R&D programme

Research brief
D-RAIL Reducing the occurrences and impact of rail freight derailments
T974

Background

In June 2009 a freight train derailment and the subsequent explosion of LPG tanks at Viareggio, Italy, resulted in 29 fatalities. It has been estimated that freight train derailments in the EU 27 cost more than Eur200m per year, almost entirely related to infrastructure and rolling-stock damage and operational disruption impacts. In response to the issue, a consortium of 20 organisations led by the International Union of Railways (UIC) co-ordinated a package of work under the Seventh Framework Programme for research, which studied the causes of derailments (such as infrastructure and rolling stock condition, and human error), analysing derailment mechanisms. RSSB, on behalf of Network Rail and the industry’s Safety Policy Group, represented the GB rail industry in this project.

Aims

The D-RAIL project aimed to increase understanding of freight derailments to facilitate a reduction in risk. Specifically, the objective of the D-Rail project was to identify ways to reduce derailments by 8-12% and a cost reduction relating to derailments of 10-20% within Europe within the next 30 years.

Findings

One of the key conclusions of the D-Rail programme shows that more than half of all derailments (and a share of 75% of the costs) could be addressed by only three types of interventions based on existing technology: hot axle box and hot wheel detectors, axle load checkpoints,
and track geometry measurement systems. While new technologies and their application were studied, the D-Rail targets are achievable with existing technologies, if properly developed, deployed, and coordinated.

Both Swiss (SBB - Swiss Federal Railways) and GB (RSSB) safety risk assessment methods suggest that none of the three measures would normally be considered reasonably practicable for wide-scale implementation based on the as low as reasonably practicable (ALARP) principle (purely on safety terms). However, it was concluded that if a more focussed strategy for targeted implementation of the measures is considered then the safety case is improved. In particular, axle load checkpoints and track geometry measurement systems become more easily justifiable.

The ALARP conclusions of the case study risk assessments are based on average national freight derailment risk levels currently estimated for Switzerland and Great Britain. It is likely that in states, or specific locations, where risk levels are higher than these assumed averages levels, the potential for improvement in safety is likely to be higher. Implementation of proposed control measures will be more easily justified, due to the proportionally higher safety benefits which will result. This might be the case where higher derailment rates have been locally observed, or there is a higher than average density of mixed traffic, or for dangerous goods corridors where the potential consequences of a derailment are higher.

**Deliverables**

The project was undertaken over a 36 month period between 2011 and 2014. It produced a set of 25 reports, developed in collaboration by the 20 project consortium members, representing infrastructure managers, operators, industry and academia from 11 countries.

Project material covering the range of work package areas is available on the D-Rail Project website [http://www.d-rail-project.eu/](http://www.d-rail-project.eu/).
Method

The D-Rail work was managed in nine work packages.

**Work package 1**

Work package 1 (derailment impact) gathered information to gain an understanding of the root causes of freight derailments. It assessed severity and impact on railway operations, the economic implications of damage to vehicles and infrastructure, and disruption. A key contribution to this work package was data analysis based on the GB Safety Management Information System (SMIS).

Causes were ranked according to the proportion of derailments occurring within each category. This analysis produced this ranking of derailment causes for Europe:

1. Axle ruptures
2. Excessive track width
3. Wheel failure
4. Skew loading
5. Excessive track twist
6. Track height or cant failure
7. Rail failures
8. Spring and suspension failure

**Work package 2**

The second work package (freight demand and operation) investigated the potential EU27 rail freight traffic levels up to 2050, considering a range of future scenarios based on socio-economic trends.

**Work package 3**

The focus of work package 3 (derailment analysis and prevention) was to identify and evaluate, through simulation and analysis, the key contributory factors associated with derailment. This included combined causal effects for the freight vehicle and track system.
Work package 4

Work package 4 (inspection monitoring techniques) provided a detailed review and critical assessment of current inspecting and monitoring techniques relating to derailment prevention and mitigation, both on board vehicles and track side.

Work package 5

Work package 5 (integration of monitoring techniques) analysed the interactions between the technical components that form a strategic monitoring network. It also considered communications between infrastructure managers, railway undertakings, entities in charge of maintenance, and vehicle owners.

Work package 6

The objective of work package 6 (field testing and evaluation) was to validate, on physical test sites, some of the novel measuring technology being considered to provide derailment mitigation.

Work package 7

Work package 7 (operational assessment and recommendation) provided a summary of the key study findings, using reliability, availability, maintainability and safety (RAMS) analysis to identify the impact of the various potential proposed solutions on the reliability, availability and safety risk of the railway system as a whole.

Hazards relating to derailment of freight trains, particularly those affected by the proposed systems, were analysed and quantified using data from the RSSB Safety Risk Model and the SSB equivalent for Switzerland. The results of the risk assessments indicate to what extent, and in what context, the proposed systems would normally be recommended for implementation under the respective ALARP-based safety decision-making frameworks for GB and SBB.
The risk reduction systems considered were:

- Hot axle box and hot wheel detection
- Axle load checkpoints
- Track geometry measurement systems

**Work package 8**

Work package 8 (dissemination and exploitation) was responsible for dissemination of the findings and conclusions of the overall D-Rail project. This included development of the project website (http://www.d-rail-project.eu/).

**Work package 9**

Work package 9 (project co-ordination) concerned the co-ordination of the overall project by the UIC and Newrail (The Centre for Railway Research at Newcastle University).

RSSB contributed primarily to work packages 1 and 7 providing freight derailment data and analysis on behalf of the GB rail industry. We also carried out risk assessment and cost-benefit analysis, and gave support in related areas such as the applicability of Common Safety Methods for Risk Assessment and Evaluation, and interpretation of the ALARP principle within the context of the GB guidance on Taking Safe Decisions (see RSSB website for details).

**Impact and benefits**

The material and conclusions contained in the 25 project reports produced by the D-Rail Programme will be used to inform the strategy decision making processes undertaken by the European Railway Agency, which was the commissioning body for the work within the UIC.
Contact

For more information please contact:

Operations Professional Lead
Research and Development Programme
RSSB
enquirydesk@rssb.co.uk

Floor 4, The Helicon
1 South Place
London
EC2M 2RB