Risks associated with Hi-Rail vehicles on the rail network

Kirsty Baxter

Manager, Compliance Strategy & Planning

Overview

- Over the last 5 years, there have been an increased number of uncontrolled movements of road-rail vehicles (RRV), track machines and/or Hi-Rails resulting in collisions with trains, road vehicles, people and infrastructure, some catastrophic.

- Has led to an increase in safety alerts from industry and regulators relating to this issue.

- These activities are important, however, it would appear there are still insufficient controls in place to manage risks to safety, specifically relating to uncontrolled movements of Hi-rails

Notable incidents

- Incidents both in Australia and in the United Kingdom involving hydraulic & friction driven Hi-railed equipment have resulted in a number of equipment runaways and serious personal injuries.
- These have included:
  - An incident involving a Hi-Rail Vehicle VT5101 (Electrical Networks EWP) began to roll freely along the down track and broke several droppers as a result.
  - An incident involving a friction drive RRV operating at Mount Kuring-gai on the RailCorp Network (NSW).
  - An incident resulting in a fatality between a track worker and Hi-Rail vehicle in Perth December 31st 2011 where it is alleged the vehicles brakes failed as it was being taken off the tracks.

Safety Alerts

- **Railcorp** – 21 February 2012 - Safety Alert – Road Rail Vehicle Runaway Conditions When Raising and Lowering on Rail.
- **Railcorp** – 27 February 2012 – Road-Rail/Hi-Rail Vehicle runaway issues.
- **Railcorp** – 5 March 2012 - Safety Alert - Road Rail Vehicles Utilising Friction Drive Runaway Potentials – Suspended from Operation.
- **ARTC** – March 2012 - Friction Drive Hi-Rail Equipment.
- **ITSR** - 22 March 2012 - Effective operation and management of Hi-Rail equipment.
- **TSV** – 19 October 2012 – Risks Associated with Hi-rail operations

Background information on Hi-rails

The majority of Hi-Rail vehicles can we broken down into three major categories. They are, according to UK classifications, self-powered, high-ride or low-ride.

- 1. 9A – Self powered – braking and traction forces are directly transmitted to the rail wheels. See Figure 1 below.

Background information on Hi-rails cont.

- 2. 9B – High ride – braking and traction forces are transmitted indirectly from the road wheels to either directly onto the rail wheels or through a drum that's fixed onto the rail wheels. The braking forces in this case come from the friction between the rubber tyre and rail wheel interface. See figures 2 and 3 for examples.

Figure 2: High ride Hi-Rail vehicle with friction drive directly on rail wheels

Figure 3: High ride Hi-Rail vehicle with friction drive directly on friction hub or drums fixed to rail wheels

Background information on Hi-rails cont.

- 3. 9C – Low ride – braking and traction forces directly transmitted to the road wheels through the interface between either the ballast or rail head and the rubber tyres. Furthermore, the load is shared between the road and rail wheels. See figure 4 below for example.

Background information on Hi-rails cont.

- Although all three Hi-rail configurations are at risk of runaways, examination of incident data and a detailed risk assessment from UK's Network Rail, determined that type 9B (high-ride) Hi-Rail vehicles posed the highest risk in terms of runaways.

- All three configurations share common runaway risks such forgetting the handbrake, errors of judgment and poor maintenance. However, type 9B Hi-rails have additional risks not shared by the other two configurations.

Analysis of the problem

- On review of various investigation reports , the biggest proportion of previous runaways has arisen during the on- or off tracking process where the operator placed the Hi-rail, with no brakes fitted to the rail wheels, into a free wheel, unbraked, condition.

- An engineering means to prevent this occurring is progressively being fitted on some Hi-rails both in the UK and Australia. In the meantime, the prevention of a freewheel condition occurring depends on the operator correctly following the on/off-tracking

- Other runaways have occurred during braking where the rails were wet and/or contaminated and gradient has also been a factor in other incidents.

CFF of RAIB report - **Runaway type**

- Twelve of the 18 runaways resulted from uncontrolled movement occurring from rest, usually during the on or off-tracking process.

- The remaining six incidents involved the vehicle not being able to stop in time, often due the conditions of the track and site (e.g. gradient and rail contamination), travelling at excessive speed, as well as a combination of both.

CFF of RAIB report: **Individual and team actions**

- The vast majority of the incidents (16) involved some kind of human error while operating the road-rail vehicle, such as the operator:
  - putting the vehicle in an unbraked condition; or
  - adopting an inappropriate technique when operating the vehicle.

- Some errors (2) occurred during preparation, such as:
  - the conditions of the track/site were not taking into account into the risk assessment; and
  - poor choice of on-off tracking location

- A few (4) errors also occurred due to a lack of communication between the operator and other track maintenance personnel (i.e. not communicating safety-critical information). There was one potential violation identified where the operator was using the vehicle in a manner contrary to procedures.

CFF of RAIB report: **Technical failures**

- Out of the 18 incidents, only three incidents were found to result from technical failure. These were due to:
  - inadequate maintenance of the vehicle (i.e. tyre pressure not maintained);
  - the design of the park brake (which was unable to be applied due to uncoupling of the hydraulic brake and oil being trapped in the system); and
  - sub-optimal load sharing between the road wheels and the rail wheels of the vehicle.
- Lack of functionality of the road-rail vehicle and equipment was found to contribute to two incidents.

CFF of RAIB report: **Local conditions**

- The track/site conditions (i.e. physical environment) were found to contribute to the majority of incidents.
  - Steep gradients contributed to 8 of the 18 incidents, which included runaways from rest as well as not being able to stop in time.
  - On three occasions, the contamination of the rail head (i.e. due to wet, ice, debris) also made it more difficult for the vehicles to stop in time.
  - On a few occasions, both gradient and rail head contamination were present

CFF of RAIB report: **Local conditions cont.**

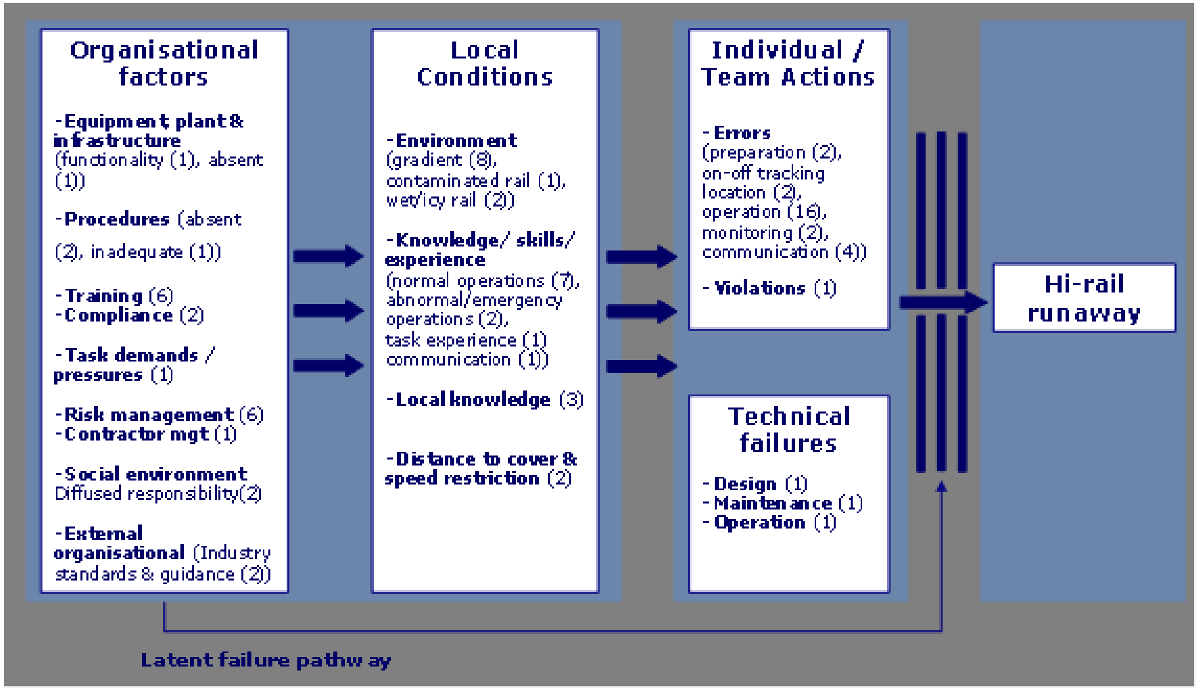
- There were also deficiencies in the knowledge, skills and competencies of operators, site managers, and other track maintenance personnel. On some occasions, it was found that the operator did not have the necessary:
  - knowledge, skills and competencies to operate the particular type of road-rail vehicle for normal operations (7 occasions);
  - knowledge, skills and competencies to operate the particular type of road-rail vehicle for abnormal operations (2 occasions), e.g., lack of knowledge about what pressing the emergency button would do when vehicle is already out of control;
  - task experience;
  - communication skills (i.e. poor English skills); and
  - local knowledge about the section of the track or network (3 occasions involving the operator and other personnel).

CFF of RAIB report: **Organisational factors**

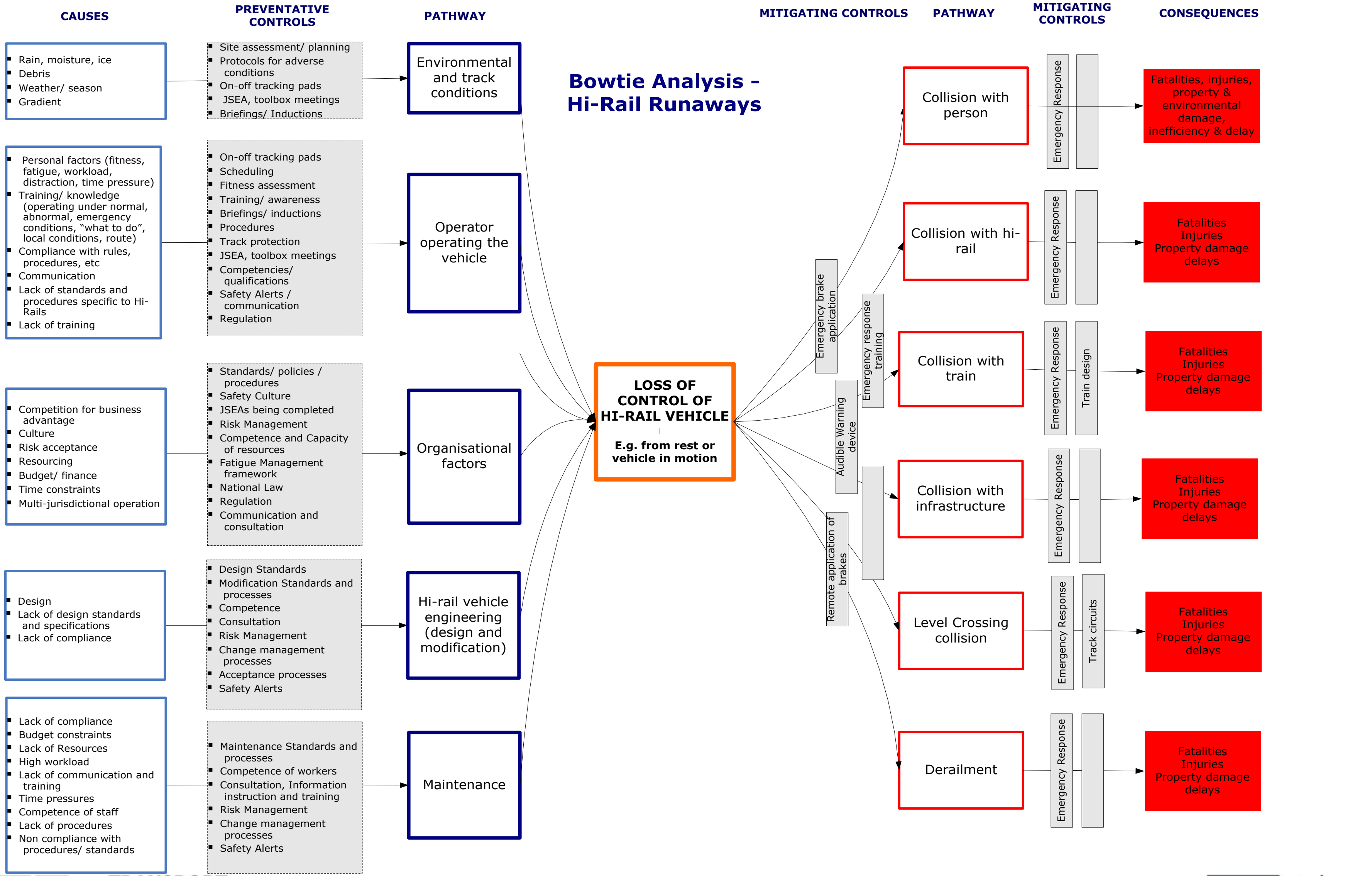
- Numerous organisational factors were found to contribute in some way to the runaways. These included:
  - absent or inadequate procedures (2 occasions);
  - deficiencies in training for both operating the vehicles and the management of the worksite (6);
  - non-compliance with policies and procedures (2);
  - considerable task demands and workload (1);
  - time pressures (1);
  - general risk management (during planning, operations, people supervision/oversight, etc) (6);
  - contract management (1);
  - social environment, particularly diffusion of responsibility to carry out some safety-critical tasks (2); and
  - lack of industry guidance and standards specific to the acceptance, operation, and maintenance of road-rail vehicles (2).

CFF of RAIB report:

- Diagram below provides an overview of the abovementioned contributing factors based on the CFF (based on Reason's (1997) Model of Organisational Accidents).
- Contributing factors are grouped into individual/team actions, technical failures, local conditions, and organisational factors



Bow-tie analysis



Summary to date in Australia

- To date, we know that since our initial questions/enquiries to industry:
  - A number of Hi-rail operators are reviewing internal processes
  - AROs and contractors have issued safety alerts/bulletins
  - Regulators have issued further safety alerts
  - Hi-rail contractors have been proactive in implementing engineering controls
  - Some RIMs have prohibited the use of 9B style Hi-rails on their networks

Going forward

- Identification of number of 9B hi-rails in use in Australia
- Eliminate the 9B system (modifications to become 9a)
- Contractors/ RIMs working with RISSB on creating best practice standards
- Consistency across all RIMs re network requirements
- RIMs and contractors have implemented controls to reduce the risks to safety associated with hi-rails
- Increased collaboration within industry - contractors and RIMs working together to undertake gap analysis of standards/controls
- An industry review occurs re training/operation of hi-rails
- RIMs / contractors are committed to safety awareness campaigns
- Increased internal auditing of use of Hi-rails and contractors by AROs and risks associated.
- Increased internal auditing of acceptance of Hi-rails onto the network and JSEAs conducted at start of job
- Improved reporting and investigating of run-away hi-rails which did not result in collision

Questions?