TRAINSAFE
SAFE INFRASTRUCTURE
WORKSHOP

DEMONSTRATION OF THE RESEARCH CLUSTER MECHANISM FOR "CONDITION MONITORING"

STAGE 1

ISSUE HIGHLIGHTED IN THE STATE OF THE ART REPORT

This resulted in the topic of ‘Condition Monitoring’ forming part of the agenda for the ‘Safe Infrastructure’ workshop.

The following is the relevant extract from the State of the Art Report

4.1.1. The Role of Safe Infrastructure

From a safety perspective, the purpose of the railway infrastructure is:

- To provide a safe mechanism of guidance for rail vehicles.
- To provide a safe signalling system.
- To provide for the safe integration of transport systems.

As the primary focus of TRAINSAFE is passive technologies, this chapter will concentrate on the civil infrastructure aspects of the first and third points, i.e. track, bridges, level crossings, and line side installations.

4.1.2. The Influence of Infrastructure on Railway Safety

A UK-based study2 by the Rail Safety and Standards Board evaluated the risk associated with the occurrence of a series of hazardous events. The risk for a given event was calculated as the product of its estimated frequency (events per year) and the severity of the consequences (fatalities per event). A fault tree analysis was used to model each hazardous event. Table 4.1 presents the results of this analysis in terms of the accidents involving trains. The role of infrastructure is clearly demonstrated, with four of the six most risky train-related events involving aspects of infrastructure (level crossings, derailments, buffer stops).

Hazardous Event	Risk (Equivalent Fatalities per Year)
Passenger train collision with a road vehicle on a level crossing	6.2
Collision between two passenger trains (other than at a platform)	5.8
Derailment of a passenger train	4.3
Derailment of a non-passenger train	3.0
Collision between a passenger train and a non-passenger train	1.2
Collision with buffer stops	1.2

Table 4.1 - Risk profile for all UK rail accidents involving trains with equivalent fatalities per year > 1 (from Muttram[2])

STAGE 2

DISCUSSION PRESENTATION FROM CONDITION MONITORING EXPERTS

A brief five minute presentation to introduce the topic to the workshop delegates. This defined the topic scope and highlighted the key specific issues to be addressed.

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Introduction to Theme 3
>> Track Condition Monitoring <<

- Parameters which require monitoring
- Current Vehicle or Track based Monitoring Systems
- Developments in Sensor and Measurement technologies

Situation

Condition monitoring is an established but growing field. The driving force for adoption in the rail industry is the need for predictive and planned maintenance to ensure the highest track availability. Yet full use is not always made of the available data, methods for measurement of some key parameters are not sufficiently developed and new sensing & measuring technologies might be able to aquire better data more efficiently.

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Integrated Rail Condition Monitoring System

Overview

- Theoretical computer generated rail models aimed primarily at improving track and vehicle design
- Various monitoring systems have been developed for assessing specific operating characteristics, eg effect of wheel defects on rail loading
- Currently no integrated system available for linking all operating variables to rate of track degradation
- Such a system would enable informed decisions to be made on operational, maintenance and renewals policies, which in turn would lead to reduced through life costs

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Integrated Rail Condition Monitoring System

1) Operational Variables
   - Tonnages, line speeds, vehicle characteristics, etc

2) Track Reactions
   - Rail loading, ballast loading, track displacement, etc

3) Degenerative Effects
   - Ballast settlement, geometry defects, rail wear, crack development, component failure , etc

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New Technology Example - Fibre Optics, A Multifunctional Rail Sensing System

Applications

- **Wheel Impact Load Detection**
  - **Wheel Flat Detection**
  - **Weigh-in-motion**
- **Track Condition Monitoring**
  - **Rail Breaks**
  - **Track Buckling**
- **Rolling Contact Fatigue Measurements**
- **Signalling**
  - **Train Detection**
  - **Speed Measurements**
  - **Automated unattended crossing warnings**

Limited use currently made of fibre optics for rail temperature sensing and points force measurements

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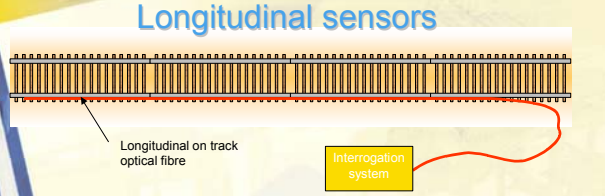
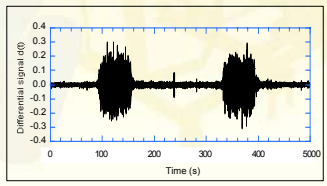
Longitudinal sensors



- Single fibre attached to web of rail
- Track detection achieved via distributed sensing techniques
- Range of 10's of kilometres possible with several metre resolution



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STAGE 3

RESULTS OF FACILITATED DISCUSSION AT THE SAFE INFRASTRUCTURE WORKSHOP

The output from a two hour session, which was then presented to the other workshop delegates for comment.

Condition Monitoring

Safe Infrastructure Workshop
29th – 30th October 2003
Leamington Spa, UK

1. What are the critical passive safety issues relating to the topic?

1. Need for consistent Condition Monitoring and maintenance regimes
2. Linking real field data with research/models to predict failures
3. Installation of track trials in different EU countries
4. What are we measuring and what needs to be monitored?
5. Lack of Condition Monitoring tools
6. Measurement of degradation
7. Prioritise areas for measurement
8. Key parameters same as other issues in safe infrastructure
9. New track vs old track
10. Condition Monitoring using new technology could help
11. Differing conditions across EU – need for consistency
12. Crack growth and wear difficult to measure
13. Feedback from Condition Monitoring leads to continuous improvement

Current Work

- UK, Italy and US have trains
- Level crossing and point machines – remote monitoring
- Step change from just collecting data to analysing and reporting automatically
- Strain gauged tracks at HABD sites to monitor vehicle condition in Australia
- Early work in object recommendations

2. What are the issues relating to standards?

1. There are no specific Condition Monitoring Standards
2. Do we need them? Yes
3. Requirement to run a Condition Monitoring/Track Condition Train

3. What are the overall recommendations (solutions) for addressing the critical passive safety issues identified in slide 1?

1. Harmonisation of what is measured across EU – standardisation and how transmitted – same interfaces
2. Measure adhesion to give warning to train on a continuous basis
3. Role of Condition Monitoring as party of whole system performance improvement
4. To monitor change in signature
5. Identification of trends
6. Understanding what makes a good length of track good

4. What are the business benefits of the proposed recommendations?

1. Knowledge has been lost due to the change from manual monitoring regimes which puts the infrastructure at risk
2. Need to have a better understanding of the business case for Condition Monitoring

5. What are the priorities for future research activity?

1. Application of steel industry (and other industries) knowledge CM processes to rail infrastructure (cost, savings, productivity)
2. Improvement in Asset Management
3. Asset/operation Monitoring
4. Status v/s condition
5. Use of case studies
6. Develop process/tool to measure degradation
7. Condition Monitoring has to be improved
8. Huge opportunity to improve with many implications
9. Application of Condition Monitoring techniques at an early stage and requires further development
10. Difficult to know where to start need to undertake strategic review