Background

Human errors are a key contributor to safety risk in many, if not all, of the potential accident scenarios that can occur on the railway network. Human errors can also have a significant impact on network reliability. The ability to identify the types of human error, classify them into the correct human error categories and quantify the probability and frequency with which they occur is important to the effective management of safety and business risk.

At present there are over 70 human reliability assessment (HRA) methodologies covering a range of industries which aim to support the consideration of human error in risk assessments. Over the last 10 to 15 years there have been many examples of risk assessments carried out by RSSB, Network Rail and rail industry consultants where there has been a requirement to quantify human error probabilities. These analyses have tended to be associated with the design of new equipment, the assessment of changes to, and the analysis of, existing operational processes where potential areas of concern have been identified. There has been no agreed method for carrying out these assessments in the rail industry so it has been up to the individual analysts or project teams to decide which to use.

As part of the industry research programme it was considered that there would be significant advantages in establishing a rail-specific methodology to provide:

- A consistent approach to human error quantification across the industry.
- Easier and quicker assessment of human error through improved usability in the railway context.
- Better identification of methods for reducing the impacts of human error.
- Improved consideration of human factors in risk assessment.

To focus the first phase of the research it was decided that the initial development project would consider the development of a
methodology for train driver-related actions only. However, although the method has been developed around train driving tasks, the resultant methodology is applicable to other human actions within the rail industry such as those associated with signallers, electrical control room operators, station staff and track workers.

The method, based on consultation with stakeholders, has been designed to be used primarily by analysts within RSSB, Network Rail and consultancies contracted to passenger and freight train operating companies, etc on a variety of risk assessment projects.

Aims

The objective of the project was to produce a railway-specific human reliability assessment (HRA) tool to enable HRA to be carried out more efficiently, more accurately, and with more consistency within the rail industry. The project aims to improve the quality and efficiency of the quantification of error for existing and future system risk assessments. This will assist in the predictive assessment of risk, with subsequent support to industry safety and potentially productivity.

Findings

The research has produced the Railway Action Reliability Assessment technique. The technique has been developed using information from an existing human error quantification approach, the Human Error Assessment and Reduction Technique (HEART) (Williams, 1992).

Guidance has been produced with support from operations specialists which relates Railway Action Reliability Assessment to the train driving context. The technique has also included a review against train driver tasks with the aim of ensuring coverage of the key driver tasks. Reviews against models of human performance have also been undertaken to ensure that key elements of human performance are covered.

The Railway Action Reliability Assessment manual presents the full methodology and places the technique within the context of human reliability assessment. This is required because application of Railway Action Reliability Assessment is only one part of the human reliability assessment process. The manual also provides hints, tips and examples to support use of the technique and a calculation sheet has been produced which will improve the reliability and consistency of resultant assessments. Both the Railway Action Reliability Assessment manual and
calculation sheet have been through user reviews with risk and human factors specialists from Network Rail, RSSB, ORR and London Underground.

**Deliverables**

From this research, RSSB is making the Railway Action Reliability Assessment manual and calculation sheet available to its members. The key users of the tools have been identified by stakeholders to be human factors and risk assessment specialists working in the industry. They will use Railway Action Reliability Assessment to improve the consideration of human error within risk assessments. It should also make these assessments quicker and more consistent. Awareness of the technique will also be of relevance to those responsible for managing or procuring risk assessment services.

Training workshops will be undertaken in Railway Action Reliability Assessment for RSSB members by RSSB specialists as and when required.

**Method**

Railway Action Reliability Assessment is consistent with elements of the HEART approach and will be familiar to previous users of HEART. This includes use of the calculation method and use of the terms Generic Task Type, Error Producing Condition, Maximum Affect and Assessed Proportion of Affect. In common with many other HRA approaches, the key steps used to estimate human error probabilities are:

1. An estimate is made for the base human error probability (HEP), referred to as the generic task type (GTT).
2. A set of performance shaping factors, termed error producing conditions (EPCs), are identified that affect that task.
3. The significance of each EPC (i.e., the size of its effect) is assessed for the task. This is termed the Assessed Proportion of Affect (APOA). The assessed effects of these PSFs are used to modify the base HEP for that task.

The project has been undertaken by RSSB human factors and risk specialists with support from operations specialists. Project stakeholders have been from Network Rail, ATOC, ORR and London Underground. The two most important steps in the project have been GTT and EPC development. The GTT review process has included:
1 Review of HEART GTTs and supporting descriptions from the HEART author to understand the GTTs as fully as possible.

2 Mapping the GTTs to the Rasmussen step-ladder model of human performance.

3 Mapping the GTTs to a train driver task inventory, to articulate their meaning and scope, in the context of train driving activities. The study has been based on a review of the GTTs against a task inventory developed at RSSB. This task inventory has been reviewed by railway operations specialists from the GB rail industry who have train driving experience.

4 Identification of additional GTTs which could support human error quantification. This has been through the identification of any parts of the step ladder model which are not well covered by the HEART GTTs, and identification of tasks in the task inventory which are not well covered by the HEART GTTs.

5 For any additional GTTs identified in (4), identify if data are available to quantify the new GTTs.

6 Removal of original GTTs based on newer data being available to replace them, or if the original GTTs are not well matched to the driver task inventory.

The key output is a revised GTT set, which has been mapped to the driver task inventory and model of human performance.

The process for the EPC review has been:

1 Grouping the HEART EPCs into a set of key areas impacting human performance (e.g. task design, environment, competence management, procedures). This has been with the aim of simplifying the EPC review process for users, supporting EPC definition and identification of potential overlaps.

2 Review of HEART EPCs against other EPC type sets to identify gaps and the level of support for HEART EPCs across other human reliability assessment techniques.

3 Some possible additional EPCs were identified as part of this process. A number of HEART EPCs are also proposed for removal.

4 To support user understanding of the meaning of EPCs, the following types of guidance have been developed:
   a Definition statements, collection of practical examples from operations specialists and guidance on the overlaps between EPCs.
Next Steps

The Railway Action Reliability Assessment method is now available for use by industry for the quantification of human error probabilities as part of risk assessments. Further research projects in this area are not currently anticipated.

Contact

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