Overview

The rail industry faces a time of challenge and opportunity following the publication of the study ‘Realising the Potential of GB Rail’¹ in May 2011. Following that study there is a renewed focus on delivering a more effective and efficient railway, with closer alignment of train operation and infrastructure. The study identified the importance of improved asset condition information to support informed asset management decisions and deliver improved levels of service. The industry is already trying to move from an ‘observe and react’ approach to failures to a more proactive ‘predict and prevent’ approach.

Currently a range of track side and train borne condition monitoring systems are used to measure various rolling stock and infrastructure component conditions. These systems mainly inform on a ‘fault’ condition and provide a ‘go/no go’ indicator. They do not generally provide an indication that the component is deteriorating towards its fault condition. Identified faults require immediate attention, with associated disruption to operation and/or maintenance schedules.

Condition monitoring forms part of the overall management and control of the in-service risk to the network from particular hazards, such as the failure of an axle journal bearing. These failures can have a significant impact on service and safety performance. Remote condition monitoring can require a significant investment in terms of initial cost and on-going maintenance. The overall costs and benefits for these systems are not well understood which has made it difficult to prove the business case for their further use.

On behalf of the Cross-Industry Remote Condition Monitoring Strategy Group (XIRCMSG), a sub-group of the Vehicle/Vehicle System Interface Committee (V/V SIC), this research project has reviewed selected remote condition monitoring (RCM). The main objective of this research is to assist business case development in this area.

This research has shown that there is a business case for exploiting RCM technology in all the areas specified for review as part of this project. Use of RCM can reduce service risks and help to improve the efficiency of maintenance regimes. The strongest business cases arise where existing RCM systems can be further exploited, or where sufficient information can be gained from a small number of RCM installations. Benefits can be gained by automating data processing and integrating condition information with asset maintenance planning tools.

It is considered that to maximise the potential benefits associated with RCM, cross-industry leadership will be required otherwise the existing fragmented approach to the implementation and use of RCM systems is likely to continue.

Aims

This research project aimed to provide a comprehensive review of the identified condition monitoring areas and carry out business case analysis for developments in these areas; with the objective of assisting the industry to make informed operational and development decisions for current and future RCM systems. This included improving existing systems, developing strategies and procedures and/or deploying new technology, strategies and procedures.

Method

Each of the selected RCM areas was reviewed as a specific package of work. The work consisted of a series of stakeholder interviews alongside desktop research to establish the current industry approach and potential future technologies, including the strengths, weaknesses, opportunities and threats. The stages required to further implement existing and future technologies were also identified.

In parallel, data collection and analysis was undertaken to populate the decision support toolkit provided in work package T857-06: Overview of the benefits and risks associated with condition monitoring. Initial analysis was carried out to identify the key parameters driving the business case for the implementation options, so that these could be reviewed and revised with stakeholders to improve the robustness of the business cases.
A key assumption adopted throughout the study was that automatic vehicle identification (AVI) was available for all RCM systems to use at no additional cost and that any data required on other relevant assets was available to be 'bought' and integrated from other systems.

**Deliverables**

For each of the six selected RCM areas reviewed, a report has been produced presenting the research findings. Each report provides an assessment of the current industry approach of monitoring in the selected area, and identifies opportunities relating to the further implementation of current and future systems. The systems that are used to monitor the selected areas have been assessed qualitatively in terms of their relative strengths and weaknesses, and the opportunities and threats...
associated with their implementation. The stages required to further implement these technologies in the future are then discussed alongside a quantitative assessment of their costs and benefits.

The six RCM areas reviewed in this research are:

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<tr>
<th>WP ID</th>
<th>RCM area (work package title)</th>
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<tbody>
<tr>
<td>T857-01</td>
<td>Monitoring of axle journal bearings using trackside systems</td>
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<tr>
<td>T857-02</td>
<td>Monitoring of wheel impact loads</td>
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<td>T857-03</td>
<td>Monitoring of pantograph integrity</td>
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<td>T857-04</td>
<td>Monitoring of overhead line integrity</td>
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<td>T857-05</td>
<td>Ride monitoring</td>
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<tr>
<td>T857-07</td>
<td>Monitoring of the DC third rail interface - geometries and power supply</td>
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The output of work package T857-06 is documented in the report: *Overview of the benefits and risks associated with condition monitoring*.

A toolkit for evaluating the costs and benefits of RCM systems to inform industry-wide RCM decisions has also been developed. This toolkit is available for industry to use when assessing the business case of other RCM developments. A toolkit user guide is also provided.

**Findings**

The findings demonstrate a business case for exploiting RCM technology in all the areas specified for review as part of this research project. RCM can reduce service risks and help to improve the efficiency of maintenance regimes. The strongest business cases arise where existing RCM systems can be further exploited, or where sufficient information can be gained from a small number of RCM system installations. Benefits can be gained by developing the systems and tools for automating data processing and integrating condition information with asset maintenance planning tools.

The greatest benefits can be gained from RCM systems when the measured data is used in a decision support tool and integrated with other asset information. In the past, some RCM systems have been used as methods for failure detection rather than methods for monitoring component condition, to plan proactive
maintenance. It has been difficult to gain investment for more advanced RCM systems as the benefits are not well understood.

It is considered that to maximise the potential benefits associated with cross-industry RCM will require cross-industry leadership; otherwise the existing fragmented approach to the implementation and use of cross-industry RCM systems is likely to continue.

Next Steps

The XIRCMSG will take forward the following recommendations to progress the thinking, development and/or communication of:

1. The XIRCMSG along with the wider rail industry will review the outputs from this initial study to determine if the resulting business cases for the RCM system specified are strong enough to warrant further investigation of the use of those systems.

2. If further investigation of any specific RCM systems is deemed necessary, the business cases should be reviewed in more detail, focusing on the benefits that can be achieved through improved maintenance planning based on the outputs of the RCM system under consideration. The business case analysis for those specific RCM systems should be refined by:
   a. Applying failure mode, effects and criticality analysis to (FMECA) to identify the key functional failures and consequences for critical assets.
   b. Defining the routine asset management processes that could be rescheduled, reduced or eliminated if the identified condition data was available.

3. The necessary data requirements should drive the specification for RCM system development. These systems specifications should be functional and not overly prescriptive.

4. Suppliers of RCM equipment should be engaged early in the specification and development process to encourage innovation.

In addition, in order to support the above the XIRCMSG will consider:

5. Provision of frameworks for capturing cost and failure information against the identified failure modes to build industry-wide models of degradation.
6 Working with stakeholders (including Network Rail, RCM Suppliers, ATOC, and the Rail Freight Group) to review existing cost assumptions in key business cases for specific applications. These should draw on a sufficiently representative sample to preserve confidentiality and improve robustness of the business cases.

The XIRCMSG will commission work to develop the RCM toolkit further to draw out a detailed benefit assessment.

Contact

For more information please contact:

Head of Engineering Research
R&D Programme
RSSB
enquirydesk@rssb.co.uk