# FASTTRACK

**RISSB**
RAIL INDUSTRY SAFETY AND STANDARDS BOARD

THE NEWSLETTER OF THE HORIZONS PROGRAM l MAY 2022

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

# Introduction: The New Normal

Since the World Health Organisation (WHO) formally declared the COVID-19 outbreak a pandemic on 11 March 2020, organisations worldwide scrambled to find their "new normal" during "unprecedented times" and the rail industry was no exception.

This was a key theme of the 2021 International Railway Summit (Youd, 2021), noting that the rail industry had to overcome numerous challenges, both operational and reputational, with passenger rail having to contend with negative media representation during each outbreak of the pandemic. Media bodies worldwide were quick to discount rail (and other public transportation) as 'unsafe', leading many people to turn to private transportation instead. These impacts were felt keenly across passenger rail organisations, and was a source of criticism for new passenger rail projects in their infancy (Suburban Rail Loop East Inquiry and Advisory Committee, 2022).

It's not all bad news however, according to Jash Bansidhar, managing director of Advantech. "This crisis created the acceleration of innovation…it's not only the way that people live and the way we are working but also how we can help the community open up again, and to make people feel safe on public transport" (Youd, 2021). Rail organisations around Australia have adapted and continued to innovate.

Organisational responses through a pandemic can be characterised broadly in different stages (McKinsey & Company, 2020)

- Resolve
- Resilience
- Return
- Reimagination and reform

The rail industry in particular has demonstrably been resilient during crisis, with attention fast turning to new innovations with a focus on the opportunities that new ways of working present.

### References

McKinsey & Company. (2020, May). *The Path to the next normal.* Retrieved from McKinsey & Co: https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Navigating%20the%20coronavirus%20crisis%20collected%20works/Path-to-the-next-normal-collection.pdf

*Suburban Rail Loop East Inquiry and Advisory Committee*. (2022). Retrieved from Engage Vic: https://engage.vic.gov.au/project/srl-east-iac/page/submissions

Youd, F. (2021, March 1). *Rail's response to Covid-19: lessons from the International Railway Summit*. Retrieved from Railway-technology: https://www.railway-technology.com/analysis/rails-response-to-covid-19-lessons-from-the-international-railway-summit/

# How industry has changed – response to COVID-19

The COVID-19 pandemic has shaken up the world and significantly changed the way the rail industry operates. Lockdowns across Australia and New Zealand since early 2020 have created new economic and social challenges and impacted the normal ways of working pre-pandemic. However, the challenges also bring opportunities.

Numerous and spontaneous periods of lockdowns, border closures and restrictions to our already isolated island countries caused us to become further isolated from the rest of the world and between each state and territory. This has brought on complex challenges. Availability of materials such as steel became scarce creating significant issues and delays to construction projects. Air travel came to a standstill, public transport patronage plummeted, resource and skills shortages increased, face to face meetings and working on site became difficult, disabling large workforces simultaneously – as pandemic numbers exponentially soared.

Some of the industry was ready, with companies like Aurecon fast tracking a year's worth of digital change in three months. For most of the rail industry, however, rapid changes in the shift from the physical form to virtual ways of working digitally and remotely i.e. transitioning to cloud-based storage, enterprise collaboration platforms and other digital tools – caused perpetual disruption.

Uncertainty, isolation, disruption and rapid change still remain challenges today as Australia and New Zealand and the rail industry adapt to the new normal. Organisations now face the challenge of managing the everyday with finding the additional balance of managing their workforce's health, welfare and wellbeing. "*Engineers are hard-wired to problem solve and never before have our problems been as wicked or complex*" [1].
Managing uncertainty, unknowns, risks and safety has certainly gotten more complex, however, managing these aspects are certainly not new to the rail and engineering industry.

Members of Fortune Magazine's CEO Initiative gathered - virtually - to discuss how to respond to COVID-19. Their big takeaway was the crisis will provoke business innovation however to navigate the path ahead, a simple organisational "*restart,*" won't be enough, a profound "*reset*" is required. The general consensus "*we won't return to normal soon* or *to the old normal ever.*"

In June 2020, the Australian Government announced a $1.5bn infrastructure stimulus package in response to Covid-19 and investing $120bn over 10 years from 2022-2023 in land transport infrastructure across Australia [2]. Around Australia, many "**rail projects and forward planning have been brought forward as a plan to create economic stimulus and jobs**". Key projects include Canberra Light Rail, Regional Rail Revival in Victoria, METRONET Thornlie-Cockburn Link and Yanchep Rail Extension, Morley-Ellenbrook, Armadale line level crossings removal and Byford Rail Extension projects in Western Australia, Significant investment in Inland Rail from BNE to VIC, Brisbane to the Sunshine Coast rail extension (QLD), Sydney to Newcastle faster rail upgrade (NSW), Melba Line Bulk Minerals Rail Hub (TAS), Tasmanian Freight Rail Revitalisation Program – Tranche 4, and more (ARA rail construction and projects).

To continue to deliver these mega rail projects, we see rail operators, clients, and consultants across Australia and New Zealand emerge and adapt in various ways to overcome the challenges during the pandemic. We asked a range of consultants, clients, rail industry workers and captured some of the key changes and ways, platforms and tools used to respond to and manage their workforce during the pandemic. They responded across a range of areas and practices, which are outlined below:

**Remote and flexible working environments**
- Transition from physical to virtual storage and working environments i.e. one drive, VPN, remote desktop
- Adopting flexible working locations and hours
- Implementing alternating rosters (i.e. Team A/B, Site/office, WFH/office)
- Introduction of alternating seating and hot desks
- Introduction of remote monitoring tools and technology for maintenance and project work

**Health and Safety and Well-being**
- Implementing Hygiene and check in stations
- Implementing temperature check in stations
- Physical distancing
- Visitor sign on systems on site

**People and global outreach for resourcing**
- Remote national and international support more common due to border closures and skills shortage

**Enterprise collaboration tools**
- MS Teams, Zoom, Web-ex meetings and breakout
- SharePoint and one drive cloud storage
- Miro for workshops and collaboration
- Bluebeam studio for reviews and comments

**Quality, tools and processes:**
- Increase use of Bluebeam studio for digital reviews, comments and verification
- Increase use of digital signatures and certificates i.e. DocuSign, Adobe acrobat sign / certificate digital sign

Many railways and governments such as the Victorian government are making the most of the reduced patronage to focus on **asset management, upgrades and maintenance** of the existing infrastructure for future needs [3] and new trains and trams [4].

As a result of reduced patronage observed on the networks, we see major and long-term shutdown go ahead. In WA, the Public Transport Authority, passenger rail operator, is planning for a 18 month **long term shutdown** to transform the 129-year-old

[Armadale line to deliver Major METRONET projects](#) and upgrades. Around Australia there has been long term shutdowns of rail lines in the past to allow major building works to be completed. These include [Dandenong (Pakenham/Cranbourne) rail line](#) for 5 weeks in 2014 in Melbourne and [Tonsley Park rail line](#) for 12-24 months in 2012 and [Grawler line](#) in 2021 so electrification upgrades could take place in South Australia.

As restrictions ease coming into year 3 of the pandemic, we see the rail and infrastructure industry is booming, skills and resource demand increase, patronage is starting to return close to what it was pre-pandemic. What we also see is a more agile and resilient workforce and railway networks, accelerated forward planning and infrastructure projects. A leap in digital and culture shifts and industry collaboration to overcome the challenges from the pandemic and reshape the future. So [what's next](#)? How is the industry reshaping? Some insights from the industry:

- [ARA - response-to-covid-19](#)
- [Reshaping not resetting: public transport post-COVID-19](#)
- [ARTC - our-response-to-covid-19](#)
- [Future-of-transport - transport-demand-post-covid19](#)
- [gamifying-our-transport-future-covid-19-world-where-user-experience is unreal](#)
- [Building-geospatial-collaborative-systems - Auckland City Rail Link](#)
- [Rail-journey-dinosaur-to-digital](#)

# Innovation in Covid response – Dynamic Timetabling

When the Covid-19 pandemic started to impact Australia at the start of 2020, many rail networks around the country saw a decline in their patronage. Specifically, Sydney Trains saw a significant reduction in patronage, as well an impact on staff availability. As a result, train timetables needed to be adjusted to match the new requirements. This led to the implementation of dynamic timetabling.

When looking at altering the standard timetable, we needed to consider many factors such as who was traveling, where they were traveling to and from, when were they traveling, why they were traveling, and what were the constraints around travel?

**Who was travelling?**
During the pandemic and periodic lockdowns, only essential workers were allowed to travel around Sydney. This changed the demographic of passengers. Many emergency services personnel still caught public transport, as well as workers in industries that were not able to shift to working remotely.

**Where were they were traveling to and from?**
With the change in demographic, there was also a change in the stations that were servicing substantial passenger numbers. It was noticed that industrial areas and suburbs with large hospitals continued to see regular passenger numbers, meanwhile stations with office buildings saw a large reduction.

**When were people traveling?**
With essential shift and trade workers really only using the network during the peak of the pandemic this meant that during the early hours between 4am - 6am the patronage remained steady, where the 7am - 9am patronage was reduced by up to 90%.

**What restrictions were placed on patrons and staff?**
There was a large push to reduce the spread of Covid19. Part of this was increasing social distancing as well as having people isolate and stay home if they were feeling unwell. Local government area (LGA) lockdowns also forced reduced patronage along certain train lines, and reduced the availability of rail staff to come to work.

**Knowing all the above information how do we dynamically alter the train timetable to better match the changed customer demand?**
A great deal of data was collected and analysed to forecast accurate numbers. From this information we were able to calculate the required frequency of service based on guidelines such as social distancing which reduced the total capacity of each train. The Workforce Management team was also able to provide daily updates on what proportion of staff were unavailable to work and forecast availability for up to two weeks in the future. From these numbers, train frequencies and stopping patterns were altered on a weekly basis, and fine-tuned daily to optimise service provisions for customers.
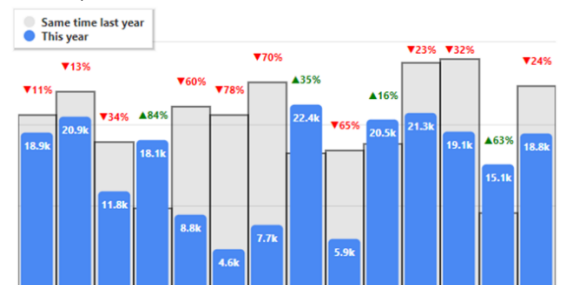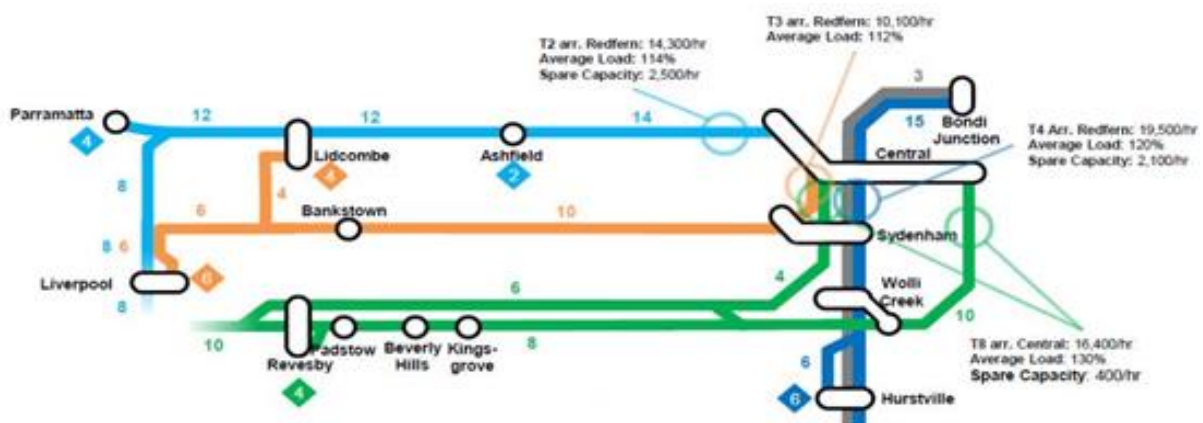


*Figure 1 - Data collected showing reduced patronage (top) and spare capacity calculations on the Sydney Trains network before Covid (below).*

An example of dynamic timetabling came in early February 2022 as we gradually were coming out of the worst of the pandemic and students were going back to school following the summer break. Some customers raised concerns that students were missing their connecting stops as the weekday timetable was running with reduced frequencies. Within 12 hours, timetables had been reworked to allow for these connections to be made, and the alterations were deployed in all future timetables.

To better deal with last minute changes, the internal rail replacement improvement program also started deploying digital screen solutions to replace paper posters at key stations allowing dynamic timetable information to be better displayed to customers and provide real time information of upcoming services.
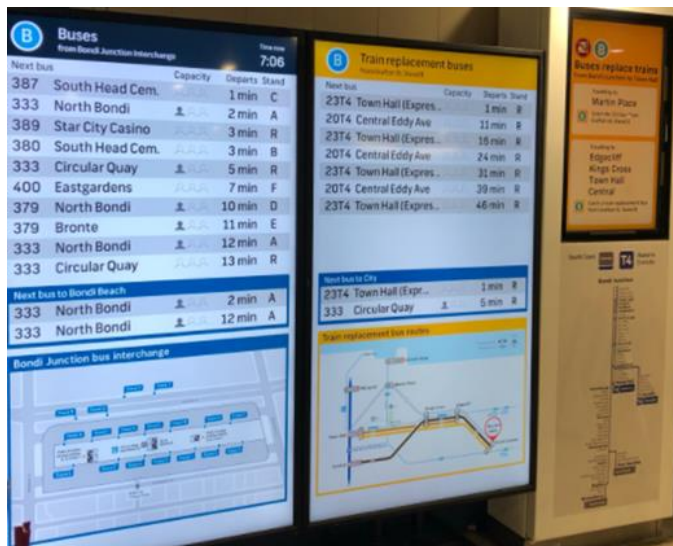


As the timetabling team were seeing reduced patronage, opportunities presented themselves. In consultation with Maintenance and Fleet divisions, we were able to provide altered rosters and access to accelerate touch time on trains; helping to improve reliability and provide increased access to track for maintenance to rectify defects. The maintenance team were able to reduce the backlog of maintenance tickets by approximately 50%. It was also discovered that due to the lower patronage major works were able to bring forward large projects such as the Sydney Harbour Bridge deck and sleeper replacement program. Dynamic timetabling in conjunction with improved rail replacement services went a long way to reducing the cost of alternative transport while minimising the customer impact.
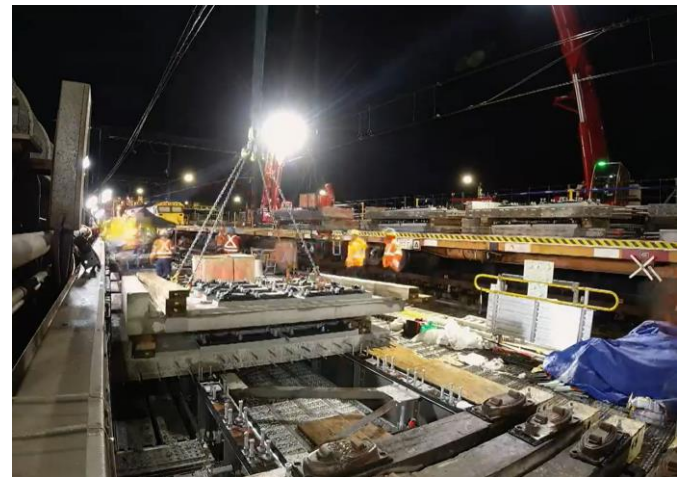


Moving forward, adaptive timetabling is becoming more necessary to allow us to deal with an ever-changing world. Live trip detail updates, faster reactions to severe weather, and increased or decreased service provision based on passenger numbers will help make the railways more reliable and sustainable. We must ensure that the systems used to make these dynamic changes are kept current, and our ways of working adjust to maintain good work life balance as well as flexibility for our customers.

# Maintenance innovation in Covid Response – VIC and NSW comparison of the states

In response to the COVID-19 pandemic the rail industry was forced to adapt to a new world of working with socially distanced teams, compromised staff availability and an ever-changing duty of care for passengers. One of the more challenging aspects to manage was the inspection and maintenance of infrastructure; ensuring the rail network remain fit for service with limited resources for routine inspection and general repairs. Operating the railways of Australia's two largest cities, we will assess the approach of Sydney Trains and Metro Trains Melbourne to managing infrastructure maintenance during the pandemic. But first, let's compare the networks,

Sydney Trains operates one of the geographically largest metropolitan rail systems in the world. An average of over one million rail journeys are made each day on the Sydney Trains network during the business week – on a fleet of 2,181 electric and diesel carriages, travelling on 1,588km of network track and stopping at 178 stations.

Metro Trains Melbourne run a network of 15 train lines with 222 stations spanning across the growing metropolis of Melbourne. With over 2,200 weekday services on a network of more than 1000-plus kilometres of track, 40,000 structural assets, 16,000 overhead structures and 2,700 signals and over 600 bridges and tunnels.

When comparing their experience, infrastructure maintenance teams from both networks seemed to encounter similar challenges during the pandemic:

1. Splitting resources into isolated teams (A and B teams) to contain exposure in the scenario of an outbreak. This meant establishing new temporary site offices around the network.
2. Facilitating safe travel in communal pool vehicles with hygiene policies.
3. Securing availability of key personnel during the LGA lockdowns (protection officers)
4. Reinventing processes reliant on handling paperwork (electrical permits and possession notes)
5. Prioritising activities of the Technical Maintenance Plan, cancelling non-critical works
6. Securing materials and equipment with global supply chain shortages and logistics delays.

Despite these challenges, both Sydney Trains and Metro Trains Melbourne managed to successfully navigate the pandemic environment while maintaining their networks. Reflecting on the experience, some silver linings have been identified as several innovative maintenance practices have emerged from the new the new ways of working.

**Metro Trains Melbourne EV120 Vehicle**



*Figure 1 - MTMs EV120 Vehicle*

From Milan to Melbourne, a new maintenance vehicle has hit the rails to keep passengers moving safely and reliably as the city emerges from lockdown.

Metro's EV120 vehicle – or 'Evie' for short – uses special sensors and cameras to examine the condition of track, overhead lines and other rail infrastructure in real-time.

The detailed data collected by Evie helps Metro identify priority network locations for maintenance and renewal, supporting an annual program worth more than $300 million.

Evie can go anywhere – with specially trained operators helping it run the full length of Metro's network which spans 16 suburban lines and more than 1,000 kilometres of track.

The vehicle is about 20 metres long, weighs about 50 tonnes, and can travel at up to 120 kilometres an hour, hauled between two trains.

Metro has been planning for Evie's arrival for four years. After being manufactured near Milan,

Italy, it took 10 weeks to be shipped to Melbourne.

Now that the EV120 is in Melbourne, Metro is busy putting the vehicle through its paces. Engineers are conducting final testing of Evie's GPS, track geometry, clearance and other key systems.

The next stage will be to commission the overhead imagery and measurement system, Ground Penetrating Radar (GPR) and corrugation rail measurement system.

**Sydney Trains Mechanised Track Patrol Vehicle**

Sydney Trains has also realised the value of condition monitoring with its Mechanised Track Patrol Vehicle. Since 2013, the suite of mechanised inspection services has grown to include a vast series of track inspection and monitoring activities, including Visual Track inspection, Track Geometry Measurement, Rail Profile Measurement and Overhead Height and Stagger Measurement. Being well established, the Mechanised Inspection Services teams is now a team of 30 staff managing the operation and maintenance of two inspection vehicles.



*Figure 2 – Sydney Trains Mechanised Track Patrol Vehicle*

Compared to manual methods of inspection, the Mechanised Inspection Services were far more adaptable during the ever-changing pandemic environment. A/B operations teams could immediately be established with their work areas completely isolated and inspection vehicles sanitised between shifts. The review and reporting teams were also isolated with processes even established for visual inspection data to be assessed from home offices. This dramatically reduced the risk of exposure and enabled business operations to continue despite key personnel being isolated to affected local government areas.

Witnessing the success of Mechanised Inspection Operations during the pandemic, Sydney Trains is enthusiastic to expand its scope

to further monitor the overhead electrical infrastructure. Projects are established to implement systems that manage overhead wire visual inspections, contact wire thickness measurement and pantograph collision detection. LiDAR technology is also being implemented to perform several measurement and inspection activities in the wider corridor, including platform clearance measurement, track centre measurement, vegetation clearance and signal sighting distance. Integration of these mechanised inspection solutions is also be performed in efforts to develop an enterprise digital twin that works communicates asset management and rail operations functions.
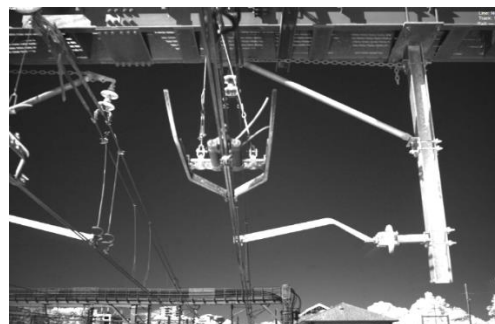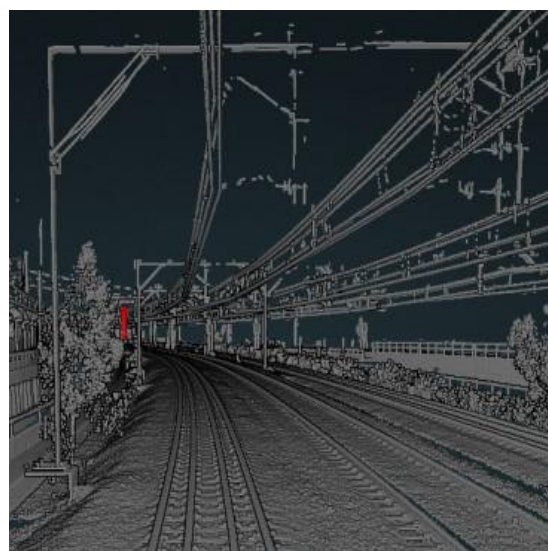


*Figure 3 - Overhead Visual Inspection*



*Figure 4 - LiDAR Point Cloud - Measurement of Signal Sighting Distance*

**Metro Trains Melbourne Goats**

Metro's Vegetation team welcomed a herd of goats to the team to get on with weed clearing near Belgrave Station. A half-hectare area of bushland at Belgrave Station required a creative weed management solution to clear the area safely and effectively. A team of 10 goats from GrazeAway, known as the Puffing Billy Goats, have been brought in to chew through the area and clear the weeds. The goats will chomp their way through some of the network's most overgrown shrubbery, reducing fuel loads and ensuring native flora and fauna can thrive.

Infrastructure Vegetation Manager Katrina Lewis says the four-legged eating machines are effective at eradicating weeds such as blackberry and watsonia, and can reach parts of the network that are difficult to access for human vegetation crews.

"Using goats is a relatively new approach, but one that will allow native species to grow while weeds are removed.

"We are putting them in areas that have been hard to access for people, vehicles or machinery. They have proven to be exceptional at their job in the first three sites where they were used," she says.

The goats are also environmentally friendly, reducing the need for harmful pesticides that may have an impact on native flora and fauna.





Ms Lewis says, "Goats are a great solution because they are far gentler on the environment than traditional cutting.

"The goats control weeds by pruning the foliage and leaf buds which exhausts the root system, killing the plant. This in turn encourages native flora and fauna to return to the area.

"They are also a pesticide-free option, and there's no need to remove vegetation waste afterwards as it is eaten or trampled."

Leased from GrazeAway, which also provides the necessary nutrition and care for the animals, the goats will eat their way through weeds for several weeks.

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# Condition Monitoring Remotely Minimising the Impact of COVID-19

Since the start of the covid pandemic, Aurizon depots have been managing the risk that a high number of covid cases would cause, specifically to staff availability, less efficient work output and in turn service disruptions. This impact could have been much more severe without the ability to remotely review the condition of Aurizon rollingstock. This remote inspection of rollingstock was typically completed from the office, but during the height of the lockdowns all non-trade staff were instructed to work from home. The regulatory based inspections of our rollingstock were not affected however as Condition Monitoring analysts could assess locomotive and wagon condition in the comfort of their own home.

Aurizon owned rollingstock has been transitioning from a traditional time-based maintenance strategy to a more condition-based approach. A large part of this has been moving to eliminate manual regulatory inspections by trade staff on coal wagons. Typically, these were completed every 21 days on a consist and required the entire train to be stopped for an extended period while the inspection occurred.

Using trackside cameras (supersites) that take high resolution images which remotely based analysts can review, Aurizon was able to significantly reduce the amount of time-based manual tasks needed to keep our rollingstock compliant.



*Figure 1: An Aurizon train passes through a supersite*

The images taken by these cameras have an MVA, (Machine Vision Algorithm) applied over them which detects abnormalities and differences to other images taken. This results in analysts only having to review exceptions as opposed to reviewing every image of the thousands collected on each train consist which passes through the supersite. Manual inspections still do occur on some components that the MVA is unable to cover.



*Figure 2: A failed hinge causing a coal wagon door to open in traffic automatically detected by the MVA*

Ultimately this means train consists can remain in operation while the examinations take place, eliminating the need for dwell time, shunting of rollingstock and manual handling.

## Other major benefits of Aurizon's vision-based supersites:

### High impact response:

- Critical defects such as open doors or a draft gear failure are known within a short period of time after the consists passing the cameras and can be quickly actioned, reducing impact to the network.

### Safety:

- The less time that trade staff have to spend around rollingstock and the rail corridor, means less potential safety concerns.
- The electronic inspections have a larger scope than physical inspections, for example, the draft gear condition is reviewed every pass of the cameras, which would previously be inspected once every year manually. This increase in critical inspections ensures our rollingstock is compliant and able to operate safety.

### Planning:

- Schedulers can prioritise work based on the severity of the fault.
- Before the rollingstock enters the shed for repairs majority of the work that needs to be completed is known.

**Reliability:**

- The physical condition of Aurizon's wagons and critical components is known every time it passes an Aurizon trackside camera as MVA algorithms are running nonstop.

**Data is Trendable:**

- Data such as wheel wear and brake block measurements can be trended, meaning we can replace them based on condition and give the schedulers ample time to plan work.
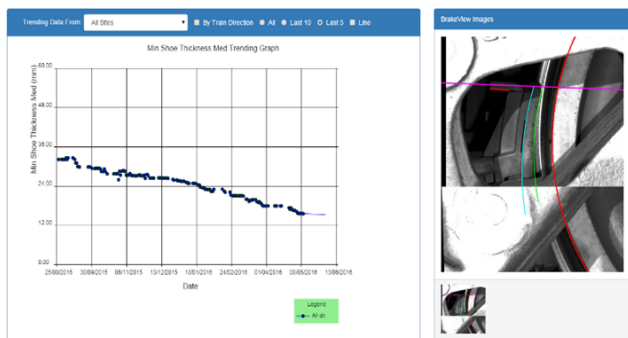


*Figure 3: Trending brake block wear over time*

# Managing a Legacy Risk Profile: A multifaceted approach to risk management

Rail is innately a dated industry, and naturally, managing legacy risks is nothing new in rail. Modern risk acceptance and design practices has moved away from the mountainous range model, identifying that modern design practices and risk appetite do not align with the ongoing limitations and costs associated. So, while new lines and transport avenues boast tunnels and open cuttings, many rail operators are left with the complexities of managing an aging alignment against the industries steadily declining risk tolerance.

While capital investment is very effective at locally mitigating the risk with slope stabilisation works, attempting to achieve a low risk profile or failure frequency comes at an excess cost with only marginal risk reduction. Then to add another layer of complexity to justifying investment, there is significant uncertainty around the future of many rail systems, due to impending rail competitors, ever-fluctuating agricultural and mining demand and evolutions in road transport. And even if we were to have an open chequebook, how do we manage the residual risk while we deliver a capital program exceeding a decade? Rail operators need an economical solution that with some right now options.

Queensland Rail has started to apply a multifaceted approach to effectively and economically managing the risk short term and into the future:
1. Targeted slope remediation capital works are being used to eliminate the risk of large scale landslides at the highest risk sites.
2. Geotechnical investigations are being undertaken to inform future capital investment further, ensuring an 'at the right time, in the right location' model.
3. Expert advice and geotechnical inspections are informing the risk profile and identifying imminent risks and slip trends.
4. Preventative works are addressing low-consequence, high-likelihood (imminent) hazards
5. Applying innovations to better monitor, view and document the risks

The first 4 approaches are nothing new to the industry, although they are refined with improvements in technology so let's delve into the innovations.

Photogrammetry and LiDAR have been used to establish a digital twin and photographic time record. The intent is that this tool is twofold, firstly it will supplement physical inspections. The original risk assessment was undertaken by walking inspection. This model provides a more holistic view for larger scale slippage and drainage paths, visibility of underlying topography through foliage, the ability to pan around a hazard for alternate viewpoints and visual accessibility to previously inaccessible areas. The time record from one data set to another enables identification of hazard worsening, comprehensive root cause analysis and trend slippage analysis. In addition, the digital twin will be safer, faster, and more cost-effective than manual inspections, reducing the organisations risk exposure.

Secondly, the model provides a geographic database for hazard annotation, trend analysis and scoping of preventative work packages. What does this mean for the business; clearer communication, proactive preventative work identification and strategic hazard analysis. To further leverage the technology, options to extend into other functional areas and build artificial intelligence into identification of hazard worsening are being investigated.



*Figure 1 – A graphic from Queensland Rail's digital twin model established using Photogrammetry and LiDAR*

The second innovation application is the installation of embankment displacement and sleeper tilt monitors. In the shorter term this technology enables monitoring of progressive and accelerated embankment movement, overlaid by rainfall, to automatically alert of a heightened risk of failure. This data informs when inspections are required and when a heightened risk state is experienced. Additionally, the record of movement over time will inform more defined measures and rates of change for alert triggers, potentially even expanding to use of piezometers and cameras. These were able to be used during COVID-19

and flood events, demonstrating their application to building business resilience.



*Figure 2 –Displacement analysis graph (left) showing real-time data recording from embankment monitors (right) after subsequent days of rainfall.*

Queensland Rail has begun to establish positive working relationships with educational institutions and other rail industry leaders, seeking to knowledge share around technologies to further inform and mitigate risk. Innovation will continue to improve decisions around risk management, towards best for business outcomes.

Thanks for reading

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