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

Induction Welding a Rail Welding Innovation for the Near Future

In the Australian rail industry, there are two main types of continuous welded rail (CWR), they are Aluminothermic Welding and Flashbutt Welding. As a rail community we are always striving to be innovative, looking for the new next best technology.

For rail welding the new next best technology is to do with variables such as, cost effectiveness (price of equipment and operators), time per weld, flexibility of use of equipment (i.e. can it be used in tunnels and are there limited operators) and the quality of the finished weld.

Induction Rail Welding is the new next best technology, with it being widely trialed in the UK. The key advantages of Induction Welding are as follows:

- Sub 6-minute welding process,
- Bend test properties similar to parent rail material in the absence of a weld,
- Microstructure is as parent rail with slight increase in hardness,
- Microstructure of heat affect zone (HAZ) is without oxidation and flaws,
- Visual appearance post-weld is clean and linear,
- Minimal consumption for point and crossing (P&C) installations,
- Deployment from various hi-rail vehicles (mobility),
- Mobile induction welder capabilities; automatic peaking of rails, self-stressing, automatic shearing and compact design for P&C installations,
- Many environmental and safety advantages – see: https://www.mirageservices.co.uk/products/induction-rail-welding-plant.

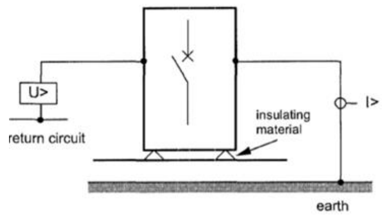
With the introduction of Induction Rail Welding to Australian rail networks in the near future, we will hopefully have a CWR type that can produce welds with the same life as the parent rail, safely and consistently. Decreasing rail breaks due to poor welds, in turn providing a safer rail network.

Voltage Limiting Devices in Traction Substations

Currently in DC traction substations there exists a hazard in the case where the negative cables from the substation are removed or stolen, a 1500V DC touch hazard may be presented to personnel working within the building who come into contact with DC Switchgear. This touch hazard is owing to the connection from the overhead conductor being energised from adjacent substations and tie stations to the negative via the bus and line transducers in new switchgear and holding coils in older switchgear. To mitigate this issue insulated flooring has been traditionally installed around DC Switchgear and designs ensure that no earthed metalwork is located within two metres of the switchgear to ensure there is no potential of a person making such contact. This however presents challenges due to the clearance requirements and footprint requirements of new substation buildings. As such the following has been suggested as a possible scheme to mitigate the issue:

- The frame of the Rectifier Unit and DC Switchgear should be connected to earth
- Frame leakage protection to be installed between the Rectifier Unit frame and DC Switchgear frame and earth to detect and trip for current flow to earth
- Ensure that the requirements of standard EN 50122-1 are met in terms of maximum touch potential that persons are exposed to in the vicinity of a substation and the protection is set accordingly
- Install a voltage limiting device (VLD) between the negative busbar and the earth busbar in the substation which will close a high speed DC circuit breaker on detection of high voltage difference between these two buses, bringing the two to the same potential and mitigating any touch potential hazard

The basic connection of the VLD is shown the following diagram taken from standard EN 50123-7



There are a number of options of operation of the VLD – defined as type 'F' or type 'O'. Type 'F' refers to a VLD configured to operate under short term (t<0.7s) fault conditions. Type 'O' refers to a VLD configured to operate over a longer term (t>0.7s) and in normal operating conditions.

It is part of the operating sequence of a VLD that if it opens under a type 'F' (fault) scenario, it will remain permanently closed until manually reset. The frame leakage relay in this instance will trip all the feeder DCCBs and the Rectifier DCCB. Closing of the VLD ensures that for a fault just outside the feeder DCCB, the remote ends will also be able to detect the fault and trigger those Feeder DCCBs disconnecting all supplies of fault current. This differs from the Type 'O' functionality which will close on detection of a high voltage potential but then re-open, should the voltage return to normal. There may however be a maximum number of operations before the Type 'O' also permanently closes the VLD.

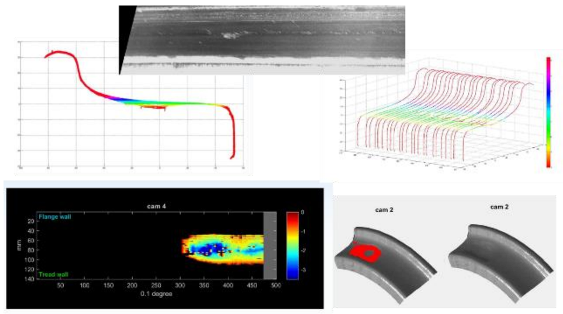
Note that a VLD doesn't provide any protection against lightning and switching overvoltage. As such a surge arrester is provided within the unit to protect the VLD against the lightning overvoltage. The settings for the surge arrester are set to be higher than the settings on thyristor voltage threshold in the VLD to avoid the unnecessary operation.

Moving forward from Time Based Maintenance

Railways have long used time based strategies to maintain rolling stock assets, usually a pre-determined time based on historical data or manufacturers recommendations. Maintenance and down time of assets can impact heavily on the cost of rail operators. Other industries use condition monitoring on machines to move from a time based regime to a more condition or predictive based scheme, how could something like this be applicable to rolling stock?
It would be a costly exercise to fit thousands of wagons with sensors to monitor their condition. Today, with the use of BeenaVision systems or similar, supersites are used monitor the condition of the rolling stock, taking images and measurements on every train pass.

There are a number of systems currently available for use

- TrainView – Wagon Body Inspection
- TruckView – Bogie, springs, friction wedges and bearings
- BrakeView – Brake Blocks, thickness and fitment
- CSCView – Underside of couplers, draft gear, axles and brake rigging
- Wheel View – Wheel profiles and associated measurements
- TreadView – Full tread profile to detect spalling or flat spots

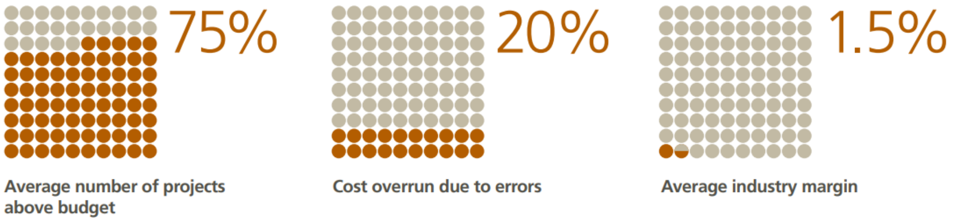


These newer technologies can be used alongside an existing network of wayside detectors, such as Wheel Impact Load Detectors (WILD), Overload and Imbalance Detectors (OLID), RailBAM (Acoustic Bearing Monitor) and Hot Wheel and Hot Bearing detectors to maintain a constant monitoring of the fleet health. These wayside systems have traditionally been used for asset damage protection (rolling stock and track) more than maintenance planning. However can also be used to monitor brake effectiveness, wheel and bearing health as examples to extend to asset health.

With such systems come a large amount of data, which even in today's environment, still pose a challenge to manage. However, technologies such as machine vision algorithms (MVA) can be applied to automatically detect anomalies and raise notifications resulting in condition based maintenance. By trending data and using machine learning there is the possibility to move away from a time based or even condition based maintenance scheme to a predictive based scheme which will improve asset utilisation and minimise maintenance costs, increasing the operating efficiency of the railway.

Project Delivery

You only need to watch an episode of Grand Designs to know that even a hardworking couple with good intentions can let things slide. At the beginning of every episode, they are asked about cost and time, to which the response is, they are building their beautiful new home in three years for $400,000. When asked about time and cost, their answer is now 4.5 years (still not finished) and $600,000.



The construction industry is no different. Since the industrial revolution our productivity has barely increased, compared to the four-fold increase of other sectors such as manufacturing.

So what will change this?

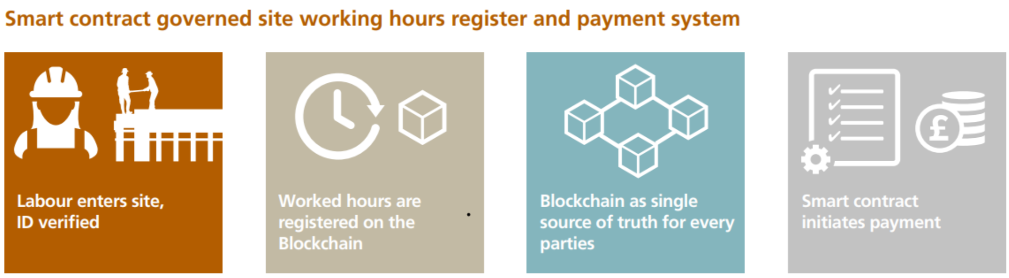
Blockchain.

When you think about what environment you want to create on a project, especially a Public Private Partnership, as many D&C plus O&M projects are today, it is one of collaboration between client, contractors, subcontractors and independent assessors. Not just this, but also accountability, trust and high performance.

Utilising blockchain to manage the project's delivery milestones draws the link between the commercial manager sitting next to the project director's office managing the bottom line, and the design consultants and design managers trying to submit the next package of work.

The fundamental concept is that all project documentation is recorded (not kept) on a blockchain. When say, a new package of works is required to be submitted, the BIM model requires update, the design report produced, drawings prepared. Once these are all submitted to the Blockchain, the review process is executed and then automatic payment can occur.

On site, what this can look like is subcontractors can sign in for the day, complete their works, sign out, and the engineers are queried to confirm the team on site, before automatic payment for the amount of logged hours is provided to the subcontractors.



Note: Images sourced from Crosby, M. (2016). BlockChain Technology: Beyond Bitcoin. 2, 16.

Inherently what this means, is that accountability is placed on all stakeholders within a project, and with this comes trust and collaboration.

A User-centered approach to reducing trackside safety risk

A key risk for the rail industry is managing the risk of a trackside safety occurrence, in particular a train to worker collision. Recently Queensland Rail have trialed a SIL-4 rated, self-monitoring Track Circuit Operating Device which is an engineering method of assuring location. The device holds the correct signals at stop in the field to protect the worksite.

Key findings of the trial included a lack of confidence with the new technology from end users. Concerns raised included the risk of unintentionally breaching Safeworking rules and a limited understanding of track circuiting principles, locations and signalling arrangements.

Further, Protection Officers are still required to enter the Danger Zone to apply the device under a track authority and therefore the risk of collision during the critical phase of deployment, as a result of ineffective assurance of location, had not been eliminated. Once deployed, the device does provide an increased level of protection to the user by eliminating the risk of a signal route being inadvertently cleared into the worksite for the signal section that the device is protecting.

The majority of stakeholders that have been involved in demonstrations or trial of the device have indicated a preference for a site specific semi-permanent application of the device and operation by remote control. The safety gain from this would result in the Protection Officer being able to activate the device without having to enter the Danger Zone, thereby substantially reducing the risk of collision with rail traffic. While this functionality for the narrow-gauge version is not currently available, this option would allow the business to assess where the safety and productivity benefit is highest and develop and test site specific application plans and procedures to minimise the risk of error by end users.

A Rail Transport Operator must consider the availability and suitability of ways to eliminate or minimise trackside safety risk. Identifying and understanding who is responsible for implementing new risk control measures is key to successful implementation and determining what is suitable in the circumstances. With newer signalling installations moving away from track circuits to modern axle counters, lifecycle of control is limited to lifespan of the track circuit equipped locations.

Adopting a user-centered approach to the introduction of new controls is critical. To manage risk, you need to understand the people. Consulting with and understanding the workforce needs to be a key consideration when determining whether a new control is suitable and is a critical step in ensuring safety so far as is reasonably practicable.

Thanks for reading

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