

## Review of human factors risk in rail vehicle maintenance and inspection

### Overview

Can we be sure that our maintenance teams are working at their best/using best practice? Anecdotal evidence suggests that rail vehicle maintenance has received less human factors (HF) input in comparison with other sectors (aviation) or other areas of rail safety. It was also believed that although HF is tackled informally there is less evidence of a formal process for applying HF good practice. RSSB commissioned Greenstreet Berman to examine HF issues relating to rail vehicle maintenance and inspection and produce practical, effective, human factors guidance.

### Aims

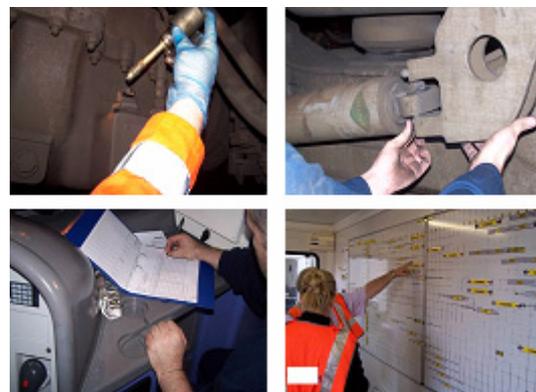
The objective of the guidance is to help those responsible for managing rail vehicle maintenance to:

- Identify human factors issues at their depot (both proactively and reactively)
- Understand the underlying causes of these issues
- Develop practical solutions to address human factors issues

### Aims

Maintenance and inspection procedures are largely dependant on humans, and

maintenance tasks provide considerable opportunity for human error to occur.



No one intends for errors to happen, but psychology tells us that, by our nature, humans are prone to error, and it is inevitable that mistakes will be made from time to time.

Rail vehicle maintenance and inspection is still very reliant on people to carry out the work. If these errors are not controlled they can lead to the occurrence of serious incidents:

#### Incident:

Train lost its pantograph.

#### Costs:

Overheads lines down on the up line  
Pantograph broken beyond repair

Passengers injured due to broken windows

#### **Immediate cause:**

A defective pantograph moving in an abnormal manner became entangled with the overhead wires, pulling them down.

#### **Underlying cause:**

Bolts missing when train left the Depot. The underlying cause was attributed to the pantograph maintenance and inspection regime which failed to give clear detailed instructions for checking the security of the bolts.

Performance of maintenance tasks is heavily influenced by the design of the task and by wider organisational issues. Many incidents associated with maintenance error are a product of the work system.

These errors can be addressed by giving consideration to human factors and by seeking to make improvements to different areas of work, for example:

- Task design
- Work planning
- Training and competence
- Organisational and safety culture
- Quality and procedures
- Fitness to work
- Environment issues
- Provision of tools and equipment
- Housekeeping
- Maintenance error reporting and monitoring
- Communication

### **Methodology**

Importantly, the work undertaken was conducted in close collaboration with a steering group representing the interests of the rail industry.

A number of key activities were undertaken to develop the guidance, for example:

- Identification of good practices using interviews and observations of work using contacts within the rail industry
- Development of an HF framework to bring together HF good practice under a series of generic headings
- Development of the evidence base for HF issues impacting on maintenance performance and their potential costs if these issues are left unaddressed (collection and analysis of both national and depot data)
- Development of the structure and content of the guidance package
- Case studies (using a paper version of the guidance).

### **The guidance**

The guidance package is aimed at anyone who has responsibility for managing maintenance operations and/or improving maintenance performance within rail vehicle maintenance depots.

It is designed to help address the HF issues that can lead to increased occurrence of human error and poor maintenance performance.

The guidance provides a systematic approach that seeks to apply HF knowledge at three clearly defined stages.

#### **Step 1 - Identifying Issues**

This section provides advice and practical tools to help identify HF issues both proactively and through the analysis of incident and accident trends.

#### **Step 2 - Decision Making Aid**

This section helps explore possible identified issues in more detail by providing a set of interview questions and advice on conducting workshops. It helps to validate and classify a problem as a particular HF issue.

### Step 3 - Selecting Solutions

This section shows how to assess the cost/benefit of different interventions. It also provides advice on how to use workshops and the database of good practice to select appropriate and effective HF solutions.

If HF is not applied in this way and at each of these stages, it is less likely that planned intervention (to address an issue affecting maintenance performance, error, or rule violation) will be successful.

### Findings

A number of tools are provided in the guidance to help apply the recommended systematic approach:

**Event Classification System** - helps to create a more thorough approach to consider and record the part played by HF in incidents and accidents.

**Maintenance Personnel Questionnaire** - provides a method to seek maintainers' views on the issues that might impact on their performance and also how their work might be improved.

**Decision Making Aid Questions** - interview questions to help define problems that have emerged from earlier phases.

**Workshop templates** - help bring a cross-section of maintenance personnel together to discuss HF issues and potential solutions.

**HF framework** - helps to link HF issues to potential solutions.

**HF Good practice** - archive of HF good practice to help identify possible solutions to HF issues.

### Presentation of the guidance

In order to make the guidance package accessible to those responsible for managing maintenance operations, and to ensure that it is easy to navigate and

find information of interest, it was developed as an electronic application available on the RSSB website. There are a number of benefits associated with providing the guidance package as an electronic application, for example:

- Information is easily updated
- Direct links are provided to relevant websites
- The tools provided can be printed out and kept

### Case studies

To help validate and improve the guidance package it was piloted at four different maintenance depots around the country

Details of two case studies are provided below:

#### Case study 1

##### Introduction

The case study visit explored procedures, documentation, and reporting work arising. Maintenance staff, team leaders, and managers were involved in interviews and workshops using the process and tools in the guidance package. This resulted in:

- A greater understanding of the human factors issues associated with work procedures and documentation
- Recommendations and solutions to address issues

##### Recommendations included:

- Review of systems, such as admin support, to reduce team leader workload
- A review of documentation that supports maintenance work (e.g. re-design default recording sheets so they are fit for purpose - e.g. delete obsolete columns to provide more space for detailing the nature of the defect)

- A review of process for reporting and recording defects - looking at the best way to report, and formalising a single procedure for reporting
- Review and update of cataloguing process to support maintainers

#### **The benefits of applying the guidance:**

- Helped to demonstrate the benefits of exploring issues and developing practical solutions in a workshop environment
- It was able to uncover the true underlying reasons for maintainer behaviour

#### **Case study 2**

An initial visit revealed tools and equipment to be an issue - this was identified through responses from the proactive technicians' questionnaire and confirmed by consultation with staff.

Numerous interventions were introduced as a result of the visit and a subsequent audit, including:

- Equipment requiring calibration stored together in designated locations
- Calibrated equipment labelled with last calibration date
- Record kept each time calibrated equipment used
- New equipment storage facility introduced
- Tool request form revised
- New shadow boards
- Stores manager conducts depot tours

The technicians' questionnaire was re-administered and the results indicated improvements in staff perception of tools and equipment issues.

The benefits of applying the guidance:

- Proactively identified a human factors issue which management were unaware of

- Provided a measure of improvement relating to this issue
- Provided the impetus for further investigation into the issue of tools and equipment use.

#### **Next Steps**

The guidance package is available on the RSSB website at:

<http://www.rssb.co.uk/pdf/research-toolkits/T399/index.html>

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