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

Climate Change Impact on Rail Infrastructure Assets

Numerous scientific studies, including CSIRO, the Australian Bureau of Meteorology and several Australian Universities, have supporting evidence to claim that changes to the climate system have occurred and are likely to continue.

According to CSIRO, Australia's changing climate represent a significant challenge to individuals, communities, governments, businesses, industry and the environment.

Both the Intergovernmental Panel on Climate Change (IPCC) and CSIRO predict climate change will result in changes to the frequency, intensity and duration of rainfall events in Australia.

A main climate factor identified as a key risk to rail infrastructure is flooding, due to unpredictable and intense rainfall extreme events, which may result in over-topping and washaways affecting the structural integrity of the tracks, bridges, culverts and embankments.

Some risk controls that can be implemented are:

- Develop/validate a register of critical climate sensitive assets
- Update stormwater drainage standards as more precise rainfall/runoff data is available
- Undertake hydraulic and hydrologic modelling to validate peak flow capacity
- Incorporate climate change parameters at the design stage of new structures (e.g. bridges & culverts)

Considering the uncertainty of climate change, rail network owners and operators need to identify the risks associated with this phenomenon to better understand the impact and mitigate the potential risk to existing infrastructure for the service life of the asset.

High Capacity Signalling

55 kilometres of next generation High Capacity Signalling (HCS) will be installed as part of Melbourne's Metro Tunnel Project. Trains will be able to run two to three minutes apart as a result of this cutting-edge technology. Current train track associated signals allow 12 - 20 trains to run per hour however high capacity signalling will allow trains to run closer together therefore increasing the amount of trains to 24 running safely and reliably per hour.

There will be dedicated control centres built across Melbourne that will be staffed with experts who will monitor the trains running through the Metro Tunnel using this new system.

High Capacity Signalling is based on a moving block signalling system that increases flexibility into the system which enables trains to operate closer together. The HCS is able to monitor the position and speed of each train operating on the train line and set consequential limits on trains that are following which will ensure that they can always stop a safe distance away from the train in front.

The new High Capacity Signalling system will work hand in hand with new High Capacity Metro Trains. These trains will have 20% more space than existing trains in an effort to reduce overcrowding. This is a timely upgrade to Melbourne's transport system as Victoria's population continues to rapidly grow.

Alternatives to the Diesel Electric

Increased efforts to reduce greenhouse gas emissions and greater community expectations around air pollution will drive change in many sectors over the coming decades. The transport industry is not immune to this pressure and railways will be expected to play a part in reducing negative environmental effects.

The continued use of diesel fuelled locomotives may be restricted as part of this change. Where the electrification of rail lines is cost prohibitive, options such as batteries and hydrogen fuel cells could be alternative locomotive power sources.

Batteries have decreased in price and increased in energy density substantially over the past decade. However, large scale adoption of battery powered locomotives would still require further improvements to battery technology, or the rail industry may need to further develop innovative solutions to bypass range restrictions such as hybrid systems. Bombardier's Electrostar electro hybrid train, in service in the UK since 2015, targets partially electrified routes where gaps between electrified track can be covered by a battery range of 50km. With further improvements to battery technology the range of these trains can be extended with less reliance placed on electrified track for recharging.

Hydrogen fuel cells show promising potential to replace the diesel engine whilst only producing water and heat. They have a quick refuelling time and superior power generation to weight compared to batteries. However, implementation of hydrogen fuels cells would require the installation and logistics of new refuelling infrastructure, as well as safety considerations due to the explosive potential of pressurised hydrogen in the event of any serious incident. There are currently only a few hydrogen fuel cell trains in existence; Alstom's Coradia iLint is currently the only hydrogen fuel cell train in commercial use running on a regional passenger service in Germany.

Drone Surveying and Mapping

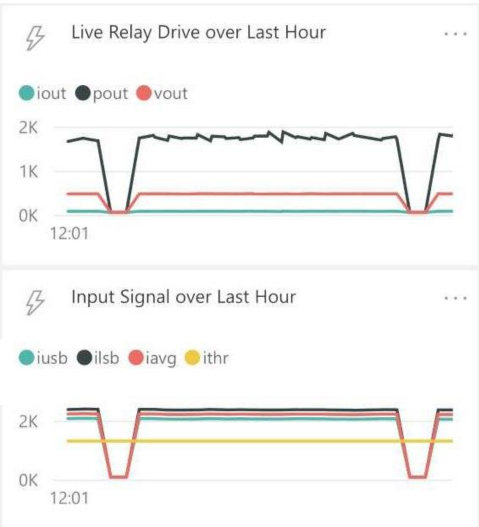
Why?

Survey is an important part of Railway design and getting this right the first time is crucial to accuracy of design. However, on site conditions are often not ideal for surveying, where there are a lot of vegetation, access issues and can often be unsafe. By using drone technology, not only that the risk is mitigated, survey data which is previously inaccessible can be extracted, increase the quality of the extraction and increase the cost and time efficiency of surveying.

What?

For example in the UK, Network Rail has implemented Vogel R3D UAV to do a range of data and image extraction. From a 25m height, the drone's 100 megapixel camera and bespoke algorithms, the drone is able to capture an accurate aerial image, extract 3D point cloud data and create a 3D model of the railway corridor. Drones such as this one, can cover a 6km section in less than an hour and still maintain a 96% level of accuracy.

Low Cost Network Connected Rail



Traditionally using a cellular modem for a single piece of equipment would cost a double-digit service fee per month to connect. With new NB-IoT and CAT-M1 4G LTE networks, pricing models are setup to charge by data-used rather than by number of connected devices.

Depending on the kind of train detection used, track circuits can potentially be spread every 700m over hundreds of kilometres of track - placing the number of track circuits well into the hundreds of units. Previous pricing models would make connecting these track circuits to cellular connections financially unfeasible. These new cellular technologies allow for predicting track circuit faults hours before they occur across entire networks financially feasible and well within our current technological capabilities.

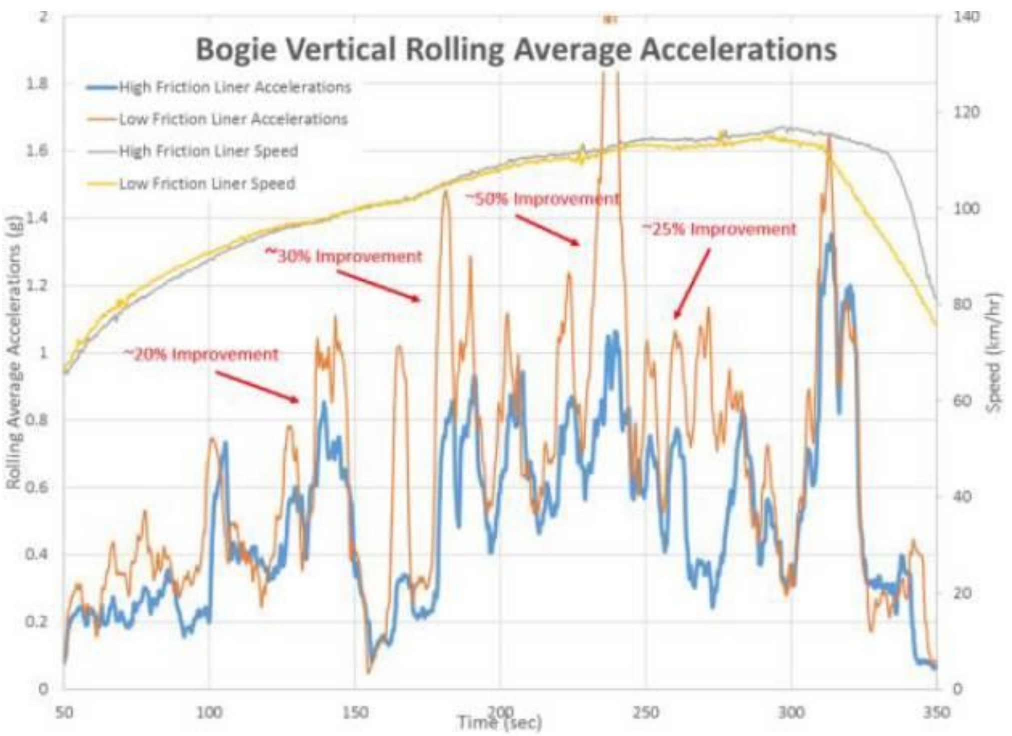
Utilisation of Computer Modelling in the Rail Industry

A vehicle rough ride is a common occurrence in older railways. This can be due to many factors in either rolling stock or the track. One operator has carried out investigations and identified a specific type of vehicle that exhibits bogie oscillations at high speed running causing rough rides. The vehicle was instrumented to determine the extent of problem. The data collected from the investigative test was analysed using an analytical model to understand the root cause of the problem. This provided the subject matter experts with possible solutions to reduce the extent of the oscillations.

As these solutions require lots of real life trial testing to provide proof of concept. Numerical modelling was utilised to conduct these iterations. The numerical model was initially validated by data received from the initial investigative testing. This provided the required confidence to model the five proposed solutions and identify which of these is able to reduce the oscillations, provide a safe and comfortable ride for the passenger, and be most cost effective given the short life left of this ageing fleet. From the five solutions tested only two were capable of achieving the ride quality index without implying major changes to the bogie design.

By applying these modifications of increasing primary spring stiffness –while maintaining compliance to safety against derailment -, the vehicle speed at which the excitation took place was increased from 105 km/hr to 119 km/hr above the vehicle's maximum operating speed of 115km/h. Secondly, increasing the dynamic coefficient of friction of the axle box liners from 0.2 to 0.5 increased the damping effect on the bogie to improve the ride quality for Metro passengers.

This methodology shows that using computer modelling is an alternative platform to predict what occurs to the train system when applying configuration changes through the model. This allows for quick view of the outcomes, repeat tests several times over in a safe environment.



These results are present at the International Conference of Rail Excellence "Awadalla, M.; Guettler, J.; Anderson, A.; Azobi, F.; Ward, D.: 'Analysis and Rectification of Poor Bogie Dynamic Behaviour by using Computer Modelling and Field Validation', IET Conference Proceedings, 2018"

Thanks for reading

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