Human Error Quantification at RSSB

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RSSB
Overview

• Introduction to RSSB

• Context of risk quantification at RSSB - the Safety Risk Model

• Railway Action Reliability Assessment

• Case study 1 – Wrong side door release

• In the cheese shop

• Case study 2 - Axle inspection
Purpose

To support its members’ (the rail industry) to achieve their objectives of improving safety and performance and value for money across the industry, with a focus on...

- Reducing safety risk so far as is reasonably practicable
- Increasing capacity (where appropriate)
- Improving operating performance and customer satisfaction (where appropriate)
How do we support the industry?

Understanding risk

Collaborating to improve

Guiding standards

Managing research, development and innovation
The Safety Risk Model
Types of Risk Assessment

Descriptive analysis and judgements about the factors relevant to the risk

Ideal for simple, low consequence events, which are well understood. Normally achieved by gathering together experts who discuss the issue and agree sensible safety arguments and resolutions.
Numerical estimates supported by expert judgement.

<table>
<thead>
<tr>
<th>Hazardous event description</th>
<th>Frequency (Events per year)</th>
<th>Consequences (No. of FWIs per event)</th>
<th>Collective Risk (Expected FWIs per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Collision between two trains</td>
<td>1.8</td>
<td>3.32</td>
<td>5.8</td>
</tr>
<tr>
<td>2. Collision of train with object on line - no derailment</td>
<td>49.7</td>
<td>0.006</td>
<td>0.3</td>
</tr>
<tr>
<td>3. Collision between two trains in station</td>
<td>6.0</td>
<td>0.025</td>
<td>0.15</td>
</tr>
<tr>
<td>4. Collision with buffer stops</td>
<td>40.9</td>
<td>0.029</td>
<td>1.2</td>
</tr>
<tr>
<td>5. Train collision with road vehicle on level crossings</td>
<td>21.5</td>
<td>0.28</td>
<td>6.1</td>
</tr>
<tr>
<td>6. Train derailment</td>
<td>14.3</td>
<td>0.30</td>
<td>4.3</td>
</tr>
</tbody>
</table>

Total collective risk from these 6 hazardous events = 17.9
Types of Risk Assessment

- Quantitative Assessment
- Semi-Quantitative Assessment
- Qualitative Assessment

The image shows a grid with the frequency of consequences marked on it. The frequency ranges from 1 to 6, and the consequences range from 1 to 6, indicating the level of risk. The grid is color-coded to represent different levels of risk:

- Green: Low
- Yellow: Medium
- Red: High
Types of Risk Assessment

- The effort and vigour of analysis should be proportionate to the complexity and importance of the decision
- Require skilled and competent people to carry them out
- A record of the decisions and judgements made must be taken
- A degree of independent review or challenge should be included
What is the SRM?

The SRM (produced by RSSB) covers the whole operation and maintenance of the GB mainline rail network*, and considers the risk exposure of:

- Passengers
- Workforce
- Public
It contains detailed analyses of hazardous events defined as having the potential to lead to death or injury on the railway.
80,000 incidents recorded per year ranging from train collisions to coffee spills resulting in passenger burns

15,000 of them resulting in injuries
What goes into the SRM - Part 2?

The Safety Risk Model

- Train derailment
- Does it obstruct the adjacent line?
- Secondary collision with a train on an adjacent line

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
How does the SRM calculate risk?

We allocate the data into 121 hazardous events.
How does the SRM calculate risk?

We then allocate it to one of three HE subsets:

**HET** - Train accidents: eg derailment/collision

**HEM** - Movement accidents: eg boarding/alighting

**HEN** - Non-movement accidents: eg slips, trips and falls
We identify the **precursors** (or causes) for each hazardous event. There are over **2,300** in the SRM.
Some Hazardous Events can have many precursors.

How does the SRM calculate risk?
How does the SRM calculate risk?

Each precursor is given an associated **normaliser**:
How does the SRM calculate risk?

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How does the SRM calculate risk?

Safety Risk Model
• Things get done based on task contracts between managers/designers and those who get things done
• These task contracts fail due to organisational and human weaknesses
• The reliability with which task contracts can be achieved is important knowledge for safety and productivity
• This has to take account of the numerator and the denominator
• Perspectives on these task contracts will vary across the organisation where they are applied, but they remain defined, often in detail
How do we quantify task reliability?

Priority:

1. Incident data/on-train data recorders
2. Simulation
3. Ask those who carry out the task
4. Railway Action Reliability Assessment
Generic Quantification Techniques

• Identify task which requires quantification

• Compare the task with the generic tasks listed in the technique

• The generic task will have a probability

• Increase this probability based on negative performance shaping factors
Railway Action Reliability Assessment

• Developed from HEART

• Draws on experiences from NARA and CARA

• Contextualised for the rail industry, train drivers

• GTT review

• EPC review

• Manual – caveats on usage and context of usage
Project Deliverables

- Technical basis reports: Generic Task Types; Error Producing Conditions; Assessed Proportion of Affect Guidance

- Railway Action Reliability Assessment manual

- Railway Action Reliability Assessment calculation sheet
Opening train doors on the correct side

Door release

PBC

Direction switch
Opening train doors on the correct side

- Door release (left)
- Door release (right)
- DRA
Context of study – Open on the wrong side

- London Overground Rail Operations Ltd. – similar issues at other train operating companies
- Interest developed from presentation on RARA
Method

- Background review
- Safety Management Information System
  - 165 relevant incidents
  - Timetable data
- Incident investigation report review and analysis
  - 39 reports
  - Roster data
- Observations, task analysis and human error analysis
- Railway Action Reliability Assessment
- Driver and driver manager workshops
  - 4 workshops; 20 attendees
Rate of human error

- Driver opens doors 88 times per day
- Incident review:
  - Action slips in door release
  - Underlying factors – equipment design and personal factors
- 42 reported door release incidents at stations – Oct 2010-Mar 2013
- Doors were released 12,599,599 times at stations (based on timetable data)
- 1 in 299,990 times
- Human error probability $3.33 \times 10^{-6}$
- Plan to publish EHF 2015
- Helped company to evaluate the task
Study Methodology

• Research project (T744) for cross-industry wheelset management group

• Task observation

• Staff and manager interviews

• Sample of depot and overhaul sites

• Cross-industry steering group
Current task

- Task: Identify an ‘intrusive’ signal when presented on the display
- Carried out throughout a shift. Automated manual and visual activities – waiting for a ‘blip’ which means that there is a crack in the axle
  - GTT R3 ‘Simple response to a dedicated alarm and execution of actions covered in procedures’ - HEP = 0.0004 (1 in 2500)
- Signals are rare
  - EPC – Unfamiliarity – Affect = 17 times worse
- Signals are masked by noise
  - EPC - Low signal-noise ratio – Affect = 10 times worse
- Environment is challenging
  - EPC – Environment – Affect = 4.5 times worse
Figure 23 Probability of detection curve for high angle scan with 45 degree probes at different frequencies.
Conclusions

- Things get done based on task contracts between managers/designers and those who get things done.
- These task contracts fail due to organisational and human weaknesses.
- The reliability with which task contracts can be achieved is important knowledge for safety and productivity.
- This has to take account of the numerator and the denominator.
- Human performance quantification is best carried out with as full an awareness of the task contract from all perspectives, including human factors.
- The numbers can be very powerful, now or in the future.
- They may or may not form part of a larger quantified model.