

Training rail accident investigators in UK[☆]

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Abstract

In the UK a number of high severity rail accidents, combined with structural change in the rail industry led to the need for revised accident investigation procedures. The revised procedure addressed identified issues with accident investigation, but to ensure maximum benefit in terms of identification of underlying causes of accidents and the production of good recommendations, training for rail industry accident investigators was required.

The development of training followed the development of the revised procedure, with key decisions including the scope of the training and the delivery method that promotes the highest degree of information transfer and individual learning. The training has been delivered to the rail industry with considerable success but has, and continues, to face challenges as the industry structure continues to evolve.

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1. Introduction

The rail industry in Great Britain has a long history of structural change with both consolidation (in the form of nationalisation in 1946) and fragmentation. British Rail was privatised in the 1994–1996 period and split into over 100 companies—responsibility for the infrastructure and trains was split. The fragmentation of the rail industry was opposed by the Unions, some politicians and many involved in the industry, but was pushed through by the political party in power. The railway system in Northern Ireland has always been separate from British Rail, and is subject to a separate legal regime.

As part of the privatisation process, railtrack became the infrastructure controller for the majority of the national rail network—London underground continued to be both infrastructure controller and operator on the underground system in London. Within railtrack a separate group with no commercial interests called safety and standards directorate was created, reporting directly to the chairman. One of the functions of this directorate was to develop and publish railway group standards on behalf of the industry. These standards are mandatory standards that apply to railtrack and all train

and station operators and were designed to help manage risks that could be passed between infrastructure controller, train and station operators. One of these standards defined the process for industry accident investigation.

The health and safety executive (HSE) is the safety regulator for all workplaces in Great Britain and it has responsibility for ensuring implementation of the health and safety at work etc. Act 1974. HM railway inspectorate (part of HSE) is responsible for safety regulation of the rail industry. It is responsible for giving approval for train companies (infrastructure operators, train operators and station operators) to operate (called railway safety cases) and investigates railway accidents and can bring prosecutions under the health and safety at work etc. Act 1974 for alleged breaches of safety legislation. The British transport police are a police force within Great Britain dedicated to the railways, and they have a statutory duty to investigate criminal acts on the railway, including allegations of murder, manslaughter and gross negligence, under criminal law.

Since privatisation the rail industry has been under enormous public scrutiny in the media and in Parliament, with very few outside the industry understanding the new structures and roles of different companies.

2. Accident investigation within the rail industry

The rail industry has always had its own accident investigation process that has sat alongside the processes operated

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by HM railway inspectorate. As part of the privatisation process a railway group standard was developed to cover the accident investigation and inquiry process. These industry processes were strained by the increasing tendency of the railway inspectorate to seek prosecution following accidents and the injection of commercial interests as a result of privatisation. The Southall accident brought these strains, particularly the tendency to seek prosecution, to a head.

3. Southall accident

At 13:15 on 19 September 1997 a side-on collision occurred between the 10:32 Swansea to Paddington high speed train, operated by Great Western trains and a freight train operated by English Welsh and Scottish, at Southall East Junction, West London. The driver of the high speed train had passed signal SN254 at danger (SPAD).

The collision caused extensive damage to the power car and a number of the coaches of the high speed train, extensive damage to the trailing freight wagons with further damage to the track and overhead line equipment. Seven people were killed and 139 persons were injured in varying degrees of severity.

Professor John Uff QC was asked by the chair of the health and safety commission to lead a public inquiry to determine: why the accident happened, and in particular to ascertain the cause or causes; to identify any lessons which have relevance for those with responsibilities for securing railway safety; and to make recommendations.

The driver of the high speed train was arrested by the British transport police on suspicion of manslaughter on 19 September 1997 and was released on bail. The public inquiry proceedings began in December 1997 with a formal opening in February 1998.

The driver of the high speed train was charged with seven counts of manslaughter on 17 April 1998, but no further progress could be made by the public inquiry pending decisions on criminal charges being considered against Great Western Trains. On 1 December 1998 Great Western Trains were charged by the health and safety executive with 'corporate manslaughter' and with offences under the health and safety at work Act etc.1974.

The trial of the manslaughter charges began at the central criminal court (Old Bailey) on 21 June 1999 and 6 days later the trial Judge rejected the prosecution's corporate manslaughter case. On 2 July 1999 Great Western Trains pleaded 'guilty' to the charges under the health and safety at work etc. Act and the Crown and HSE decided to abandon its action against the driver of the high speed train. Great Western Trains were fined £1.5 million and were ordered to pay the prosecution costs.

The public inquiry commenced hearings on 20 September 1999 (just over 2 years after the accident), and were adjourned on 30 September for a week at the request of the passenger groups who required more time. On 5 October

1999 a major rail collision occurred at Ladbroke Grove. Hearings of the Southall public inquiry resumed on 25 October and were concluded on 25 November with final submission on 20 December 1999.

Professor Uff QC made 93 recommendations under 12 separate headings in 'the Southall rail accident inquiry report' published by the health and safety commission in 2000. The accident investigation recommendations focused on the need for the rail industry inquiry to proceed without delay and laid the building blocks for Lord Cullen to recommend creation of an independent accident investigation body in the Ladbroke Grove part 2 report.

3.1. The need for change

The need for improvements in process of rail accident investigation were driven by five key factors.

- Increased tendency by safety regulator to seek prosecution.
- Results of fragmentation and privatisation of UK rail industry.
- Lack of opportunities for learning about accident investigation.
- The delays in the Southall accident investigation due to the legal process.
- Increased public scrutiny of rail industry.

The industry response to these drivers, led by railtrack safety and standards directorate (which became railway safety and now the rail safety standards board) was to substantially revise the railway group standard defining the process, and to instigate training in the industry accident investigation process and accident investigation techniques.

4. The new railway group standard

The railway group standard was fully revised and after several rounds of vigorous industry consultation and comment the new railway group standard was formally published in December 2001, and came into force in February 2002.

During the process of revising the Standard the Ladbroke Grove accident occurred (see later) and the revised railway group standard addressed the key accident investigation recommendations for the industry. The process of revising the standard went in parallel to the Ladbroke Grove public inquiry (which reported some 2 years after the accident).

The overall purpose of the railway group standard is to:

- provide a consistent, comprehensive and structured process for the investigation of accidents/incidents in order to prevent, or reduce the risk of their recurrence, without apportioning blame or liability;
- provide for the independent investigation of the most serious accidents/incidents;

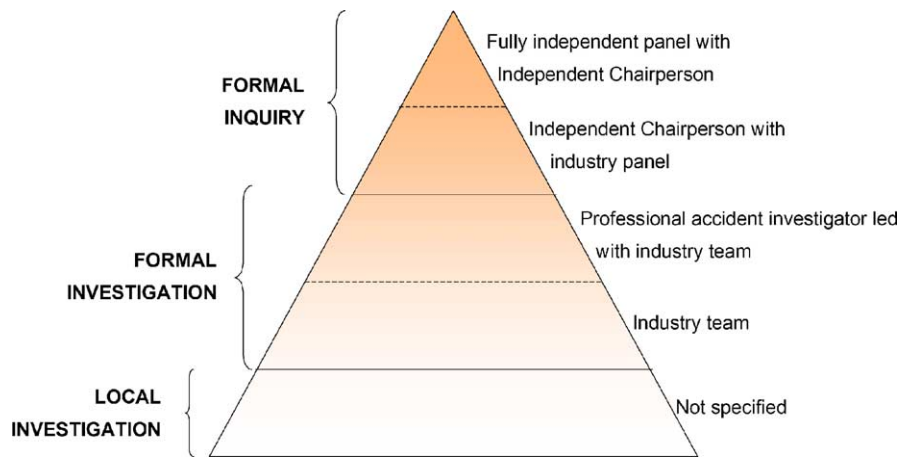


Fig. 1. Investigation hierarchy.

- enable information obtained from inquiries/investigations to be shared with, and used by, organisations with a direct responsibility for maintaining, or improving, railway safety.

The standard also tied down a number of definitions and types of inquiry/investigation. Three types of investigations are defined:

- Formal inquiry.
- Formal investigation.
- Local investigation.

The standard defines for these types of investigation the processes to be followed, the leadership and composition of investigation teams and the reporting requirements. The formal inquiry and formal investigation types have been further sub-divided in actual practice and this leads to a hierarchy of investigations (Fig. 1).

To illustrate these types with typical accidents:

Formal inquiry	
Fully independent panel	Multi-fatality passenger accident
Independent chairperson	Track worker fatality/serious injury
Formal investigation	
Professional investigator led	High-potential signal passed at danger
Industry team	Operating irregularity
Local investigation	On-depot incident

The standard provides some flexibility in determining the type of investigation, usually based on the learning potential.

The railway ethos of trying to find out what happened and learn the lessons has been captured in the process definition. One independent chairperson of formal inquiries described the sentiments underpinning the operation of the process that in his experience all the industries parties has always been 'prepared to put commercial interests to one side'.

For all formal inquiries and formal investigations there are four principal objectives:

- to establish the facts;
- to determine the immediate causes of the accident;
- to determine the underlying causes of the accident;
- to develop robust recommendations.

The standard also took the opportunity to fix a number of terms to increase consistency—two key terms are the immediate and underlying causes.

4.1. The immediate cause(s)

"The immediate cause(s) is an unsafe act or unsafe condition which causes an accident or incident"

4.2. The underlying cause(s)

"Underlying cause(s) are any factors which led to the immediate causes of accidents or incidents, or resulted in such causes not being identified and mitigated"

The revision of the process (as defined by the standard) and development and early deliveries of the training happened in parallel, and then as the standard was finally published the training courses were able to immediately reflect the new standard.

5. Training

The tender for development and delivery of training in rail accident investigation was sent out by railtrack safety and standards directorate in March 1999 and attracted a large number of respondents. After an evaluation process the contract was awarded to Arthur D. Little in November 1999. One of the key factors in awarding this contract was that Arthur D. Little was not involved in rail accident investigation, but

has significant rail industry experience and experience of accident investigation in the process and energy industries.

The training was called accident investigation/formal inquiry training and was aimed at all involved in rail accident investigation within the industry (investigation leaders and team members, safety directors and those responsible for assessing and acting upon investigation recommendations). There are other training providers covering rail accident investigation and the practical aspects of evidence collection, but this accident investigation/formal inquiry training is used by rail safety and standards board (formerly railway safety) to help develop incoming formal inquiry chairpersons and is regularly reviewed by it to ensure it meets current needs.

Just before the award of the contract for the training, the Ladbroke Grove accident occurred, and the public inquiry was held as the training was being launched.

5.1. Ladbroke Grove

At 08:09 on 5 October 1999 a head-on collision occurred between 08:06 Paddington to Bedwyn Thames train turbo and the 06:03 Cheltenham to Paddington First Great Western high speed train at Ladbroke Grove junction. The combined speed of impact was about 130 mph, and the driver of the Thames turbo had passed signal SN109 at danger. Immediately following the crash, diesel from the high speed train ignited causing a severe fire. Thirty-one people died as a result of the crash (24 on the Turbo and 7 on the High Speed Train) and a further 227 people were admitted to hospitals following injury.

Lord Cullen, who had chaired the piper alpha public inquiry, was appointed by the health and safety commission to conduct a public inquiry. Lord Cullen split the inquiry into two main parts, with part 1 looking at the actual accident and part 2 taking a much wider look at the industry post-privatisation.

Lord Cullen's part 2 report was published in 2001 (some 2 years after the actual accident) and it explores a number of key organisational and regulatory themes for the post-privatisation rail industry and covered accident investigation. Phrases in the report about accident investigation include:

- 'It is inappropriate for the safety regulator to carry out the function of investigation since it might be necessary for the investigator to examine the decisions and activities of the safety regulator itself'.
- 'It is clear that in general the overriding public interest lies in the swift determination of the causes of rail accidents, the publication of the report and the implementation of only safety lessons'.
- 'Applying and disseminating the lessons of accidents and incidents (including near misses) . . . was inhibited by the 'blame culture', and lack of a co-ordinated system for the collation of recommendations and ensuring they were followed up'.

A number of the 74 recommendations in the part 2 report related to accident investigation, and two are particularly related to the existing rail industry processes.

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| 62 | The sole objective of the investigation of accidents or incidents should be the prevention of accidents and incidents. It should not be the purpose of such investigations to apportion blame or liability. |
| 63 | The appointment of an independent chairman and, where appropriate, independent members for the panel of a formal inquiry, is endorsed. |
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In addition to recommendations on the rail industry's own processes, Lord Cullen took the suggestion from Professor Uff's Southall recommendations on the need for an independent investigation body and made nine key recommendation about the creation of a rail accident investigation body.

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| 57 | The responsibility of the health and safety executive (HSE) for the investigation of rail accidents should be transferred to an independent body, here referred to for convenience as the railway accident investigation branch (RAIB). |
| 58 | The investigation of rail accidents and incidents of whatever nature should be brought under the overall control of the RAIB. |
| 59 | The more serious cases should be the subject of inquiry by the RAIB. The categories of case which would fall to the RAIB to inquire into should be the subject of further study. |
| 60 | The less serious cases should be delegated to the industry to be dealt with by formal inquiry or formal investigation. However, the RAIB should have the ability to call in any case for inquiry by itself where that appears to be appropriate. |
| 67 | The RAIB should exercise a supervisory function in regard to the working of formal inquiries and formal investigations. |
| 69 | The reports of RAIB inquiries and formal inquiries should be published, subject to the protection of the identity of persons involved. |
| 70 | The rail industry safety body should maintain a current record of: <ol style="list-style-type: none"> a. the recommendations of RAIB inquiries 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 in relation to stated timescales. |
| 71 | The RAIB should regularly examine the reports of formal investigations in order to determine whether there are matters of importance which should be brought to the attention of the industry. |

73 The statements made by witnesses in connection with RAIB inquiries and industry inquiries and investigations should not be disclosed to the police, save by order of a judge.

The creation of the rail accident investigation branch required changes to the existing legislation and these proposals are now going through the Parliamentary process. The impact of the RAIB will be discussed later.

6. Accident investigation/formal inquiry training

The training was designed to cover all the members and leaders of formal investigation panels and formal inquiry teams. An early decision was taken to split the training into two separate courses.

- A 3-day core course for all members and leaders.
- And a 2-day supplementary course for leaders.

The supplementary course would only be accessible to those that have successfully completed the core course, and initial estimates suggested that only one in three core course delegates would need to attend the supplementary course.

In overview:

Core course

Explanation and practice in applying industry process.
Introduction to range of generic accident investigation tools.
Evidence collection, interviewing, analysis and conclusion/recommendation.
Importance of effective reporting to be understood.
Assessment of understanding tested through written exam.
Guest speaker presentation by an independent chairperson.

Supplementary course

Complexities of technical evidence to be demonstrated.
Skills for preparing and running accident investigations.
Range of different cases to be shown.
Writing effectively to be practised.

6.1. Core course

The core course was designed to provide training in the application of the industry process, but it was not designed as a briefing on the process itself. A key decision for the core course was which investigation techniques should be included—there are many commercially available techniques, books and software programmes? The railway group standard does not provide any guidance on types of techniques to be used, as it specifies the process and the desired outcomes. After discussion with existing railway accident investigators the decision was to cover four general causal

analysis techniques and then allow the delegates to decide which they would use.

The four techniques selected are:

- Analysis of events.
- Barrier/defence identification and analysis.
- ‘Checklist’ analysis.
- Unstructured analysis.

And these four techniques are demonstrated in the core course. Central to all Arthur D. Little training courses is the principle of using a mixture of briefings and case studies to promote learning, supported by suitable materials. For the core course, it was decided to use a single case study over the 3 days, broken into a number of separate elements.

Working with railtrack safety and standards directorate (which became railway safety and in 2003 rail safety and standards board), a real accident where a track worker was critically injured when struck by a moving train was selected. Significant discussions with the actual formal inquiry chairman were held to understand how the accident was investigated and to develop suitable materials for the course. About 10% of additional fictional material was added to cover several aspects not seen in the actual investigation.

The case study is split into six parts:

- Introduction—two page ‘fax’ outlining the incident type and bare facts.
- Initial evidence gathering—15 pages of evidence that could be readily gathered on site.
- Review of on-site interview and safety critical communication—extracts from the on-site interview with the train driver involved and the transcript of the emergency call from the accident site to the remote control centre.
- Role-play interview—opportunity to interview the person responsible for the on-site safety of the injured track worker.
- Factors for consideration—15 pages of evidence that were collected at the formal inquiry panel meeting.
- Conclusions and recommendations—producing the key elements of the accident report.

A typical course delivery with 16 delegates will be split into four case study groups for the entire 3 days. The case study groups are generated by the trainers, to ensure as far as possible a good mix of experience and industry sectors in each group. For this reason no single company courses have been run—mixed courses are necessary to reflect the composition of actual investigation teams. Supporting this is a maximum number of delegates from any one company per course.

Unlike many other Arthur D. Little courses there are no model solutions for the case study and there is very little interference by trainers in the case study work. There are often tensions and disagreements within case study teams, and this is a reflection of reality! At the end of the course all the delegates get copies of the conclusions and

recommendations produced by all the groups on the course. This serves to highlight the similarities and differences that can evolve from the evidence gathered!

To provide the delegates with further insights into actual investigations two sessions beyond the briefings and case study are included. A short session at the end of the first day, in the form of a slide show, illustrates some of the potential physical and technical challenges of investigating real railway accidents. A second session at the end of the second day is included to provide an opportunity for a guest speaker to share their thoughts and answer questions from the delegates. For the first year a number of retired senior officers from the British transport police were used, but after delegate feedback it was decided instead to use actual formal inquiry independent chairmen.

The guest speaker session usually takes the format of a discussion about 'interesting investigations' the chairman has been involved in, followed by an open question-and-answer session on railway accident investigation.

This has proved to be a real success, allowing delegates to ask about the real-life implementation of the process, as well as providing the chairmen an opportunity to meet industry members who may be involved in future investigations. Railway Safety and Standards Board also sends one of their senior managers involved in managing the investigation process to demonstrate their support to the training and to listen to the types of issues emerging from the delegates.

The course is residential—we have found that discussions in the coffee breaks and meals are just as important for competence development as the formal sessions. To maximise the case study time a pre-reading handbook is sent to all delegates 2 weeks before course commencement.

To conclude the core course, a 90 min closed-book written exam is used to test delegates understanding of the investigation process. Fifteen questions cover the entire range of material used during the course, and the pass mark is set at 60%. It is recognised that this is not a perfect measure of investigation competence, but provides a measure of the understanding of the underlying principles and the industry process.

6.2. *Supplementary course*

The supplementary course was designed to introduce the potential complexities with technical evidence, and to develop key skills in leading investigations and writing reports. The supplementary course uses three different case studies illustrating different technical and operational aspects of the railway. Attendance on core course and passing the core course exam is a mandatory requirement before attendance on the supplementary course. However, unlike the core course, no exam is used. Testing the competence of investigation leaders with a written exam was not seen to be worthwhile.

The first case study is designed to provide experience of setting up an inquiry. Information is provided about a rail-

way accident involving a broken axle on a freight wagon and subsequent derailment and secondary collision. Delegates are given details of the organisations involved and written reports from direct and indirect witnesses. From this information delegates are asked to select the organisations to provide inquiry panel members and observers. Delegates then go on to decide which staff they would like to interview and to develop an interview schedule. A subsequent part provides the delegates with a technical report commissioned from an external expert and ask the delegates to review the report and to decide what to do with it (for example conduct a further investigation, commission additional studies, or write recommendations).

The second case study involves a derailment of an over-speeding freight train on a poor section of track. Initial evidence gathered suggests five possible immediate causes and the delegates are provided with a large amount of technical evidence from the various organisations. Delegates have to review the evidence and decide which possible immediate causes can be eliminated and how they would go about determining the most probable immediate cause. The case is unusual as the actual independent chairperson commissioned two different companies to model the derailment with widely different results!

The third case study provides delegates with an opportunity to practice writing plain English. While it may seem quite simple, it is in reality very difficult to explain complicated operational and technical issues, without apportioning blame and in a way that can be understood by all who might need to read and act upon the accident report.

Both the core and supplementary courses are delivered by two tutors—one from Arthur D. Little and one from industry. The Arthur D. Little tutor provides strong process knowledge, experience of accident investigation, training course delivery and facilitation skills for small and large groups, underpinned by a working knowledge of the rail industry. The industry tutor provides many years of practical rail accident investigation experience.

7. The current situation

7.1. *The courses*

Some 3 years after inception, the core course remains substantially unchanged. The materials are revised regularly (now using version 10) but the overall structure and the case study have stood the test of time well. Over 250 delegates have attended 17 courses and feedback shows the course is meeting delegate needs.

Ongoing delegate feedback, and analysis of the completed exam papers helps to identify areas for improvement.

However, the supplementary course has proved more difficult in knowing what to include and how to pitch the delivery. To date seven courses have been run with 90

delegates. Delegate feedback led to it being completely redesigned in 2002 to reflect changing needs of leaders of accident investigation teams—more focus on the potential technical challenges, practice in writing recommendations and more opportunities to share experiences. The changes made a step-change in delegate feedback.

The courses however remain a challenge to deliver effectively due to the wide number of industry parties and the continuing introduction of new people into the industry and accident investigation positions.

7.2. The future?

The future of the training is uncertain with the creation of the Rail Accident Investigation Branch currently going through the legislative process. It is believed that the existing rail industry processes will continue (this was endorsed by Lord Cullen in the part 2 inquiry into the Ladbroke Grove accident), and if there is an industry process there will continue to be a need for training in effective application of the process.