Total recs issued 2012 | Recs issued 2013 Total | Total recs issued 2013 | Recs issued 2014 Total | Total recs issued 2014 | Recs issued 2015 Total | Total recs issued 2015 | Recs issued 2016 Total | Total recs issued 2016 | Recs issued 2017 Total | Total recs issued 2017 | Recs issued 2018 Total | Total recs issued 2018 | Recs issued 2019 Total | Total recs issued 2019 | Recs issued 2020 Total | Total recs issued 2020 | Recs issued 2021 Total | Total recs issued 2021 | Recs issued 2022 Total | Total recs issued 2022 | Recs issued 2023 Total | Total recs issued 2023 | Recs issued 2024 Total | Total recs issued 2024 | Recs issued 2025 Total | Total recs issued 2025 | Recs issued 2026 Total | Total recs issued 2026 | Recs issued 2027 Total | Total recs issued 2027 | Recs issued 2028 Total | Total recs issued 2028 | Recs issued 2029 Total | Total recs issued 2029 | Recs issued 2030 Total | Total recs issued 2030 | Recs issued 2031 Total | Total recs issued 2031 | Recs issued 2032 Total | Total recs issued 2032 | Recs issued 2033 Total | Total recs issued 2033 | Recs issued 2034 Total | Total recs issued 2034 | Recs issued 2035 Total | Total recs issued 2035 | Recs issued 2036 Total | Total recs issued 2036 | Recs issued 2037 Total | Total recs issued 2037 | Recs issued 2038 Total | Total recs issued 2038 | Recs issued 2039 Total | Total recs issued 2039 | Recs issued 2040 Total | Total recs issued 2040 | Recs issued 2041 Total | Total recs issued 2041 | Recs issued 2042 Total | Total recs issued 2042 | Recs issued 2043 Total | Total recs issued 2043 | Recs issued 2044 Total | Total recs issued 2044 | Recs issued 2045 Total | Total recs issued 2045 | All recommendations completed/closed in 2011

34 Source: ORR.
Role of investigations

Sometimes, the RAIB makes recommendations on organisations outside the railway industry. Examples include the Cumbria Police, Department of Health and the Department for Transport.

4.1.1 Ongoing RAIB investigations

There were a further 16 events that occurred during 2010 which were still under investigation by RAIB at the end of the year. These are listed in Table 3.

Table 3. Ongoing RAIB investigations (at 31 December 2010)

<table>
<thead>
<tr>
<th>Incident date</th>
<th>RAIB investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/11/2010</td>
<td>Investigation into an incident involving a passenger train near Stonegate, East Sussex</td>
</tr>
<tr>
<td>05/11/2010</td>
<td>Investigation into an accident involving a heavy goods vehicle and a train near Oxshott, Surrey</td>
</tr>
<tr>
<td>17/08/2010</td>
<td>Investigation into an incident involving a freight train near Shap, Cumbria</td>
</tr>
<tr>
<td>17/08/2010</td>
<td>Investigation into a collision between a passenger train and a lorry on a level crossing near Sudbury, Suffolk</td>
</tr>
<tr>
<td>13/08/2010</td>
<td>Investigation into the runaway of an engineering train from Highgate to Warren Street</td>
</tr>
<tr>
<td>20/07/2010</td>
<td>Investigation into runaway and collision near Raigmore, Inverness</td>
</tr>
<tr>
<td>10/07/2010</td>
<td>Investigation into the collision of a passenger train with a fallen tree at Lavington, Wiltshire</td>
</tr>
<tr>
<td>06/06/2010</td>
<td>Investigation into derailment near Falls of Cruachan, Argyll</td>
</tr>
<tr>
<td>12/05/2010</td>
<td>Investigation into the derailment of an engineer's train near Gloucester Road, London Underground</td>
</tr>
<tr>
<td>04/05/2010</td>
<td>Investigation into runaway wagons at Ashburys, Manchester</td>
</tr>
<tr>
<td>30/03/2010</td>
<td>Investigation into a track worker struck by a train at Cheshunt Junction, Hertfordshire</td>
</tr>
<tr>
<td>06/03/2010</td>
<td>Investigation into a train struck by a length of rail at Washwood Heath, Birmingham</td>
</tr>
<tr>
<td>20/02/2010</td>
<td>Investigation into the derailment of a passenger train at East Langton, near Market Harborough, Leicestershire</td>
</tr>
<tr>
<td>04/02/2010</td>
<td>Investigation into an incident involving a freight train partly loaded with ballast stone, at Romford station</td>
</tr>
<tr>
<td>18/01/2010</td>
<td>Investigation into a fatal accident on a level crossing at Moreton-on-Lugg, Herefordshire</td>
</tr>
<tr>
<td>22/12/2009</td>
<td>Investigation into a near-miss involving a freight train and two passenger trains at Carstairs, South Lanarkshire</td>
</tr>
</tbody>
</table>
4.1.2 RAIB Bulletins

When RAIB’s preliminary examination of an incident suggests that a full investigation would not lead to further significant safety lessons for the rail industry, in some cases it still provides related information or advice in the form of a bulletin.

During 2010, RAIB issued 11 such bulletins:

Table 4. RAIB bulletins published in 2010

<table>
<thead>
<tr>
<th>Publication Date</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>30/09/2010</td>
<td>Derailment at Dingwall, Scotland, 22 January 2010</td>
</tr>
<tr>
<td>23/07/2010</td>
<td>Train collision with level crossing gate, Stow Park, Lincolnshire, 20 February 2010</td>
</tr>
<tr>
<td>21/07/2010</td>
<td>Collision between a freight wagon door and signal in Kilsby Tunnel, 15 March 2010</td>
</tr>
<tr>
<td>21/07/2010</td>
<td>Serious injury to a loader at Hoo Junction, Kent on 14 April 2010</td>
</tr>
<tr>
<td>16/06/2010</td>
<td>Fatal accident at a user worked crossing on 2 September 2009</td>
</tr>
<tr>
<td>07/05/2010</td>
<td>Runaway and collision on the Welshpool and Llanfair Light Railway 3 March 2010</td>
</tr>
<tr>
<td>07/05/2010</td>
<td>Train door incident at Liverpool Street London 4 February 2010</td>
</tr>
<tr>
<td>07/04/2010</td>
<td>Collision between part of a freight train and a passenger train at Carluke, Scotland, 18 August 2009</td>
</tr>
<tr>
<td>21/01/2010</td>
<td>Passenger train collision with road vehicle at Broken Cross bridge between Salisbury and Grateley, 22 September 2009</td>
</tr>
<tr>
<td>14/01/2010</td>
<td>Collision between train and trolley at Kentish Town, 26-27 October 2009</td>
</tr>
<tr>
<td>08/01/2010</td>
<td>Passenger train collision at Darlington on 3 October 2009</td>
</tr>
</tbody>
</table>

4.1.3 RSSB analysis of key RAIB recommendation themes

Recommendations tend to reflect the nature of the incident from which they arise, but they also indicate the weighting given to the event by the investigating organisation. In other words, only the tip of the accident/incident/unsafe act or condition pyramid is represented by looking at recommendations in detail.

It should be noted, therefore, that numeric analysis of recommendation trends has little statistical validity. Indeed, a single report may generate multiple recommendations for one category. In the interests of continuity, however, we have used the categorisation process applied in previous years to RAIB and formal inquiry recommendations.
### Table 5. SMIS recommendation categories

<table>
<thead>
<tr>
<th>Cat code</th>
<th>Recs category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Signalling system</td>
<td>Lineside SPAD controls, signal sighting issues, train planning and regulation, operation of the signalling equipment.</td>
</tr>
<tr>
<td>B</td>
<td>Competence management</td>
<td>Training and development, driver management, competence systems, briefing, assessment, staff selection procedures, drugs and alcohol, fitness for duty, fatigue.</td>
</tr>
<tr>
<td>C</td>
<td>Rules, standards and instructions</td>
<td>Modification /development of rules and predefined standards for operation, standards/process change management.</td>
</tr>
<tr>
<td>D</td>
<td>Vehicle operation and integrity</td>
<td>Train-borne safety equipment, fire protection, vehicle maintenance, train data recorders, crashworthiness, in-cab ergonomics.</td>
</tr>
<tr>
<td>E</td>
<td>Infrastructure asset management</td>
<td>Managing contractors, track/signalling maintenance operations, work planning, technical specifications, method statements.</td>
</tr>
<tr>
<td>F</td>
<td>Event mgmt/investigation/ reporting</td>
<td>SPAD management, public accident investigation, site investigations, post-accident management, formal investigations, formal inquiries, public inquiries, fault reporting, emergency procedures.</td>
</tr>
<tr>
<td>G</td>
<td>Monitoring and audit</td>
<td>Monitoring activities, safety performance monitoring, follow-up processes.</td>
</tr>
<tr>
<td>H</td>
<td>Research and development</td>
<td>Suggested research topics/specific areas of research.</td>
</tr>
<tr>
<td>J</td>
<td>Safety communications</td>
<td>Defining and communicating safety responsibilities, general safety related communications, meetings, techniques, methods and equipment.</td>
</tr>
<tr>
<td>K</td>
<td>Culture</td>
<td>Management commitment, organisational change.</td>
</tr>
</tbody>
</table>

### Chart 4. RAIB recommendation distribution (%) – 2010

![Pie chart showing RAIB recommendation distribution](image-url)

- **Signalling system**: 1%
- **Competence management**: 11%
- **Rules, standards & instructions**: 10%
- **Vehicle operation & integrity**: 4%
- **Event mgmt/investigation/reporting**: 8%
- **Safety communications**: 8%
- **Research & development**: 7%
- **Monitoring & audit**: 10%
- **Infrastructure asset management**: 41%
RSSB’s figures suggest that, in 2010, the largest recommendations component was *infrastructure asset management* (41%). This tallies with the emphasis of the Precursor Indicator Model (see Chapter 2, *Review of train accident risk*). Further analysis on the issue of infrastructure maintenance and derailments may be found in section 5.1.2 (*Infrastructure maintenance*).

Comparing 2009 with 2010, reductions in the *percentage* of recommendations can be seen for:

- *Rules, standards and instructions*,
- *Signalling system*,
- *Vehicle operation and integrity*,
- *Safety communications*,
- *Culture*,
- *Event management/investigation/reporting*, and
- *Competence management*.

However, there has been a rise in the percentage of recommendations which deal with:

- *Monitoring and audit*,
- *Research and development*, and
- *Infrastructure asset management*. 

![Chart 5. Recommendation categorisation – by year (%)](chart5)
Role of investigations

Of these, *Infrastructure asset management* has seen the most acute rise over the analysis period. Twelve RAIB investigations include recommendations in this category\(^{35}\):

- 6 investigations into derailments (*Marks Tey, Stewarton, Cummersdale, Windsor & Eton Riverside, Wigan North Western, Gillingham*).
- 2 investigations into fatal level crossing incidents (*Fairfield, Halkirk*).
- 1 investigation into an overhead line failure (*St Pancras International*).
- 1 investigation into a bridge failure (*Feltham*).
- 1 investigation into a maintenance error incident (*Greenhill Upper Junction*).
- 1 investigation into a collision between two passenger trains (*Exeter St Davids*).

The ORR also keeps a record of the status of all RAIB recommendations. This is available on its [website](#).

4.1.4 Progress against RAIB recommendations on RSSB

In the RAIB *Annual Report 2009*, the RAIB Chief Inspector commented that ‘at the time of writing […] 44 recommendations [have been] made to RSSB. These are detailed in the table overleaf, along with their status per the ORR.’

---

\(^{35}\) *Infrastructure asset management* covers issues related to managing contractors, track/signalling maintenance operations, work planning, technical specifications and method statements.
### Table 6. RAIB recommendations on RSSB

<table>
<thead>
<tr>
<th>Incident date</th>
<th>Published date</th>
<th>Type of report and location</th>
<th>Rec. no.</th>
<th>Accepted by RSSB?</th>
<th>Action plan in progress?</th>
<th>Closed in SMIS</th>
<th>Closure accepted by ORR</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/01/2006</td>
<td>18/06/2006</td>
<td>Cutting of rail on the side opposite traffic near Thirsk</td>
<td>1</td>
<td>✓</td>
<td>✓</td>
<td>28/03/2007</td>
<td>16/01/2009</td>
</tr>
<tr>
<td>25/11/2005</td>
<td>08/01/2007</td>
<td>Autumn Adhesion</td>
<td>8</td>
<td>=</td>
<td>N/A</td>
<td>17/11/2008</td>
<td>In progress</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>=</td>
<td>N/A</td>
<td>17/11/2008</td>
<td>In progress</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>=</td>
<td>N/A</td>
<td>17/11/2008</td>
<td>In progress</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>=</td>
<td>N/A</td>
<td>17/11/2008</td>
<td>In progress</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>=</td>
<td>N/A</td>
<td>17/11/2008</td>
<td>In progress</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>=</td>
<td>N/A</td>
<td>17/11/2008</td>
<td>In progress</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>=</td>
<td>N/A</td>
<td>27/02/2008</td>
<td>08/12/2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>18</td>
<td>✓</td>
<td>✓</td>
<td>In progress</td>
<td></td>
</tr>
<tr>
<td>14/01/2006</td>
<td>30/01/2007</td>
<td>Derailment at Haymarket, Edinburgh</td>
<td>7</td>
<td>✓</td>
<td>✓</td>
<td>02/06/2007</td>
<td>30/04/2008</td>
</tr>
<tr>
<td>16/04/2006</td>
<td>30/01/2007</td>
<td>Snow packed track line at Dronfield</td>
<td>8</td>
<td>✓</td>
<td>✓</td>
<td>05/10/2007</td>
<td>15/11/2008</td>
</tr>
<tr>
<td>15/02/2007</td>
<td>30/04/2007</td>
<td>Train derailment at Harrogate</td>
<td>9</td>
<td>✓</td>
<td>✓</td>
<td>08/04/2008</td>
<td>04/03/2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>✓</td>
<td>✓</td>
<td>19/03/2008</td>
<td>09/11/2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>✓</td>
<td>✓</td>
<td>11/03/2008</td>
<td>09/11/2009</td>
</tr>
<tr>
<td>10/06/2006</td>
<td>30/08/2007</td>
<td>Train door incident at Desborough</td>
<td>9</td>
<td>✓</td>
<td>✓</td>
<td>19/12/2008</td>
<td>08/12/2009</td>
</tr>
<tr>
<td>29/04/2007</td>
<td>28/02/2008</td>
<td>Train door incident at Desborough</td>
<td>3</td>
<td>✓</td>
<td>✓</td>
<td>03/11/2007</td>
<td>01/10/2010</td>
</tr>
<tr>
<td>01/02/2008</td>
<td>25/09/2008</td>
<td>Collision of a train with a derailed loaded goods train, Barrow upon Soar</td>
<td>3</td>
<td>✓</td>
<td>✓</td>
<td>15/09/2008</td>
<td>26/01/2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>25a</td>
<td>✓</td>
<td>✓</td>
<td>31/07/2009</td>
<td>25/01/2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>25b</td>
<td>✓</td>
<td>✓</td>
<td>31/07/2009</td>
<td>25/01/2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>25c</td>
<td>✓</td>
<td>✓</td>
<td>31/07/2009</td>
<td>25/01/2011</td>
</tr>
<tr>
<td>27/08/2007</td>
<td>30/10/2008</td>
<td>Train overspeeding through an emergency speed restriction at Ty Mawr Farm Crossing</td>
<td>1</td>
<td>✓</td>
<td>✓</td>
<td>14/01/2009</td>
<td>13/11/2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>✓</td>
<td>✓</td>
<td>15/09/2009</td>
<td>26/01/2010</td>
</tr>
<tr>
<td>01/03/2008</td>
<td>27/05/2009</td>
<td>Derailment of containers from freight wagons near Cheddington and Hardendale</td>
<td>4</td>
<td>✓</td>
<td>✓</td>
<td>09/11/2009</td>
<td>09/11/2009</td>
</tr>
<tr>
<td>21/10/2006</td>
<td>28/07/2009</td>
<td>Near miss at Llanfair AQCL near Aberystwyth</td>
<td>5</td>
<td>✓</td>
<td>✓</td>
<td>05/10/2009</td>
<td>05/05/2010</td>
</tr>
<tr>
<td>26/04/2008</td>
<td>14/09/2009</td>
<td>Freight train collision at Leaf-up</td>
<td>6</td>
<td>✓</td>
<td>✓</td>
<td>08/02/2010</td>
<td>22/01/2010</td>
</tr>
<tr>
<td>22/11/2008</td>
<td>19/11/2009</td>
<td>Double fatality at Bayes &amp; Wyles Quay, Skelmersdale, Huddersfield</td>
<td>7</td>
<td>✓</td>
<td>✓</td>
<td>08/02/2010</td>
<td>22/01/2010</td>
</tr>
</tbody>
</table>

36 Source: SMIS and ORR. Note that ‘Closed in SMIS’ means that RSSB has entered a statement in SMIS which either describes the worker undertaken to satisfy the recommendation or outlines which it deems the recommendation inappropriate.

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Role of investigations

4.2 Progress against Formal Inquiry recommendations

Between 2002 and 2006, RSSB and its predecessor Railway Safety, was responsible for extracting lessons from accidents by investigating their causes. The company produced 49 Formal Inquiry reports during this period, which produced a total of 533 recommendations. Of these, 532 had been closed by 1 January 2010.

The remaining recommendation relates to the accident at Blake Street on 7 August 2005, in which a Class 66 locomotive ran away from a worksite and derailed at Alrewas, having travelled 11.7 miles at speeds of up to 45 mph.

The remaining recommendation is as follows:

*Revise the parking brake control/indication system on Class 66 locomotives, including: a) A major reduction in the latching time for the parking brake motor contactors. b) Providing positive indications of the latching of motor contactors, and of the brake being On or Off on the driver’s console. c) Amending the Dowty indication to display the chevrons whenever the parking brake status is indeterminate or in transition. d) Maintain the electrical supply to the parking brake motor after operation of the battery isolation switch, for a sufficient time to allow application/release of the parking brake to be completed. Objective: To simplify the man-machine interface and avoid uncertainty over its status.*

Only one Class 66 remains to be modified in the manner recommended; the work is scheduled for completion in 2011.

RSSB will track progress on this outstanding recommendation. Once complete, RSSB will close its Formal Inquiry tracking function for good.
5 Incident Causal Classification System analysis

RSSB receives investigation reports from all railway organisations, which is a mandatory requirement under Railway Group Standard GO/RT3119 (Accident and incident investigation). Currently, around 4,500 investigations have been stored, dating back to the late 1990s.

The conclusions in these reports hold much valuable information about event causes, but once the recommendations therein have been acted upon, there is a danger that some of their learning points will be lost or will not reach other parties who could benefit from them.

Work began in 2009 to help provide information relating to previous accidents in a consistent and efficient manner, which sought to identify systemic shortcomings – for the purpose of learning from operational experience – to accident investigators, safety managers and analysts across our industry. This led to the development of the Incident Causal Classification System (ICCS).

The ICCS taxonomy is based on the one created by RAIB, which is aligned with the European Rail Agency. Each cause is split into five levels and the user can pick more than one cause depending on what is written in the conclusions section of an investigation report. The five levels are:

1 Industry area is the general area of the industry where the cause originated.

2 Sub-area adds more detail to the industry area.

3 Phase

4 Safeguard add increasing detail as to what went wrong and why.

5 Weakness

The Industry area is the sector of the industry where the incident occurred (for example, infrastructure, operations etc). The Sub-area adds more detail by focusing on a specific task, like shunting or train driving. The last three levels are independent of each other, and of Industry areas and Sub-areas; they deal with weaknesses, barriers and controls, and the combinations of failures thereof, in order to build up a picture of the cause.

The ICCS holds all RAIB reports, along with a number of Formal Investigations and rail accident investigations from outside Great Britain. It is also being populated with reports from other industries, such as the Baker Panel report into the Texas City oil refinery accident, in a move to ascertain how other industries learn from safety events which may have parallels with our own.37

37 On 23 March 2005, the BP Texas City refinery experienced a process accident. It was one of the most serious US workplace disasters of the past two decades, resulting in 15 deaths and more than 170 injuries.
Chart 6 shows the various report types currently stored in the ICCS, broken down by report type.

As one would expect, the majority of reports in the ICCS relate to GB rail. However, a growing number relate to overseas railways and other industries. As the dataset grows, it will be possible to analyse common underlying causes across all these areas. This will allow a wider range of learning ideas and initiatives to be shared.

5.1 Lessons learnt from rail industry investigations

5.1.1 SPADs – the ongoing story

Most of the Network Rail investigations received by RSSB concern SPADs. The risk from SPADs has fallen to 76% of the September 2006 baseline figure. There were 307 Category A SPADs during 2010, which is the second lowest annual total since the systematic collection of data began in 1985 (the lowest being 2009, at 261). For more information, see RSSB’s website: [http://www.rssb.co.uk/SPR/Pages/signals_passed_at_danger.aspx](http://www.rssb.co.uk/SPR/Pages/signals_passed_at_danger.aspx).

The RED 25 DVD (released November 2009) featured an incident which was initially classed as a SPAD, but was later re-designated a possession irregularity. The crew of a tamper and a Person in Charge of Possession (PICOP) saw that the barriers of a CCTV level crossing

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38 The methodology employed to assess category A SPAD risk proved to be sensitive to the effects of volatility in the data. Therefore, RSSB recently devised a revised means of assessing whether a change in SPAD risk ranking results represents any underlying change in risk rather than just volatility. In addition, the old measure of risk was based on a benchmark set at March 2001. This was prior to the introduction of TPWS (which was completed at the end of 2003), as well as the elimination of Mk 1 rolling stock (substantially completed by the end of October 2005), both of which had a considerable effect on the reduction of SPAD risk levels. To discount these two factors from the calculations, and to portray a more current indication of trends in risk level, it was decided to fix a new benchmark date at September 2006 for future assessments of SPAD risk.
were still raised to road traffic as the machine was approaching. The operator was able to bring it to a stand some 120 metres short of the interface. Poor communication, Rules violation and a lack of teamworking were the learning points raised by this incident.

In addition, RED 25 includes news of the *TPWS in Practice DVD*, along with notes on how track worker safety can be improved. To access the briefing notes, click here: [LINK](#).

The future SPAD situation may be affected by the implementation of the European Rail Traffic Management System (ERTMS). The European Rail Agency (ERA), which was established to help reinforce safety and interoperability across the European Union, also acts as the system authority for ERTMS. Its website may be accessed here: [http://pdb.era.europa.eu/](http://pdb.era.europa.eu/)

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**Chart 7.** Industries and incidents covered by all RAIB reports within the ICCS (whole population: 155 reports)

<table>
<thead>
<tr>
<th>Inner circle Industry area:</th>
<th>Outer circle Incident type:</th>
</tr>
</thead>
<tbody>
<tr>
<td>GB Rail</td>
<td>Collision</td>
</tr>
<tr>
<td>Tram</td>
<td>Collision with third party</td>
</tr>
<tr>
<td>Heritage Rail</td>
<td>Derailment</td>
</tr>
<tr>
<td>London Underground</td>
<td>SPAD</td>
</tr>
<tr>
<td>N. Ireland Rail</td>
<td>Operating irregularity</td>
</tr>
<tr>
<td>Channel Tunnel</td>
<td>Harm to person (movement)</td>
</tr>
<tr>
<td></td>
<td>Runaway</td>
</tr>
<tr>
<td></td>
<td>Near miss</td>
</tr>
<tr>
<td></td>
<td>Other</td>
</tr>
</tbody>
</table>

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Most RAIB reports, both since analysis began (54) and during 2010 alone (6), have dealt with derailments. Forty-one give *Infrastructure* as an *Industry area* cause, with *Maintenance* the largest single *Sub-area* failure.

### 5.1.2 Derailments – reports published in 2010

#### Infrastructure maintenance

Chart 8 shows that RAIB published seven reports on derailments during 2010. Of the seven, those covering the incidents at *Windsor & Eton Riverside, Marks Tey, Wigan North Western* and *Cummersdale* echo the infrastructure maintenance issues raised in last year’s *Learning from Operational Experience Annual Report*.

The *Cummersdale* derailment\(^{39}\), however, also highlights issues with safety critical communications and the examination of the line by a train driver. RAIB’s investigation identified a number of causal factors:

- The warm weather on the day of the accident.
- Insufficient expansion gaps in the jointed track.
- Control of rail creep in the area of the derailment was not effective.
- The tight joints in the vicinity of the derailment site were not reported.
- The track was disturbed at a naturally weak point on the day before the derailment.
- There was a lack of recognition of the risk being imported by disturbing the track.

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\(^{39}\) At around 14:20 on 1 June 2009, a passenger train derailed on a severe track buckle near Cummersdale in Cumbria. The driver had been asked to examine the line to find a defect reported by the driver of the preceding train. The driver scanned the line at 40 mph. On noticing the severity of the buckle when it was 200 metres ahead, he applied the emergency brake, but was unable to stop the train before its leading bogie was derailed. There were no injuries among the 15 passengers and two crew members on board.
• The speed of the train whilst examining the line was too high due to a lack of caution by the driver.

• The signaller omitted to instruct the driver not to exceed 20 mph.

• The signaller and driver did not come to a clear understanding regarding the nature of the track defect.

Network Rail repaired the track at the derailment site, carried out rail adjustment, installed additional rail anchors and removed keys to minimise the risk from further track buckles. It also made organisational changes and carried out briefings to front line staff on relevant track standards.

Furthermore, the company issued an internal safety bulletin to remind track maintenance engineers that a number of factors may contribute to track buckling.

The driver and conductor of the passenger train were re-briefed on safety critical communications, the timely reporting of incidents, and the need to stop a train immediately in such circumstances. The train operating company is also reviewing its training and assessment procedures for drivers and conductors to give clearer directions on actions following discovery of hazards encountered during service running.

In order to facilitate wider industry learning and raise awareness of similar operational safety issues, RSSB also filmed a reconstruction of the incident, which was included in the RED 26 DVD, released in February 2010. (Click here to access the RED 26 briefing notes.)

Wagon maintenance
The freight train derailments at Marks Tey and Wigan North Western feature issues with wagon maintenance. The incident trains in both cases included bogie vehicles.

One of the wagons involved in the incident at Marks Tey on 12 June 2008 was only partly laden. RAIB’s investigation suggested that the wagon in this state did not meet the vertical dynamic performance requirements of the relevant Railway Group Standard, having been introduced into service by British Rail prior to the issuing of that standard. An underlying factor was the absence of action to address the vertical dynamic performance or previous derailments of the wagon design.

At Wigan North Western on 25/26 August 2009, the leading bogie of the twelfth wagon in a 40-car container train derailed at low speed as it ran into Platform 1. RAIB identified two causal factors:

• The track had been installed to a minimum radius of 140 metres without the fitting of a check rail.

• The wagon had a twist in its frame that had not been correctly compensated.

Both factors had to be present to cause the derailment. One of the underlying factors was that the rolling stock owner’s maintenance plan did not specify how to correct frame twist in wagons of the type involved in the incident.
Bridge maintenance

At 06:12 on 27 January 2009 the last six wagons of a bogie tanker train carrying a mixed consignment of gas oil, diesel and kerosene derailed as the consist crossed a metal underbridge south of Stewarton, Ayrshire.

The bridge, which takes the railway over the A735, collapsed and the derailed wagons overturned, coming to rest at various positions to the south of the structure.

The immediate cause of the derailment was the collapse of the bridge that followed the catastrophic structural failure of its east and centre main girders. Heavy corrosion had weakened these main girders such that they were no longer able to carry the loading from trains that were permitted to run over the bridge.

RAIB found the causal factors to include:

- The form of construction of the bridge, which meant there was a hidden corrosion trap that affected the inner surfaces of the main girders; the corrosion resulted in a loss of thickness of the web plates of these girders, and in places holes formed.
- The use of incorrectly assumed dimensions for the thicknesses of these web plates in the last two routine assessments of the bridge (undertaken in 1982 and 1994), and no allowance for web plate corrosion loss; this meant that the calculated live load capacity of the east and centre main girders was higher than it should have been and, as a result, the reports of corrosion defects were not acted upon.

The Branch also listed a number of contributory factors, including the following:

- No arrangements had been made to inspect the hidden parts of the east and centre main girders where the heavy corrosion on the web plates was occurring.
- The web plates on the main girders were not fully repaired when the heavy corrosion would have been revealed when the east side of the bridge was waterproofed in 1987.
- The bridge superstructure was not repainted when the waterproofing work was done, or afterwards.
- The lack of any action in response to the web plate corrosion issues that were identified during the last routine detailed examination of the bridge, and highlighted immediately in an urgent defect report in October 2003.
- The lack of any response to the continued reporting of web corrosion defects in the routine annual visual examinations that followed the last detailed examination.
- The lack of a formal means of alerting Network Rail (the railway infrastructure owner) to urgent findings arising from special assessment calculation work that was undertaken.
in response to work that Network Rail did nationally in order to verify the live load capacity of all its underbridges because of a legal notice issued by the ORR.

Following the accident, Network Rail investigated the condition of its metal bridges that are of similar construction to Bridge 88. Other types of bridges having key similarities to Bridge 88, for instance ballasted timber decks, are also being considered.

An approach using risk-based criteria, which includes the condition of visible parts of the structure, has been used to select priority bridges for investigation. For each of these, a review is undertaken to gain assurance on the condition of parts that are difficult to see, or potentially hidden. Network Rail is using the findings from these inspections to develop and undertake a programme of extended checks of all centre main girders with buried concrete-metal interfaces or with potential debris traps that are similar to that found on Bridge 88.

A new asset register and reporting information system – the Civil Asset Register and electronic Reporting System (CARRS)\(^{40}\) – has recently been implemented nationally. Network Rail is using this to manage the receipt of examination reports, record the outcomes of evaluations, and manage intervention actions raised to address identified defects.

When undertaking a new assessment, engineers are now required to compare their findings with the results of the previous assessment and comment on the differences.

**Management of earthworks**

At 19:21 on 28 November 2009, a passenger train was derailed by debris from a landslip of the cutting on the eastern approach to Gillingham tunnel, Dorset. The landslip had been caused by water overflowing from a blocked ditch, which weakened the soil at this point.

The derailed train was running at 64 mph when it left the rails 204 metres ahead of the tunnel entrance. It continued to the entrance, and then for a further 200 metres into the tunnel, before stopping.

Two passengers reported minor injuries. The leading coach suffered damage to its bodywork and to equipment mounted beneath the coach body.

Approximately 450 metres of track required repair. The line remained closed for five days. The consequences could have been more severe if the train had struck the wall around the tunnel entrance instead of running into the tunnel mouth.

The immediate cause of the accident was a landslip triggered by water overflowing from a blocked ditch.

RAIB found the causal factors to be as follows:

\(^{40}\) Along with various maintenance procedure failings, the lack of an asset management system was also found to be an underlying factor in the Malahide Viaduct collapse in Ireland on 21 August 2009.
ICCS analysis

- The Victorian cutting design did not take adequate account of the interaction between geology, groundwater and heavy rainfall;
- Roots were not dealt with properly during maintenance work;
- The person who inspected the ditch did not have appropriate guidance about how to deal with roots;
- There was no Network Rail process for establishing the drainage ditch condition to be achieved during maintenance work; and
- Lack of action in response to a memo issued on the subject in March 2000.

Possible causal factors were:

- The ditch may have been dug out to an inadequate size during maintenance work;
- The ditch was inspected without appropriate guidance about the size of ditch required; and
- The evaluation did not consider information available from historic documents.

Network Rail’s off-track drainage management process was an underlying factor, because it does not include a process for providing inspection and maintenance staff with adequate information about required ditch sizes.

Since the accident, the cutting slope has been trimmed to a gentler (ie more stable) slope and the crest drain capacity has been increased at the accident site.

Network Rail and South West Trains are currently installing a new mobile phone system known as GSM-R, which will considerably improve communication with trains in tunnels.

Controllers at the Wessex Integrated Control Centre have been reminded that, if a rescue train may be needed to evacuate passengers from an incident site, suitable train(s) should be kept available until there is sufficient information to reach a final decision on the means of evacuation.

A number of incidents between 2005 and 2007 led RAIB to undertake a study of Network Rail’s management of earthworks. The report was published in December 2008. To access the report, click here: LINK

5.2 Lessons learnt from non-GB rail investigations

In order to demonstrate the ICCS’s capability to draw parallels between learning points raised by accidents on the main line GB network and other railways and industries, we focussed on collisions with third parties and collisions in which competence and compliance issues were found to have been causal.

5.2.1 Competence and compliance – collisions

During 2010, a formal investigation report was released which dealt with the collision of an engineering train with a trolley which had been left on the line at North Somerset Junction on 20 September 2009. The report found that the incident had been partly caused by issues with competence and compliance.
An interrogation of the ICCS database shows that it currently holds six reports which highlight similar causal factors. These may be categorised as follows:

- GB heavy rail (1 – North Somerset Junction)
- London Underground (1)
- UK Heritage rail (1)
- UK metro (2)
- Marine sector (1)

Although there can be no statistical significance attached to this, it does show competence and compliance issues to be prevalent in many other areas of transport. The remainder of this section provides details of the points raised by some of the non-GB heavy rail investigation reports in the full ICCS dataset.

**UK Heritage rail**

On 15 August 2007, at Lydney Junction on the Dean Forest Railway (DFR), a steam-hauled passenger special struck a set of manually operated level crossing gates.

The impact detached one gate from its mountings. It then struck and seriously injured one of the two crossing keepers on duty. Although various organisational arrangements were lacking and the railhead conditions were poor, the RAIB’s report into the incident also found that the locomotive crew’s lack of training and experience in controlling the train under such conditions were insufficient. Among other post-accident actions, the DFR appointed a qualified health and safety director.

**UK metro (Croydon Tramlink)**

At New Addington on the Croydon Tramlink in November 2005, a tram heading for the terminus in thick fog passed a stop signal before coming to rest blocking the adjacent line to Croydon. At around the same time, another tram left the New Addington terminus for Croydon on the partially blocked line.

The brakes were only applied when the two trams were about 1.5 metres from each other, resulting in a collision. Neither tram was derailed but the collision caused significant damage to both. There were no injuries, though two whiplash injuries were later reported.

RAIB found the immediate cause of the accident to be that the driver of the second tram did not react in a timely manner to the obstruction caused on the line. The Branch recommended that ‘Tram Operations Ltd should carry out a programme to re-train all their drivers on the necessity to use the hazard brake in an emergency. Training and routine assessments should include understanding and demonstration by the driver in the operation of the hazard brake.’

**Marine**
The Marine Accident Investigation Branch (MAIB) has also investigated collision incidents in the ICCS analysis period.

On 8 August 2009, for example, two powerboats collided during a race at the Dover Regatta, causing fatal injuries to one crew member.

The collision occurred when one boat lost control, turned sharply and reduced speed significantly. The boat following behind had little opportunity to take avoiding action and struck the side of the first, close to where its co-driver was seated.

The MAIB revealed that the event took place on a foreshortened and compromised course, under confusing rules and without the risks being properly assessed. Despite this, it was approved by the Royal Yachting Association (RYA), and a large proportion of untrained novice and inexperienced competitors were permitted to race.

Ultimately, it was the ability of the crews of the two boats that collided which caused the collision. However, they were racing under the auspices of an organisation that the investigation concluded had been insufficiently focused on safety, and had not made adequate attempts to control the race, or educate the crews about the risks they faced.

Following an investigation into a similar accident at Portland Harbour on 19 June 2005, the MAIB recommended the RYA should:

'Consider the safety issues arising from this accident, and develop a pro-active safety management system which is subject to an independent audit by a professional body, to ensure effective oversight of powerboat racing. Particular attention should be given to developing procedures for the oversight of the K-Class racing classes.'

The RYA accepted the recommendation, however the investigation found that the safety lessons identified in the earlier accident had not been applied effectively across the sport, as intended by the RYA Council. This had allowed a number of systemic weaknesses to persist, which set the pre-conditions for the accident at Dover.

Following the MAIB’s investigation, the RYA Council has affirmed its ownership of safety, including the need to provide clear guidance and oversight of safety issues at all levels of the RYA. Within the RYA this will include: providing subordinate committees and structures with defined responsibilities, authority and accountability; promoting a culture of continuous safety improvement; and enhancing the auditing and monitoring of safety.

**Learning point:** Are your competence and compliance systems in order?

### 5.2.2 Collision with third party

On the railway, ‘collision with third party’ usually occurs at level crossings, the road vehicle incursion at Great Heck in 2001 being a notable exception. An interrogation of the ICCS database shows that it currently holds three reports which highlight similar causal factors. These may be categorised as follows:

- Air (1)
Overseas rail (1)

UK Heritage rail (1)

As with the previous example, there can be no statistical significance attached to this, but it does show collisions with third parties to be prevalent beyond GB heavy rail. The remainder of this section provides details of the points raised by some of the non-GB rail investigation reports in the full ICCS dataset.

Air

In the case of the accident to Flight VQ-TIU near North Caicos Airport, Turks and Caicos Islands, British West Indies on 6 February 2007, the third party was considered to be the ground. The aircraft crashed soon after takeoff. On board were one pilot and five passengers. The pilot received fatal injuries; the passengers sustained mainly major injuries, but all survived.

According to the Air Accident Investigation Branch (AAIB), the circumstances of the incident suggested that the pilot became spatially disorientated to the extent that the aircraft diverged from its intended flight path and reached an irrecoverable situation. The environmental conditions were conducive to a disorientation event, and a post-mortem toxicological examination showed that the pilot had a level of blood alcohol which, although below the prescribed limit, was significant in terms of piloting an aircraft and would have made him more prone to disorientation. On GB rail, the report into the fatal buffer stop collision at Cannon Street in 1991 led to a recommendation that legislation be introduced to make it an offence for railway employees with safety responsibilities to be impaired by the consumption of alcohol or drugs (hitherto, only alcohol had been covered). This came into force under the Transport and Works Act 1992.

The AAIB investigation identified the following causal factors:

- The aircraft adopted an excessive degree of right bank soon after takeoff. This led to a descending, turning flight path which persisted until the aircraft was too low to make a safe recovery.
- The pilot probably became spatially disorientated and was unable to recognise or correct the situation in time to prevent the accident.

The investigation identified the following contributory factors:

- The environmental conditions were conducive to a spatial disorientation event.
- The pilot had probably consumed alcohol prior to the flight, which made him more prone to becoming disorientated.
- The flight was operated single-pilot when two pilots were required under applicable regulations. The presence of a second pilot would have provided a significant measure of protection against the effects of the flying pilot becoming disorientated.

Overseas rail

At about 14:48 (local time) on 5 March 2008, a low-speed collision occurred between a train and a double trailer road-train at the Stirling Street level crossing at Birkenhead, South
ICCS analysis

Australia. The impact speed was sufficient to roll the prime mover and the first semitrailer onto their sides and to derail the lead bogie of the locomotive. The road-train driver was slightly injured; the two train drivers were shaken but otherwise uninjured.

The Australian Transport Safety Bureau's investigation found that the Stop sign assembly had been moved from its original position during an upgrade and that a Stop line was not visible on the road surface. The investigation also found that the road-train involved in the collision was not authorised to operate on Stirling Street as no Heavy Vehicle Permit (HVP) for this vehicle had been issued by the Department for Transport, Energy and Infrastructure.

Safety issues identified by the investigation relate to compliance of the level crossing with relevant standards, notification to the rail infrastructure manager of a non-compliance identified at audit and the issuing of HVPs for road-train routes that involve level crossings.

UK Heritage rail

At 12:15 on 15 September 2009, two trams travelling in opposite directions collided at the passing loop on the upper section of the Great Orme Tramway, Llandudno. One person suffered minor injuries as a result.

In April 2000, a similar collision at the same location injured 17 people. RAIB found the immediate cause of the 2009 collision to be that the lower points moved under one tram, directing its rear into the path of another.

A causal factor was the wheel forces overcoming the tumbler's holding force and changing the position of the points. This was the result of three factors:

- The effectiveness of the holding force on the points had reduced due to wear and degradation of the points.
- The points did not have a facing point lock.
- There were no procedures in place to routinely measure the condition of, or undertake remedial actions upon, the points.

The underlying factors were that:

- There was a lack of a comprehensive risk assessment of the points.
- There was a lack of competent audits by the tramway and the Council.

Over the closed period between October 2009 and March 2010, the operator undertook remedial work on the upper loop, including:

- Correcting the vertical alignment (cross-level and gradient) by lifting the track and adding approximately 70 tonnes of ballast.
- Adding ballast retention boards to reduce the movement of ballast on the embankment.
- Correcting the lateral alignment of the track.
- Renewing deteriorated sleepers and bearers.
• Providing additional support to the heel areas of the points.
• Measuring and overhauling the tumblers, including adding a variable length arm to allow the output force from the tumblers to be adjusted.

The tramway has also investigated the operation of the monitoring system to understand possible failure modes and to inform future inspection and test procedures. It is in the process of undertaking risk assessments and reviews of inspection and maintenance procedures.

**Learning point:** Do you look beyond your own operation for insights or initiatives?

It is widely recognised that the Baker Panel review into the Texas City oil refinery disaster of 2005 and the Haddon-Cave report on the Nimrod accident of 2006 contain lessons from which the rail industry would benefit. By recommending RSSB’s National Incident Reporting System (NIR-Online) as a model for sharing lessons and best practice, the report on the Buncefield oil depot explosion of 2005 showed that other industries can also learn from rail.

As the above section suggests, lower level investigation reports from beyond GB heavy rail may also yield similar transferrable lessons.
6 Confidential Incident Reporting and Analysis System

Learning does not only occur after an accident; many valuable lessons are revealed by what might be termed ‘accidents waiting to happen’.

Reports to the industry’s Confidential Incident Reporting and Analysis System (CIRAS) focus mainly on such ‘near miss’ events or perceived deficiencies in safety systems and arrangements.

By systematically capturing this knowledge, which comes from workforce members who have daily operational contact with the railway, it is possible to identify issues before they cause injury.

Maintaining confidentiality is a key aspect of CIRAS. It is recognised that this may sometimes restrict the information that can be disclosed. However, the advantage is that reporters may be able to state their real concerns and describe underlying causes, often more openly than they would to their line manager. The result is that CIRAS has the potential to provide unique insights into safety issues.

CIRAS reports not only serve to supplement evidence from more conventional analyses, but can also describe the potential circumstances for accidents in some detail. Such information can be used proactively to reduce the possibility of such accidents and incidents from ever happening in the first place.

CIRAS encourages reporting, no matter how insignificant it may seem at the time. Operational experience tells us that what appears to be insignificant may have repercussions for safety later on. We may never know exactly what information has been able to prevent an accident through timely intervention.

The ongoing, structured programme of industry engagement continues to target relevant audiences in different industry sectors. Stakeholders are also asked for feedback on every single report, and often provide valuable suggestions as to how the service can be improved. CIRAS also exhibits throughout the year at key industry events to raise awareness of the service.

The majority of reports to CIRAS have already been through internal company channels - even so, around 40% contain new information. To a company with a proactive approach to safety management, it may not matter if the information comes from internal or external reports.

Safety management can demonstrate robustness by incorporating a ‘systems approach’, whereby information contained in a CIRAS report can be openly discussed and actioned appropriately. The distinction between internal and external reporting may be an artificial one. If a company is generally positive about the value of reporting, it is likely to be positive about the potential value of a CIRAS report.
6.1.1 Who reports to CIRAS?

Chart 9 shows the distribution of reports categorised by reporter occupation.

- The top four reporter categories in 2010 were:
  - Drivers - 46
  - Track workers - 43
  - Conductors - 27
  - Station staff - 26

- Train drivers have consistently submitted the largest number of reports, but it is particularly positive to note that other groups feel able to raise safety issues too, including trainers, engineers and electricians.

6.1.2 Why do people report to CIRAS?

Perhaps surprisingly, the majority of issues (78%) reported have previously been taken through internal company channels, a figure that remains consistently high from year to year. It is, however, true that some staff report to CIRAS because they find it difficult to raise sensitive issues with their managers – they still want their concern progressed, but in a way which guarantees confidentiality.

Chart 10 shows why reporters feel it necessary to raise an issue with CIRAS, even though it has been reported first internally.
58% believed the response from their company was inadequate.

23% believed the response to be adequate but had not seen any changes or implementation at work.

16% claimed they had received no response whatsoever.

It should be noted that concerns which get as far as CIRAS are likely to represent a small proportion of all the issues that are pursued through a company’s internal processes.

6.1.3 Key issues of concern in CIRAS reports during 2010

CIRAS received 530 contacts on a diverse range of topics in 2010. Of these contacts, 264 (50%) became reports after the screening process. A breakdown showing the percentage of these reports recorded against industry risk categories is shown in Chart 11. Reporters predominantly focus on the potential for accidents or incidents; the reports therefore represent the perceived risks that reporters identify in the course of carrying out their duties.
6.1.4 Positive outcomes from CIRAS reports received in 2010

CIRAS monitors the outcomes from the reporting process to ascertain the value and benefits delivered to the railway industry. Positive outcomes from CIRAS reports are recorded where the CIRAS report prompted an investigation, briefing, review or change. Some of the best examples of positive outcomes are highlighted below:

- **Problems with electric couplings on Class 170 units**: A joint working group was formed with the TOCs involved and Network Rail to help find a solution to the problem and monitor progress. All parties perusing possible solutions and efforts made to reduce side effects from the problem such as brake applications.

- **Machine Controller competencies lacking**: as a result NR issued an Infrastructure Group Safety bulletin along with a rolling programme of site compliance visits across the infrastructure.

- **AWS equipment not set up as per Rule Book**: staff were reminded about the relevant section in the Rule Book to ensure they are aware of the correct set up. Additional checks will be made by an independent engineer.

- **Toilet waste discharge on to tracks**: NR has approached the RSSB to undertake research into the effects of allowing trains to discharge onto the track. Many preventative procedures are in place and any reported locations are thoroughly cleansed.

- **Inadequate rest period due to roster**: an additional shift was implemented into the roster to eliminate the short rest period. This now ensures that staff receive rest periods of more than 12 hours. The report helped the company to focus attention on finding a solution.
7 RSSB’s role in rail industry learning

Much of the work undertaken by RSSB on behalf of the rail industry is LOE-related. RSSB builds consensus and facilitates the resolution of difficult cross-industry issues. It provides analysis, knowledge, a substantial level of technical expertise, along with powerful information and risk management tools, and delivers to the industry across a whole range of subject areas.

These services help the industry to:

- Where reasonably practicable, continuously improve the level of safety in the rail industry.  
- Drive out unnecessary cost.
- Improve business performance.

7.1.1 Safety performance analysis and planning

All accidents and incidents which occur on the mainline railway are input into the industry’s Safety Management Information System (SMIS), which was introduced in 1998.

These events are then coded, categorised and validated by analysts for many purposes, the results being fed into the industry’s cycle of safety planning and performance reporting, which supports both duty holder and joint industry safety improvements. Key outputs include RSSB’s Annual Safety Performance Report (ASPR), the industry Safety Risk Model (SRM) and a Precursor Indicator Model (PIM).

Railway companies use this data and intelligence, together with their own experience and understanding of risk, to compile their own safety plans. Periodically, RSSB collates these plans, together with company initiatives and projections of the safety benefits they will achieve, into the railway Strategic Safety Plan (SSP). Monitoring the delivery against the trajectories defined in the SSP helps the rail industry combat the risk from complacency in safety management against which the Baker Panel warned.

RSSB generally works on the ‘plan, do, review’ learning principle outlined in the HSE document Successful health and safety management (‘HSG65’), which fits into elements of rail industry safety management systems. This is referred to as the ‘industry data to decision making audit trail’ (see Figure 1).

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41 This issue is considered in some detail in the RSSB publication Taking safe decisions, which sets out the rail industry consensus for how to make such decisions.
42 See Baker Panel, p. i.
7.1.2 Incident causal classification system

RSSB receives investigation reports from all railway organisations, which is a mandatory requirement under Railway Group Standard GO/RT3119 (Accident and incident investigation). Currently, around 4,500 investigations have been stored, dating back to the late 1990s.

The conclusions in these reports hold much valuable information about event causes, but once the recommendations therein have been acted upon, there is a danger that some of their learning points will be lost or will not reach other parties who could benefit from them.

RSSB is working on a way to analyse all accident reports through an Incident Causal Classification System (ICCS). Work began in 2009 to help provide information relating to previous accidents in a consistent and efficient manner, which will seek to identify systemic shortcomings – for the purpose of learning from operational experience – to accident investigators, safety managers and analysts across our industry.
The ICCS holds all RAIB reports, along with a number of Formal Investigations and rail accident investigations from outside Great Britain. It is also being populated with reports from other industries in a move to ascertain how other industries learn from safety events which may have parallels with our own. An example is the Baker Panel report into the Texas City oil refinery process accident. The report was far reaching and its lessons in safety culture could be applied to the rail industry.

We have noted that the investigation into the explosion at Buncefield Oil Storage Depot recommended the use of RSSB’s national incident reporting system (NIR), showing that the oil industry is also prepared to learn from rail. The ICCS will help facilitate these learning patterns as it is developed.

Sample analyses may be found here: ICCS analysis, and in RSSB’s recent Road-rail interface safety performance safety performance report.

7.1.3 Human Factors
RSSB’s Human Factors capability supports Industry and other groups within RSSB across a wide range of topics and activities. RSSB supports industry and specialist professionals serving the railway in:

- Integrating human factors within risk management approaches.
- Taking a risk-based approach to human factors.

For more information, see the RSSB website: [LINK](#)

7.1.4 Safety Management Systems
Working closely with Industry Stakeholders, RSSB provides support to Industry with regard to the development, implementation and continuous improvement of Safety Management Systems.

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43 On 23 March 2005, the BP Texas City refinery experienced a process accident. It was one of the most serious US workplace disasters of the past two decades, resulting in 15 deaths and more than 170 injuries.

44 RSSB is currently conducting research into the development of safety performance indicators in response to requests from members for work to address the underlying issues raised by the Baker Report.

45 In the early hours of Sunday 11 December 2005, a number of explosions occurred at Buncefield Oil Storage Depot, near Hemel Hempstead. At least one of the initial explosions was of massive proportions and a large fire engulfed much of the site. There were no fatalities, but over 40 people were injured.
In support of LOE, RSSB is currently developing guidance on accident and incident investigation within an industry agreed framework. The guidance (R&D Project T847: High level SMS Guidance and Good practice and guidance on Industry Safety Assurance) is scheduled for publication during 2011.

For more information, see the SMS pages of the RSSB website: [LINK](#).

### 7.1.5 RED DVD

RED is a series of programmes about operational safety initiatives, including SPADs, which are of potential interest to anyone operating and managing the railway – from drivers and signallers to managers and specialists at all levels. It makes extensive use of incident reconstructions to make clear learning points which remain in the memory.

By funding and facilitating this series, RSSB assists the Operational Focus Group (OFG) in promoting a more progressive and open safety culture in which there is respect for the contribution of all and a recognition that there are still many systemic issues that must be addressed if improvements are to continue to be delivered. OFG and RSSB hope that the RED series will help to shape the attitudes and perceptions of every viewer throughout the industry, by improving knowledge and understanding about SPADs and other operational issues.

A summary of the learning points raised by RED DVDs released in 2009 may be found [here](#).

If you would like to receive RED, please contact the Susan Cassidy, Programme Manager (Operational Safety): [susan.cassidy@rssb.co.uk](mailto:susan.cassidy@rssb.co.uk).

### 7.1.6 Operational Feedback

RSSB’s Operational Feedback function tracks recommendations from Formal Inquiries on industry, along with recommendations on RSSB from RAIB investigations. Learning is also facilitated by considering qualitative information, which is used to help inform the Safety Risk Model and is also provided to RAIB, the national stakeholder groups and European safety partners. The current suite of publications includes the following:

- **Worldwide Accident Investigation Summary** This monthly summary covers rail accident investigations from across the world, providing a synopsis of the event, its causes and the recommendations that have been made to mitigate them. It forms part of a regular set of papers to the national programme groups. Of these, OFG cascades the information to the OPSRAMs, thus facilitating wider learning throughout the industry.

- **Operational Feedback Updates** These are *ad hoc* reports produced to highlight issues raised by overseas rail accidents and inquiries into non-rail events with a view to promoting pan-industry learning.

- **Red Alert articles** RSSB submits regular articles to *Red Alert* magazine. These are abridged versions of the **Operational Feedback Updates** and are designed to reach a wider audience and encourage debate.
Appendices

Appendix 1. Bibliography


Lord Cullen, *The Public Inquiry into the Piper Alpha Disaster* (HMSO, 1990)


Haddon-Cave QC, Charles *The Nimrod Report – an independent review into the broader issues surrounding the loss of the RAF Nimrod MR2 Aircraft XV230 in Afghanistan in 2006* (HMSO, 2009)

Hall, Stanley, *Beyond Hidden Dangers* (Ian Allan, 2007)

HSE, *Successful health and safety management* (HSE, 2008)

NHS, *ABC of Knowledge Management* (NHS, 2005)


RSSB, *Taking safe decisions – how Britain’s railways take decisions that affect safety* (RSSB, 2008)


Appendix 2. Rail accidents involving passenger fatalities since 1997

This table lists all train accidents that have led to passenger fatalities since 1997. The accident inquiries led to many and varied findings and recommendations which have been followed up elsewhere. However, the issues listed in the fifth column of the table were highlighted in more than one accident and prompted some of the research listed in the final column.

The learning from these accidents, and the research that followed, contributed to the development of the overall industry approach to these issues.

<table>
<thead>
<tr>
<th>Date</th>
<th>Incident location</th>
<th>Incident type</th>
<th>Passenger/ workforce fatalities</th>
<th>Issues raised</th>
<th>R&amp;D project (T number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>Southall</td>
<td>Passenger train SPAD and collision with freight train</td>
<td>7</td>
<td>Isolation of safety systems, Passenger containment, vehicle crashworthiness.</td>
<td>T424</td>
</tr>
<tr>
<td>1999</td>
<td>Ladbroke Grove</td>
<td>Passenger train SPAD and collision with passenger train</td>
<td>31</td>
<td>Signal sighting issues, Multi-SPAD signal processes, driver training and competencies, Vehicle crashworthiness, bogie retention, passenger containment, drivers’ cabs.</td>
<td>T118, T189, T190, T424</td>
</tr>
<tr>
<td>2000</td>
<td>Hatfield</td>
<td>Passenger train derailment</td>
<td>4</td>
<td>Bogie retention, coupler strength, vehicle crashworthiness.</td>
<td>T118, T177</td>
</tr>
<tr>
<td>2001</td>
<td>Great Heck</td>
<td>Passenger train collision with road vehicle, derailment and subsequent collision with freight train</td>
<td>10</td>
<td>Vehicle crashworthiness, bogie retention, drivers’ cabs, lifeguards and obstacle deflectors.</td>
<td>T118, T120, T189, T190</td>
</tr>
<tr>
<td>2002</td>
<td>Potters Bar</td>
<td>Passenger train derailment</td>
<td>6 (+ 1 MOP)</td>
<td>Bogie retention, passenger containment (the latter discussed in the context of Potters Bar post-investigation).</td>
<td>T424, T118</td>
</tr>
<tr>
<td>2004</td>
<td>Ufton Nervet</td>
<td>Passenger train collision with road vehicle on level crossing and subsequent derailment</td>
<td>6</td>
<td>Passenger containment, bogie retention, coupler strength, drivers’ cabs, lifeguards and obstacle deflectors.</td>
<td>T118, T189, T424, T521, T522, T524, T528, T818</td>
</tr>
<tr>
<td>2007</td>
<td>Grayrigg</td>
<td>Passenger train derailment</td>
<td>1</td>
<td>Passenger containment.</td>
<td>T118, T310</td>
</tr>
</tbody>
</table>

More information may be found in RSSB’s Report on improvements in the safety of passengers and staff involved in train accidents.
Appendix 3. Chief Inspector’s foreword to the RAIB Annual Report 2009

Chief Inspector’s Foreword

In the 12 months covered by this report the Rail Accident Investigation Branch has completed and published 33 reports, 9 bulletins and started a further 21 investigations; 20 concerning specific accidents or incidents and one concerning a series of accidents.

The main purpose of this report is to highlight the safety issues in the industry today as we see them through our investigations and the actions that are being taken to address these issues. Section 1 of the report gives our overview whilst Section 2 itemises each recommendation we have made in 2009 along with previous recommendations that were seen as open at the end of 2008 and the status of those recommendations as reported to us.

The consequences of an accident are not a reliable indication of the size of the risk to safety nor the potential for more serious consequences. Therefore the RAIB must take that into account in deciding what it will investigate, based on early information regarding the incident and the RAIB’s judgement as to whether an investigation has the potential for significant learning and improvement of safety. This is why we investigate incidents or near misses. By the time a serious accident occurs, for some of those involved, our investigation is too late.

Regarding the number of investigations we undertake, a simple comparison with our European equivalents is unlikely to be meaningful as it will fail to take into account some key differences. The National Rail Accident Investigation Bodies (NIBs) vary enormously between the European member states. Some are very well established whilst others are still in the process of establishing their operations; some only investigate those rail systems which are subject to European law whilst others, like us, investigate other railways such as the metros (e.g London Underground) and tramways (e.g Croydon and Manchester’s Light Rail Systems). Some use in-house capability to do most of the investigation work whilst others, to a large extent, use investigation work carried out by others including the police and industry.

I decided we would publish all of our investigation reports not only on our own website but also on that of the European Rail Agency, as this provides broader access to safety information regarding light rail, metros and other railways that may benefit others outside of the UK.

Last year we conducted 49 preliminary examinations and, based on early information about these accidents or incidents, we started 20 investigations. Of the 20 investigations we started last year 15 were on rail systems which are the subject of European legislation. Of those 15; three were fatal accidents (five people were killed; four people in crossing accidents and one person whilst working on the tracks); one was a total collapse of a bridge whilst a train was travelling over it; two were very near miss fatal accidents (one involved a worker being struck by a train; the other where a wheelchair user had to throw himself clear of his chair on a crossing to avoid being stuck by a train); three were accidents which under slightly different circumstances would have been serious; and the remaining six indicated significant risks to safety which warranted independent investigation.
While the way we investigate is very different from the former Industry Formal Inquiries⁴, the number of Formal Inquiries was not so very different from the current number of RAIB investigations. A review of Rail Safety and Standard Board’s (RSSB’s) website⁵ indicates in the three years from January 2002 to December 2004 before the RAIB became operational, 39 such Inquiries concerning the UK’s national rail system were commenced; an annual average of 13. Last year RAIB commenced 15 such investigations. The average number of recommendations per formal inquiry was 10 - which is higher than the RAIB’s average of six recommendations per report in the last two years.

The UK’s railways in general continue to deliver high levels of safety but it is impossible to measure how many accidents are avoided through the work of the RAIB. However, since RAIB went live in October 2005 and up to December 2009 the industry had reported it had implemented 445 of RAIB’s recommendations (239 had been validated as such by the ORR). These statistics do not reflect the additional actions that the industry take during the course of RAIB’s investigations thereby negating the need for a RAIB recommendation⁶. Each implemented recommendation is a change to the railway or the way in which railway people do their work; each reflects an improvement made by the industry to further the safety of passengers, workers and the public.

In 97% of the cases where RAIB is aware of the response to its recommendations, measures to implement the recommendations are either in progress or are complete. I believe this is an indication of a very positive engagement between industry and the work we do.

I said in last year’s annual report that we had found recurring issues relating to:

a) worksite management;
b) management of fatigue;
c) planning possessions and weaknesses in conveying related information to staff;
d) inspection standards for track and related guidance to staff;
e) location and signage of decision points at crossings;
f) examination and assessment of risks associated with crossings and design for good sighting; and
g) management and operation of Road Rail Vehicles.

Many of these issues have continued to be evident during 2009. This year our report makes reference to further reoccurring issues relating to:
a) maintenance standards for track and guidance to staff;
b) management of earthworks;
c) freight train preparation; and
d) Red Zone working.

ORR and industry parties have indicated that steps have been taken in many of these areas or work is underway.

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¹ Formal Inquiries were managed by Railway Safety and more recently by Rail Safety and Standards Board (RSSB)
² www.rssb.co.uk
³ RAIB reports include details of such industry activity.
We believe there are cases where, had our recommendations been implemented sooner, or more completely, it is very likely that a second incident would have been avoided. We have continued to discuss such cases with both specific industry parties and ORR throughout the year. We hope this might inform the ORR’s new recommendation handling process and also help inform industry both in their decisions when prioritising their work on safety and their own monitoring of repeat causality amongst the broader base of industry investigations.

The RAIB has in the past expressed concerns about the length of time it has taken for the ORR to report the progress of implementation of RAIB recommendations and the ambiguity of the status of a recommendation when it is reported as ‘closed’. However, in early 2010 the ORR introduced a new system of recommendation handling that is aimed to give more timely and structured reports. The reports received by us since April this year, in general, have provided better information on the measures taken and also a timeframe for implementation agreed between the ORR and the duty holder. More recently the ORR has confirmed that it will no longer use the term ‘closed’ in its reports but instead indicate when a recommendation has been fully implemented thus providing a far better understanding to those individuals affected by rail accidents, the industry, the public and the RAIB.

I mentioned in last year’s Annual Report that at the time of publication the RAIB had not received confirmation from ORR that any of the Grayrigg recommendations had been satisfactorily completed. The accident at Grayrigg occurred in February 2007 and the RAIB published its final report in October 2008. The ORR has since provided details of the timeframes agreed between them and Network Rail for implementation of the related recommendations. These range from mid 2010 to early 2012. A number are declared by Network Rail as complete, three have been validated by ORR as such, and two as partially complete.

In relation to RAIB’s Grayrigg recommendation 29 which concerned establishing thresholds of working hours for safety critical staff, we have since investigated another accident (East Somerset Junction – published in November 2009) and made further more detailed recommendations concerning the same issue. ORR have reported that Network Rail are now reviewing their controls and standards concerning working hours and are considering revised working hour limits with a view to implementing a new standard in the first quarter of next year.

Of the eight Grayrigg recommendations that were made to parties other than Network Rail, five have been reported as complete and we await confirmation of the outcome of the remaining three.

Accident investigation has produced valuable evidence about the effectiveness of current standards and whether they convey to the staff who use them the understanding intended. RAIB investigations have also identified apparent knowledge gaps that could be filled by specialist studies or research.

The RAIB has to date directed a total of 44 recommendations to RSSB regarding proposals for changes to standards and for research. We are working with RSSB to better understand RSSB’s recommendation handling process, how decisions made concerning our recommendations align with the principles of As Low As Reasonably Practicable (ALARP) and how to better engage with the industry committees as and when appropriate.
Appendices

Chief Inspector’s foreword

At the time of writing this report, of the 44 recommendations made to RSSB, ORR have reported 30 are implemented, no changes will be made to standards in response to three recommendations and 11 recommendations are under consideration by ORR; but RSSB have indicated to ORR that in seven of those 11 cases no measures are proposed to be taken.

The RAIB continues to foster contact with overseas organisations and works with the European Rail Agency and the NIB Network to share its experience and best practice and to learn. The RAIB is engaged in a number of specific initiatives with investigation bodies both in Europe and further afield internationally.

Last year we asked readers of our Annual Report to give us feedback on whether they found its content and style useful. Although we received limited feedback, we have tried, where possible, to take those comments on board. I would again like to ask for your views to help us shape next year’s report (please refer to the feedback questionnaire at Annex C or the electronic version on our website: www.raib.gov.uk/publications/annual_report/annual_report_feedback_form.cfm). Subject to your views, we intend to make next year’s report much shorter and capitalise on links to information within our website. This way we hope to enable readers to access only those sections they wish to read and help us produce the report more efficiently.

Finally, and importantly, I wish to thank those railway organisations and individuals, and particularly the injured and bereaved, who have constructively contributed to our investigations, thus helping us in our work to improve safety.

Carolyn Griffiths
Chief Inspector of Rail Accidents
28 September 2010
## Appendix 4. Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td><strong>Accident</strong></td>
<td>This term refers to an event that causes harm or damage that was not intended by its victims. Suicides are not therefore classed as accidental fatalities. However, injuries sustained as a result of other people’s behaviour (for example, from assaults or trains striking objects that have been deliberately placed on the line) are classed as accidental if the injured party did not intend to come to harm.</td>
</tr>
<tr>
<td><strong>Train accidents</strong></td>
<td>are accidents occurring to trains and rolling stock.</td>
</tr>
<tr>
<td><strong>Individual accidents</strong></td>
<td>are accidents to people on railway premises or on trains, but excluding injuries sustained in train accidents.</td>
</tr>
<tr>
<td><strong>Child</strong></td>
<td>This term is used to describe a person aged 15 years or below.</td>
</tr>
<tr>
<td><strong>Fatalities and weighted injuries (FWI)</strong></td>
<td>An overall measure of safety harm, taking account of injury and fatalities in the following way: \ One FWI = one fatality = 10 major injuries = 200 RIDDOR-reportable minor injuries or class 1 shock/traumas = 1,000 non RIDDOR-reportable minor injuries or class 2 shock/traumas.</td>
</tr>
<tr>
<td><strong>Fatality</strong></td>
<td>Death within one year of the causal accident.</td>
</tr>
<tr>
<td><strong>Hazardous event</strong></td>
<td>An event that has the potential to lead directly to death or injury.</td>
</tr>
<tr>
<td><strong>Level crossing</strong></td>
<td>The ground-level interface between a road and the railway. Improper use refers to occasions when users cross when a train is imminent, but are either honestly mistaken about its proximity and the warnings given by signs, sirens and so on (error), or deliberately disregard them (violation). Proper use refers to occasions when users begin to cross entirely legitimately, but unforeseen events lead to a transgression (as when a motor vehicle breaks down half-way across a crossing, or the level crossing fails due to an error outside the user’s control). RIDDOR-reportable level crossing equipment failures relate to any failure of equipment at a level crossing that could endanger users, where the level crossing is on a running line. Note it does not include misuse of equipment. Sleeping dogs are crossings that have fallen into disuse, although individuals may still have the legal right to use them.</td>
</tr>
<tr>
<td><strong>Major injury</strong></td>
<td>An injury to a passenger, staff or member of the public as defined in Schedule 1 to RIDDOR 1995 (including most fractures, amputations, losses of consciousness), or where the injury resulted in hospital attendance for more than 24 hours.</td>
</tr>
<tr>
<td><strong>Minor injury</strong></td>
<td>Physical injuries to passengers, staff or members of the public that are not major injuries. For workforce, minor injuries are RIDDOR-reportable if they result in greater than three days’ lost time. For passengers and members of the public, minor injuries are RIDDOR-reportable if the injured person was taken from the accident site direct to the hospital. Other minor injuries are not reportable under RIDDOR.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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</tr>
<tr>
<td><strong>Network Rail managed infrastructure (NRMI)</strong></td>
<td>This falls within the boundaries of Network Rail’s operational railway and includes the permanent way, land within the lineside fence, and plant used for signalling or exclusively for supplying electricity for operational purposes to the railway. It does not include stations, depots, yards or sidings that are owned by, or leased to, other parties. However, it does include the permanent way at stations and plant within these locations.</td>
</tr>
<tr>
<td><strong>Passenger</strong></td>
<td>A person on railway infrastructure, who either intends to travel, is travelling or has travelled. Note this does not include passengers who are trespassing or who commit suicide – they are included as members of the public.</td>
</tr>
<tr>
<td><strong>Passenger train</strong></td>
<td>A train that is in service and available for the use of passengers.</td>
</tr>
<tr>
<td><strong>Potentially higher-risk train accidents (PHRTA)</strong></td>
<td>Accidents that are RIDDOR-reportable and have the potential to result in harm to any or all person types on the railway. They comprise train derailments, train collisions (excluding roll backs), trains striking buffer stops, trains striking road vehicles at level crossings, and trains running into road vehicles not at level crossings (with no derailment).</td>
</tr>
<tr>
<td><strong>Precursor</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Precursor Indicator Model (PIM)</strong></td>
<td>An RSSB-devised model that measures the underlying risk from train accidents by tracking changes in the occurrence of accident precursors.</td>
</tr>
<tr>
<td><strong>Public (members of)</strong></td>
<td>Persons other than passengers or workforce members (that is, trespassers, persons on business and other persons). Note this includes passengers who are trespassing (when crossing tracks between platforms, for example).</td>
</tr>
<tr>
<td><strong>RIDDOR (Reporting of Injuries, Diseases and Dangerous Occurrences Regulations)</strong></td>
<td>RIDDOR 1995 is a set of health and safety regulations that require any major injuries, illnesses or accidents occurring in the workplace to be formally reported to the enforcing authority. It defines major injuries and lists notifiable diseases – many of which can be occupational in origin. It also defines notifiable dangerous occurrences, such as collisions and derailments.</td>
</tr>
<tr>
<td><strong>Running line</strong></td>
<td>A line that is ordinarily used for the passage of trains, as shown in Table ‘A’ of the sectional appendices.</td>
</tr>
<tr>
<td><strong>Safety Management Information System (SMiS)</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Safety Risk Model (SRM)</strong></td>
<td>A quantitative representation of the safety risk that can result from the operation and maintenance of the GB rail network. It comprises 125 individual models, each representing a type of hazardous event (defined as an event or incident that has the potential to result in injuries or fatalities).</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<td>-----------------------------------------------------------</td>
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</tr>
<tr>
<td>Signal passed at danger (SPAD) (without authority)</td>
<td>Signal Passed At Danger (without authority): an incident when any part of a train has passed a signal designated as a ‘Stop’ signal without the driver having been given the correct authority, or where an in-cab signalled movement authority has been exceeded without authority.</td>
</tr>
<tr>
<td>Category A SPADs are split into 4 distinct types for the designated lead organisation responsible for the investigation to confirm. These are:</td>
<td></td>
</tr>
<tr>
<td>A1 – When a SPAD has occurred and, according to available evidence, a stop aspect indication or end of in-cab signalled movement authority was displayed or given correctly and in sufficient time for the train to be stopped safely at it.</td>
<td></td>
</tr>
<tr>
<td>A2 – When a SPAD has occurred and, according to available evidence, the stop aspect indication or end of in-cab signalled movement authority concerned was not displayed or given correctly, but was preceded by the correct signals or indications.</td>
<td></td>
</tr>
<tr>
<td>A3 – When a SPAD has occurred and, according to available evidence, verbal and/or visual permission to pass a signal at danger was given by a handsignaller or other authorised person without the authority of the signaler.</td>
<td></td>
</tr>
<tr>
<td>A4 – When a SPAD has occurred and, according to available evidence, a stop aspect, indication of end of in-cab signalling authority was displayed or given correctly and in sufficient time for the train to be stopped safely at it, but the train driver was unable to stop his/her train owing to circumstances beyond his/her control (for example, poor rail head adhesion, train braking equipment failure or malfunction etc).</td>
<td></td>
</tr>
<tr>
<td>Strategic Safety Plan</td>
<td>This is a joint statement by the companies responsible for Britain’s mainline rail network setting out an agreed industry approach to managing safety. The 2008-2010 plan was developed by bringing together commitments made by industry companies in their own individual safety plans, thus creating a linkage with the duty holder planning process.</td>
</tr>
<tr>
<td>Suicide and suspected suicide</td>
<td>A fatality is classified as a suicide where a coroner’s verdict is suicide. It is classified as a suspected suicide where the coroner has yet to return a verdict or returns an open verdict, but where objective evidence of suicide exists based on the application of Ovenstone criteria.</td>
</tr>
<tr>
<td>Track worker</td>
<td>A member of workforce whose responsibilities include engineering or technical activities on or about the track. This includes track maintenance, civil structure inspection, S&amp;T renewal/upgrade, engineering supervision, acting as a controller of site safety (COSS), hand signaler or lookout and machine operation.</td>
</tr>
<tr>
<td>Trackside</td>
<td>This is a collective term that refers to the running line, Network Rail managed sidings and depots.</td>
</tr>
<tr>
<td>Train accident</td>
<td>See Accident – Train accidents. RIDDOR-reportable train accidents are defined in RIDDOR 1995. To be reportable under RIDDOR, the accident must be on or affect the running line. There are additional criteria for different types of accident, and these can vary depending on whether or not the accident involved a passenger train.</td>
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<tr>
<td>Term</td>
<td>Definition</td>
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</tr>
<tr>
<td>Derailment</td>
<td>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.</td>
</tr>
<tr>
<td>Train fire</td>
<td>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.</td>
</tr>
<tr>
<td>Train striking road vehicle</td>
<td>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.</td>
</tr>
<tr>
<td>Collision between trains</td>
<td>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.</td>
</tr>
<tr>
<td>Roll back collisions</td>
<td>occur when a train rolls back (while not under power) into a train on the same line (including one from which it has decoupled).</td>
</tr>
<tr>
<td>Setting back collisions</td>
<td>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.</td>
</tr>
<tr>
<td>Shunting movement/coupling collisions</td>
<td>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.</td>
</tr>
<tr>
<td>Coming into station collisions</td>
<td>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.</td>
</tr>
<tr>
<td>In running (open track) collisions</td>
<td>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.</td>
</tr>
<tr>
<td>Collisions in a possession</td>
<td>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.</td>
</tr>
<tr>
<td>Open door collision</td>
<td>This occurs when a train door swings outward, coming into contact with another train.</td>
</tr>
<tr>
<td>Buffer stop collision</td>
<td>This occurs when a train strikes buffer stops. Accidents resulting in only superficial damage to the train are not reportable under RIDDOR.</td>
</tr>
<tr>
<td>Trains running into objects</td>
<td>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.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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</tr>
<tr>
<td><strong>Trains striking animals</strong></td>
<td>This includes all collisions with large-boned animals and flocks of sheep, and collisions with other animals that cause damage requiring immediate repair.</td>
</tr>
<tr>
<td><strong>Trains being struck by missiles</strong></td>
<td>This includes trains being struck by airborne objects, such as thrown stones, if this results in damage requiring immediate repair.</td>
</tr>
</tbody>
</table>
| **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. TPWS brake demands are classified as being **interventions** or **activations**. These two terms are sometimes viewed as being mutually interchangeable, however, they do each have their own distinct meanings, which should be used when referring to TPWS brake demands associated with category A SPADs, as follows:  

a) **TPWS Intervention**  
   A TPWS intervention occurs when the TPWS applies the brakes in the absence of (or prior to) the driver doing so. For example:  
   - A train starting against a TPWS-fitted signal at danger without authority will result in an **intervention** when the train passes the signal.  
   - A driver taking no action to apply the brake on approaching a signal at danger and passing over the overspeed loops too quickly will also result in an **intervention**.  

   In short the safety system ‘intervenes’ if the driver has not taken the appropriate action.  

b) **TPWS Activation**  
   This occurs when a driver has already applied the brakes before the TPWS operates. For example:  
   - A driver might already be braking on the approach to a red signal, but still passes over the overspeed sensor too quickly, resulting in an **activation**.  
   - If a train passes a TPWS-fitted signal at danger, despite having applied the brakes in an attempt to stop at it, then an **activation** results.  

   In short the safety system ‘activates’ to back up the driver’s brake application.  

**TPWS reset and continue** incidents occur when the driver has reset the TPWS after an intervention (or activation) 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. |
| **Workforce**                             | Persons working for the industry on railway operations (either as direct employees or under contract).                                                                                                       |
Appendix 5.  Glossary

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Expansion</th>
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<tbody>
<tr>
<td>ABCL</td>
<td>automatic barrier crossing locally monitored</td>
</tr>
<tr>
<td>AHB</td>
<td>automatic half-barrier crossing</td>
</tr>
<tr>
<td>ALARP</td>
<td>as low as reasonably practicable</td>
</tr>
<tr>
<td>AMA</td>
<td>annual moving average</td>
</tr>
<tr>
<td>AOCL</td>
<td>automatic open crossing, locally monitored</td>
</tr>
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