FASTTRACK

THE NEWSLETTER OF THE HORIZONS PROGRAM l June 2021

INSIDE THIS ISSUE – WHAT IS SHAPING THE RAIL INDUSTRY TODAY AND INTO THE FUTURE

ATMS ANRP - Pathway to Harmonisation

NTC's National Rail Action Plan (https://www.ntc.gov.au/sites/default/files/assets/files/National-Rail-Action-Plan.pdf) was published in January 2020, which identified that common standard operating rules for safe work could improve safety and reduce operating costs across the rail industry.

ARTC being the Rail Infrastructure Manager for a significant portion of Australia's Freight Rail Network operates to three (3) different safeworking rules and procedures which historically have aligned with state borders:

- NSW—NSW Network Rules and Procedures;
- Vic— TA20 Code of Practice for Victorian Mainline Operation; and
- WA/SA/West Vic— Code of Practice for the Defined Interstate Rail Network.

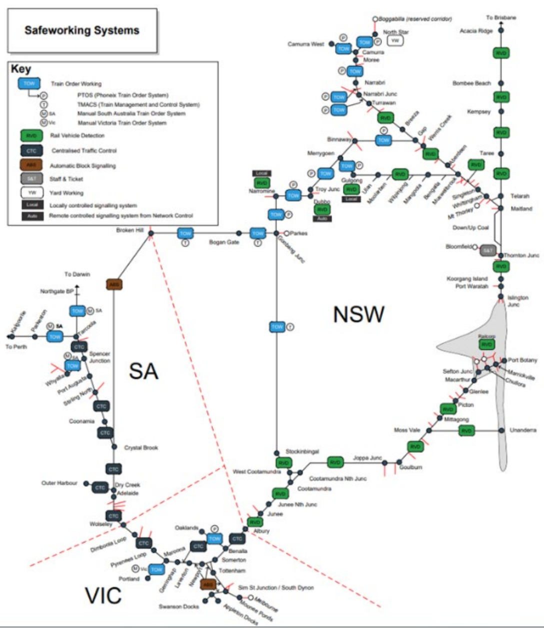


Figure 1: ARTC Interstate Rail Network

These different network rules and procedures have resulted in a variety of Signalling, and Train Control and Management Systems across ARTC's network including, PTOS, TMACS and Manual Train Order Working, Local and Remote Rail Vehicle Detection, Centralised Traffic Control, Automatic Block Signalling, Yard Working, Staff and Ticket and recently, ARTC's newly developed Advanced Train Management System (ATMS).

The fragmentation and differences in signalling and safeworking systems is a real cost to ARTC and its customers within the freight industry, because of the differing system maintenance, staff competency and training, etc., and stifles overall improvements in safety.

ARTC is now in the roll-out process of the ATMS across the Defined Interstate Rail Network, with major projects such as Tarcoola to Kalgoorlie (T2K) and Inland Rail already in the design and implementation phase. This represents ARTC's first real opportunity to harmonise its safe work rules and signalling systems.

Utilising RISSB's Australian Network Rules and Procedures (ANRP) product, ARTC's ATMS Operational Integration team is developing the ATMS ANRP, with a view to remove/reduce the issues associated with multiple safeworking systems and interface boundaries.

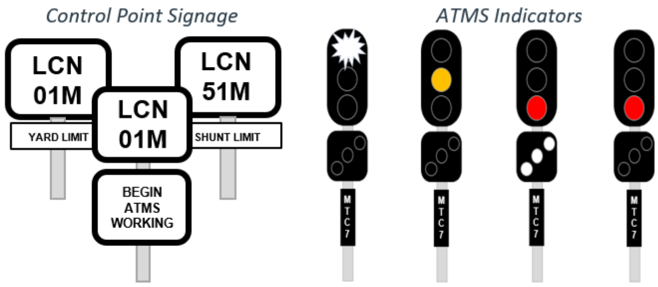


Figure 2: Standardised ATMS Trackside Infrastructure

Engagement and consultation with key operational stakeholders focussed on topical areas of safeworking risk, namely: uniform infrastructure, standardised trackside signage (depicted in Figure 2), and consolidated Work on Track methods (Exclusive Occupancy, Joint Occupancy and Working outside the Danger Zone). Other safeworking improvements is a single communication protocol and alignment of responsibilities for all rail safety workers across ARTC's Rail Network.

The ATMS ANRP will provide a common standard for operations and safe work, will reduce the number of Work on Track methods (reduction from 16 as currently used, to a total of 3), simplifying and reducing complexities in the decision-making processes for accessing and protecting track, whilst improving safety through benefits offered by the ATMS.

Remote Monitoring of Track Geometry

Rail operators and assets owners inspect and monitor their networks track geometry to ensure the safety and reliability for the users. Currently, the adopted methods for inspection and monitoring of track geometry are:

- Patrol and walking visual inspections
- Measurements taken with a specialised hi-rail track recording car
- Measurement from surveying of the rail
- String line measurements from in-situ monitoring devices
- Hand operated track geometry measuring trolleys

The primary issue with the current methods is that it requires an on-site presence. Depending on the method adopted and length of track needing to be assessed, it will require the track to be occupied or the works needing to occur during live running of trains with the appropriate protection measures put in place. Occupying tracks is extremely costly due to the loss in revenue from not operating services and the need to provide alternative transportation for freight and passengers. Alternatively, if the monitoring and inspection occurs when the tracks are live, it creates many safety hazards for personnel. It can also be inefficient when doing long extents of track.

ESIM has developed a system known as the Unmanned Diagnostic System (UDS) which can measure the typical track geometry parameters that operators monitor. The system allows them to understand the condition and faults within their network without the need for personnel to be present on site.

The ESIM UDS system has been developed to be able to be retro fitted onto existing revenue earning trains. This allows for a more frequent monitoring of the tracks resulting in faults being detected quicker enhancing the safety of the track. Additional to the onboard subsystem, line side calibration systems need to be set up at regular intervals which synchronises and uploads the data. The data is uploaded onto an online diagnostic dashboard that provides access to reports and graphs generated from the data collected from the UDS system.

The typical monitoring measurements that are taken for track geometry are track gauge, cant, twist, top and line. The ESIM system can measure all of these parameters. Further development of the system may enable it to measure additional rolling stock parameters.

The measurements that are taken by the system can then be compared against a set of pre defined maintenance interventions limits. This can inform the operator or asset owner on the course of action required. In cases where the track faults exceeds limits, speed restrictions and potentially even track closures may be required to mitigate risk of an incident occurring.

Figure 1: Subsystem mounted underneath rolling stock

Figure 2: Lineside infrastructure which recalibrates, synchronises and shares the data

The system has been adopted by RFI (Rete Ferroviaria Italiana) who are the infrastructure manager of the rail networks in Italy. With the growing demand on rail networks globally, adopting systems like the UDS that increase system reliability whilst also minimising down time needed for maintenance and inspection will be highly valuable to rail operators.

Wearing Down Maintenance Down-times

The increasing national demand for higher frequency passenger and freight timetables continues to reduce the available track access windows for maintenance works.

The luxuries of track closures, power isolations, and heavy plant access are becoming more and more competitive. Rail Maintainers are reaching towards newer innovative methods to conduct previous tasks safely and reliably.

Condition based monitoring techniques and off track non-intrusive measurements are some great examples providing the foresight to reduce maintenance down times on rail infrastructure. However there are still some unavoidable circumstances requiring spot closures to perform tasks.

The confirmation of contact wire thickness measurements at suspected thin spots is one such task. The copper overhead contact wire that provides electrical power to the vast majority of Australian urban passenger services is, by its nature, subject to contact wear. Wire thickness approaching elastic limits needs to be monitored closely and accurately ideally until scheduled adjustment or replacement windows. An ability to monitor this aspect of the electrical infrastructure relatively disruption free until repair is vital to overhead wire traction system maintenance.

An initiative to overcome this saw Sydney Trains develop an Overhead Wire Laser (OWL) Micro-meter. The in-house developed device (initially created by a graduate project) now provides maintenance staff with ability to spot measure the thickness of the live contact wire using an electrically insulated stick; causing minimal disruption to the rail network.

The walk on, walk off, innovative live measurement technique provides a highly accurate measurement of the wire thickness without the need for time consuming and service costly power isolation, hi-rail plant access, or long term track closures/diversions.

The device's internal #laser micro-meter, housed in a purpose build #3D_printed enclosure, provides a swift and accurate profile of the wire thickness straight to a user friendly #phone_app.

The previous technique used to the same accuracy level required a cumbersome hand held dial miro-meter applied to the rail diverted and de-energised overhead wire, conducted by staff in a hi-rail elevated work platform and recorded on paper.

Depending on the wire wear rate of a busy rail line, the accuracy of a measurement down to 0.1mm can be the difference between immediately stopping all services on the line, and waiting with confidence until the upcoming weekend's scheduled possession to correct the wire defect.

Keeping safely provided train services on time is the major focus of railways. New techniques making tasks easier and safer such as these are the undoubted future of maintenance.

Figure 1 Overhead Wire Laser (OWL)

Figure 2 Maintenance Staff Using OWL

Rigid Overhead Contact System (ROCS) - Sydney Metro

The overhead conductor rail system is a kind of overhead power-feeding lines containing a rigid conductor rail placed over the vehicle, connected to the supporting structures or to the tunnel or subway tracks ceilings using a set of clamps and supports. Overhead conductor rail can be made in form of a U-shaped aluminium hollow profile with an open carter below it for inserting the contact wire, or in form of a solid copper profile.

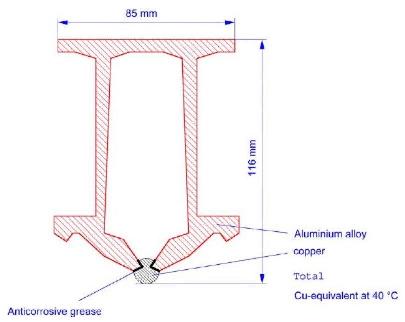


Figure 1: Contact Support Profile

The first overhead conductor rail system has been installed in 1984 in Zurich and it's still operated with no need to maintenance operations until now.

Sydney Metro is Australia's biggest public transport project. From the north west, metro rail is being extended under Sydney Harbour, through new underground city stations and beyond to the south west. The ROCS overhead system is designed and used in tunnel sections. In 2024, Sydney will have 31 metro railway stations and a 66 km standalone metro railway system, revolutionising the way Australia's biggest city travels.

An Overhead Rigid Conductor Rail System (ORCS) consists of a continuous conductor bar suspended in multiple points, placed at the contact height above the track. Supports carry the staggered conductor rails to achieve uniform wear of the collector strips, supplying the vehicles with electric energy by a current collector device arranged on the vehicle roof.

The quality of current collection and the subsequent running speed of rigid conductor rails depends much on the horizontal position of the contact surface. Consequently, the spacing between the supports needs to be shortened with increasing running speed to reduce variations in the contact line level. The maximum span between two suspensions is 12 m and varies in relation to the speed. The larger cross sections of conductor rails improve current capacity, short-circuit resistance, reduce voltage drop and power losses.

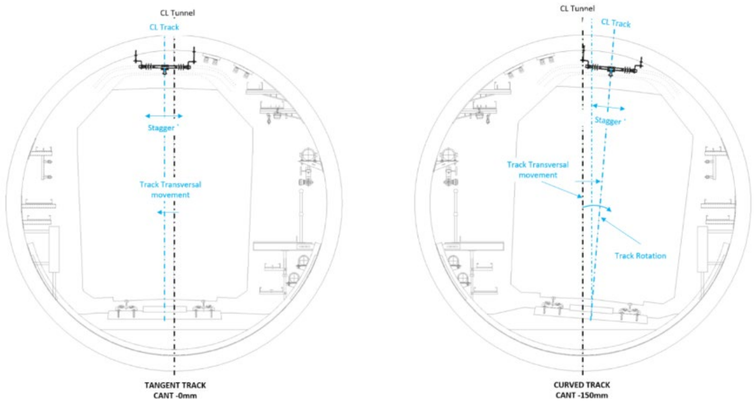


Figure 3: Tunnel ROCS Support

The fixed-point clamps (installed in the middle of the ORCS) allow the total length to split in two directions; The variations of length occur due to the thermal expansion caused by temperature changes. To allow for expansion without deformation, the sections of the ORCS have a maximum length of 500 m. At the entrance of tunnels, the contact wire and the catenary wire of the traditional line are anchoring to the front wall of the tunnel. In the area of transition between the traditional line and the ORCS, special bars are used to ensure a smooth passage of the pantograph between two areas with different elasticity.

Change Management - Risk Culture[1]

The rail industry at a new trajectory in Australia, the growth – patronage, revenues, and investment in infrastructure to transform the rail network is unprecedented. Does the industry have the appetite for a change?

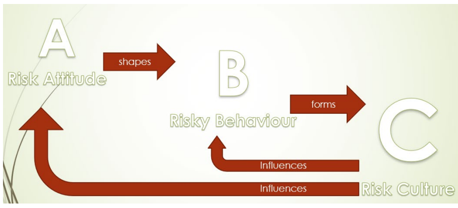
Current situation[2]

The Australasian Railways Association (ARA) has conducted a study and found that the Rail industry requires a major cultural change (workforce planning, environment & technical knowledge)

With all the new and innovation being introduced in the rail industry, within the constraint industry, the one key thing required in successful change management is understanding the organisation's risk culture. Risk culture is a set of shared attitudes, values, goals, and practices that characterises an organisation's attitude towards risks.

So where do we start?

The A>B>C Model Approach to Risk Culture[3]



There is a model which describes that attitude shapes behaviour, behaviour forms culture and culture influences both attitude and behaviour.

An approach to managing this as follows:

- Baseline – identify current risk culture
- Identify target risk culture
- Understand the gap using Comcare approach[4]
- Design and implement change program

Key to developing a successful change program is understanding cultural differences. The perception of risk is influenced by each individual subjective judgement which in turn is typically dependent on cultural background.

How do cultural differences affect risk?

- Communication (language, body language, expression)
- Perception (level of acceptable risks)

There are many models on this including:

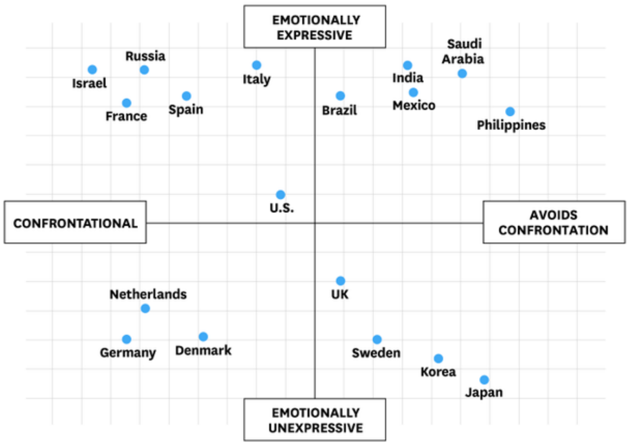


Figure 1: What gets you to say 'yes' in one culture and 'no' in another[5]

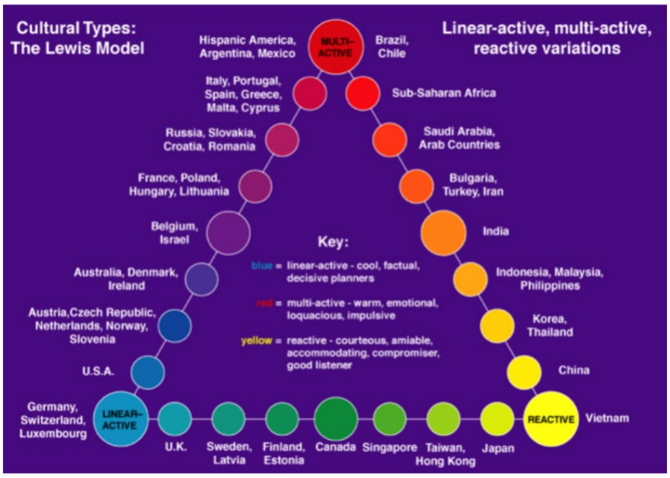


Figure 2: Lewis Model - Dimension of Behaviour[6]

To ensure successful implementation of a healthy risk culture, IRM has developed a risk culture aspect model which focuses on four themes

Steps	IRM Risk Culture Aspect Model[7]
Tone at the Top	Risk leadership, clarity of direction
	Ways the organisation responds to bad news
Governance	Clear accountability when managing risk
	Transparency and timeliness of risk information
Decision-Making	Well informed risk decisions
	Reward appropriate risk-taking through performance management
Competency	Status, resourcing and empowerment of risk function
	Embedding of risk skills across the organisation

This is one of the aspects to successfully embed changes.

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[1] https://www.railtechnologymagazine.com/articles/rail-new-mandate-pa-consulting

[2] https://www.parliament.vic.gov.au/images/stories/committees/etc/24australasianrailwayassocappendix2.pdf

[3] Hillson, D. (2013). The A-B-C of risk culture: how to be risk-mature. Paper presented at PMI® Global Congress 2013—North America, New Orleans, LA. Newtown Square, PA: Project Management Institute.

[4] https://www.finance.gov.au/sites/default/files/2021-02/2021%20Comcover%20Risk%20Management%20Benchmarking%20Program%20Risk%20Management%20Maturity%20Model.pdf

[5] Erin Meyer "Getting to Si,Ja, Oui, Hai and Da," December 2015 <https://hbr.org/2015/12/getting-to-si-ja-oui-hai-and-da

[6] Erin Meyer "The Lewis Model Dimensions of Behaviour," December 2015 <https://www.crossculture.com/the-lewis-model-dimensions-of-behaviour/

[7] Hillson, D. (2013). The A-B-C of risk culture: how to be risk-mature. Paper presented at PMI® Global Congress 2013—North America, New Orleans, LA. Newtown Square, PA: Project Management Institute.

Automated Track Inspection System (ATIS)

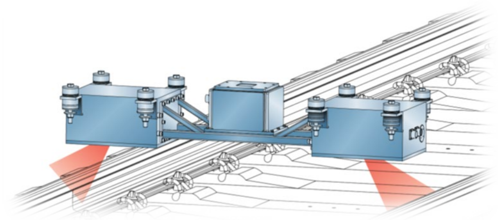

Figure 2: Depiction of track recording equipment

The status quo

Condition monitoring of track infrastructure has traditionally consisted largely of manual inspections such as road patrols from hi-rail vehicles, as well as track geometry and overheads recording using a dedicated track vehicle at irregular intervals.

Manual inspections are typically performed at intervals of one week and rely on a dedicated vehicle and trained personnel resources. Human factors play a role in these inspections, and can impact the consistency and accuracy of measurements, as recording of information varies.

Track recording vehicles are much more consistent and accurate, however the irregular intervals at which they're performed are too infrequent to take advantage of the data and build predictive models.

Introduction of ATIS

With improvements in technology, it is now possible for recording devices to be retro fitted to rollingstock services which already navigate the network.

There are four main inspection components of ATIS:

- Track geometry measurement
- Overhead wire geometry measurement
- Pantograph collision detection
- Visual recording from front facing cameras

Figure 1: Track Recording Device

What does it do?

Sensors, laser and camera-based systems capture information at line speed while an onboard computer undertakes primary processing. Data is then transmitted via the 4G network to databases where it can be further processed and automatically uploaded into a format that is compatible with the Rail Infrastructure Manager's (RIM) asset management system.

The benefits

The benefits of ATIS are widespread and substantial:

- **Rail safety** – as defects are identified and reported immediately and frequently
- **Available network capacity** – increased as no additional train paths are required as the rollingstock are already traversing the network in most instances, particularly of value where the network has capacity constraints
- **Automated and integrated with asset management systems** – saving time and resources in processing information, enabling earlier intervention by asset managers and maintainers
- **Improved identification of defects** – as defects are more readily and accurately measurable and assessable by RIMs
- **Reduction in temporary speed restrictions (TSRs)** - by better understanding the underlying defects, standardizing and improving the TSR management approach
- **Improvements in resource planning** – as the predictability of defects is improved and maintenance is predictive rather than time based or unplanned and reactive
- **Reduced manual inspection requirements** – improving resource availability

The result is the ability to be more aware of condition and deterioration to put systems in place to improve reliability and performance of the asset and reduce Whole of Life (WOL) asset cost.

Further potential

As the technology continues to mature and becomes more readily available, the potential exists to embed machine learning to visual images and predict new defects or the deterioration of existing defects. The data also has the potential to be used to build a digital twin of the Network and provide further benefits to the RIM.

Aurizon have undertaken trails on the Central Queensland Rail Network (CQCN) with promising results. ATIS is currently in the process of being developed and rolled out throughout the CQCN.

Rail Manipulation in Tight Spots

Rail Maintenance in hard to access locations is often neglected until defects are significant enough to warrant emergency repairs. One of the biggest reasons is the available access and the ability for new rail strings/required componentry to be placed where they are required. Currently within the Sydney Trains Network the only delivery method of rail greater than 27.5m is via the Robel Railset or a Conventional loco drawn Railset. Both of these require Diesel locos to enter confined spaces which significantly reduces their working time. This is often why there is so much redundant rail within the network which can impact the operation of trains if not managed.

Figure 1: TRT Unit Moving Rail on Slab Track

The McCulloch TRT (Trac Rail Transponser) are small self driven units which when combined significantly increase the manipulation capabilities of rail in tight spots. They are rubber tracked which enables them to work over various ground conditions. The machines comprise of essentially a mechanised "A-Frame" and the units can work with rail strings from 6m up to 430m. A major advantage is this can allow new rail to be placed in more suitable location to the heavy haul rail sets and moved into place via these units. Another advantage is that redundant rail can be tracked out of hard to pick up locations – such as the city underground.

The TRT units allow for easier track maintenance as they can carry various turnout components such as switches and turnout crossings. Conventionally this would require two separate pieces of hi-rail plant to safely complete. The units are controlled via a remote controller allowing the operator to easily maintain exclusion zones whilst the works are being carried out. These machines are currently being used by Laing O'Rourke Australia for these purposes and have greatly improved production and safety, key projects for this have been for Adelaide Torrens Junction upgrade and Melbourne MTM works.

Thanks for reading

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