Research into obstacle detection at level crossings (T522)

Background
In November 2004 a train collided with a stationary vehicle at Ufton automatic half-barrier (AHB) level crossing, causing the train to derail leading to six fatalities on the train, including the train driver. The Formal Inquiry into the accident made a number of recommendations, one of which called for research into whether or not a practical system could be developed to detect and warn drivers of an obstruction at AHBs in Great Britain. The Rail Safety and Standards Board (RSSB) therefore commissioned Arthur D Little to research obstacle detection, widening the scope to include both AHB and manually controlled barrier crossings with closed-circuit television (MCB CCTV).

What is obstacle detection?
A key step in the research was to describe carefully what is meant by obstacle detection at level crossings, and what an ideal system would aim to achieve. It would:

- Improve safety at level crossings for all users (road and rail)
- Cause minimal train operational or road traffic delays
- Be affordable in terms of costs to install, operate and maintain
- Be practical to use and maintain

In seeking solutions that could deliver overall benefits to the railway, all of these requirements needed to be considered, although any solution would have to make compromises and strike a balance between these.

A key point is that obstacle detection is more than just the equipment that detects an object on the level crossing; it will typically include equipment in other locations and the human element. An effective system needs to:

- **Detect** the object reliably and with high integrity
- **Communicate**
- **Respond** to this quickly and reliably in order to prevent a collision with the approaching train

This study has shown that it is the communication and response of the detection that is the most challenging (and potentially the most costly) part of the system as a whole.

Aims of the research
The aims of the study were to:

- Identify the current risk and estimate the safety benefits of obstacle detection at level crossings in Great Britain
- Identify possible obstacle detection solutions
- Evaluate potential obstacle detection solutions
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How was the research undertaken?
A review of historical accident data for both AHBs and MCB CCTVs was carried out to establish a theoretical base case risk that could be mitigated by obstacle detection. This gave the approximate maximum safety benefit that could be achieved with an ‘ideal’ system that was fitted at all crossings, mitigating hazards associated with vehicles zig-zagging around barriers, vehicles stationary on the crossing and cars queuing on the crossing (blocking back) etc.

Potential obstacle detection solutions were identified from interviews with suppliers of obstacle detection systems or components, and interviews with representatives from rail administrations with experience of obstacle detection. The potential solutions were initially analysed (with stakeholder input) with respect to safety, costs, human factors, operations and practicalities. These solutions were screened to identify six potential options for further detailed evaluation. The results of the analyses were also used to develop a basic specification for a full-barrier crossing with obstacle detection.

Research findings
The research produced a number of detailed findings with the seven key findings given below:

- Analysis shows that applying obstacle detection at AHBs (without providing full-barriers) is potentially highly problematic, or at best would give very small safety benefits. The main difficulties are the short time available to provide a warning to the approaching train, and the fact that without full-barriers, users may enter on to the crossing and cause significant disruption to rail services, even if there is no safety incident.
- It is possible that obstacle detection applied to AHBs without upgrading to full-barriers could result in an increased overall safety risk due to unnecessary heavy braking incidents (caused by users being detected after entering onto the crossing once it has been activated).
- Using obstacle detection to upgrade existing AHBs to full-barrier automatic crossings (a new type - ‘AFBs’) has been assessed as offering the greatest potential safety benefits, although it would also be the most costly.
- Application of obstacle detection at MCB CCTV level crossings has the potential to reduce risk but not eliminate it, since some of the causes of accidents could not be prevented.
- An assessment of potential costs and safety benefits shows that no options would provide safety benefits that are greater than the costs of fitment at all AHBs or MCB CCTVs. This means that using obstacle detection to upgrade level crossings to improve safety could only be supported at the highest risk locations, or where a broader business case could be developed, possibly at the time the crossing equipment is due for renewal.
- There have been a number of successful applications of obstacle detection at level crossings in other countries. All of these have either been at full-barrier crossings, or have enabled the use of full-barriers by upgrading from half-barriers.
- The greatest technical challenges in successfully developing obstacle detection systems are likely to relate not to the obstacle detector itself, but rather in providing an effective means of
communication and response to prevent an accident.

Next steps
This research has led to the identification of two activities that should be considered for taking forward by the rail industry:

- Development of the specification provided in the report for obstacle detection primarily as a means of providing automatic full-barrier crossings (either as upgrades from existing AHBs, or as replacements for existing MCB CCTVs).
- Development of trackside indicators, as a lower cost alternative to using traditional railway signalling, in conjunction with automatic full-barrier crossings. This will need to carefully consider human factors issues and any possible safety disadvantages over traditional railway signalling. This could usefully tie in with any other programmes of work looking into developing lower cost level crossings, such as use of predictor technology to remove the requirement for interface with the existing signalling system.

Network Rail is actively assessing what trials need to be carried out on its system in order to gain confidence in one or more solutions involving obstacle detection. It is also actively developing the concept of an ‘AFB’ – an automatic full barrier crossing with integral obstacle detection.

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