THE STEPHEN MARICH LECTURE:

How to use data is rail's big challenge

TONY DUBOUDIN

Images TONY DUBOUDIN

+ Ben Lombardo, managing director of Speno Rail Maintenance Australia, and son Kane (right), who also works with Speno, met up with Bruce Butt of Rail Geometry.

More than 200 railwaymen and women and students attended the Stephen Marich lecture in railway engineering at the Victorian Arts Centre in Melbourne in March, organised by the Institute of Railway Technology at Monash University.

The annual event honours the 40-year contribution to the industry of Dr Stephen Marich – a pioneer of heavy-haul railway research in Australia.

The attendees gathered this year to hear veteran American railway engineer and expert on rail asset management and performance Gary Wolf share with an Australian audience some of his 46 years' experience in the industry.

Mr Wolf took his audience on a wide-ranging tour of the issues associated with the rail-wheel interface, improving rail asset life and some of the most up-to-date solutions while putting things into historical perspective.

Some of the topics Mr Wolf touched on included the use of drones to access otherwise-inaccessible and dangerous areas, trackside wheel monitoring, the use of ultrasound to detect faulty or worn bearings and the use of onboard and in-cab videos.

He made the important distinction that railways did not want data, they wanted useable information. He said they wanted the "As" when it came to information:

- automated algorithms to find faults;
- autonomous systems;
- accuracy;
- asset management;
- accessible databases;
- answers, NOT data; and
- all kinds of weather and environments – reliability.

Mr Wolf listed the various forms of track and infrastructure monitoring which were currently in use before looking ahead to emerging technologies.

He listed the legacy technologies as:

- ultrasonic rail flaw detection;
- track geometry measurement;
- gauge restraint measurement systems (GRMS);
- ground-penetrating radar (GPR);
- rail profile and rail wear;
- rail friction measurements (tribometers);
- bridge monitoring; and

+ Guest networking preceded the lecture.

THE STEPHEN MARICH LECTURE:

+ IRT director Ravi Ravitharan presented guest speaker Gary Wolf with a certificate of appreciation from IRT, accompanied by Railway Technical Society of Australasia chair Phillip Campbell OAM.

• slide detectors or seismic detectors.

He then listed what he identified as the new emerging and developing technologies:

• automated cross-tie/sleeper inspection and grading, X-rays;
• vision system to inspect fasteners, bolts, plates, rail seat abrasion;
• track deflection measurement; track stiffness;
• autonomous wagon measurements of performance and geometry;
• rail surface conditions (RCF – corrugations, weld dips and micro-cracks) (eddy current); and
• rail neutral temperature monitoring.

Mr Wolf said ballast integrity was one area that had not received as much attention as he believed it should and praised the use of ballast monitors, which were relatively inexpensive yet could monitor earth slip and provide alerts when subgrade was compromised.

On the issue of onboard locomotive monitoring technologies he said in the United States, under new federal law, any locomotive operating at more than 30mph (48kmh) put in service since 2009 must carry event recorders and monitors must be crash-hardened and have 25 channels and PTC functionality. This replaced an earlier law which stated that only eight channels of data were required.

Onboard locomotive video cameras are not mandatory under federal law but many railways are using them, mainly focusing on the track ahead. Some railways are experimenting with in-cab video cameras, which are used mainly for accident investigation and condition monitoring of locomotive performance.

Mr Wolf listed some of the companies producing monitoring and video devices, including Mrail, Harsco Rail, Deuta-Werke, SAIC and Wabtac.

He then moved to rail-vehicle-mounted condition monitoring systems and painted a rosy picture of the future for such equipment.

Currently, most nominally monitor vehicle location via GPS, lading temperature, shock/impact damage, and hatch and door close/opening and tank pressure.

Newer technology will allow monitoring of bearing temperature, brake status and vehicle ride quality and speed, reduce idle dwell time and demurrage, prevent theft, monitor locomotive fuel level and consumption and prevent unauthorised asset use.

Looking ahead, Mr Wolf said he also saw a great future in the use of drones by railways. He listed the key benefits of the technology as:

• **speed** – They can be quickly deployed after storms and are faster than getting employees out to carry out inspections and with track protection.
• **safety** – Drones can be used in locations that are unsafe or dangerous for humans, such as on bridges, piers and rock formations, in snow, avalanche areas and floods, at derailments (HAZMAT) and in culverts and tunnels.
• **economics** – They reduce labor and energy costs, reduce the time taken for inspections, reduce track time requirements, improve capacity and improve worker safety.

Wayside detection and inspection was the next point touched on by Mr Wolf. Again, he listed the existing or legacy systems and compared them with the new and developing technologies. He listed the legacy systems in use today as:

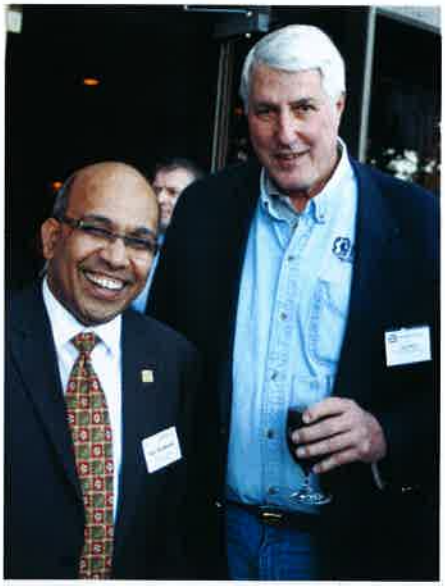
• hot box detectors;
• dragging equipment;
• high and wide clearances;
• wheel impact load detection (WILD);
• truck performance detectors (TPD);
• truck hunting detectors;
• wheel profile;
• hot/cold wheel; and
• low air hose.

He listed the new and emerging technologies as:

• wedge rise;
• brake shoe thickness;
• coupler securement;
• safety appliances (ladders, grab irons, platforms); and
• ultrasound and acoustic hot box detectors.

Mr Wolf said that before automated

+ Dr Stephen Marich responded with his thoughts on this year's lecture.



+ IRT director Ravi Ravitharan welcomed guest speaker Gary Wolf.

technology came to the scene railways relied on visual inspections, physical testing and inspection, and shop measurements. These had problems including human bias in making assessments, the condition of the human (sickness, impairment, ailments), environmental influences (darkness, rain, snow, bright sunlight, distance, time) and measurement errors.

He listed the enormous amount of data produced in North America by detection devises and the amount of information produced:

- incoming: 300-plus wayside detectors reporting 4300 trains a day or 400,000 vehicles a day equalling 470,000,000 records a month; and
- outgoing: 50-plus outbound data feeds with 1.7 million vehicles monitored and 1600-plus daily event notification messages sent out.

Mr Wolf, using data produced by the University of Illinois in 2010, estimated the savings to US railways of improved condition monitoring as US$110 million ($144m) broken down as:

- reduced derailments as an average of US$38m ($50m)a year;
- reduced labor costs at US$35m ($46m) a year (estimated); and
- reduced in service failures US$37m ($48m) (estimated).

Mr Wolf then covered a number of issues relating to bearing overheating and failure, the distribution across the US of wayside detectors and their efficiency, and the various commercial products designed to detect bearing failure and overheating, as well as dragging equipment detectors and high and wide detectors.

Other issues he covered included wheel monitoring, broken and deformed wheels, wheel track performance monitoring, track hunting detectors and automated wheel inspections.

He said that the emerging wayside detection technologies included machine vision, track wedge rise, brake shoe thickness, securing coupling, safety appliances such as ladders, grab irons and platforms, and acoustic and ultrasonic bearing detectors.

Mr Wolf concluded by posing the question: "Where does all the data go?"

He pointed out that one locomotive produces 260 gigabytes of data a day, which translates across a 3000-locomotive fleet to a staggering 730 terabytes of data every day.

He said that private companies in the US collected much data on other companies' equipment and track but sharing was practically non-existent.

Railways needed to learn how to use "big data" to effectively utilise the data coming from all the sensors deployed in the field, Mr Wolf said. They must turn data into decisions on matters such as when to tamp and when a bearing would fail.

They also needed to understand how data mining and artificial intelligence could help to find trends and predictive relationships within the mounds of data: "We need to find the needle in the haystack."

Mr Wolf said there had been significant advancements in automated detection, inspection and monitoring systems in the past 15 years. Many technology developments had been at small start-ups that had been absorbed into larger corporations. There were inherent advantages to offering turnkey suites of inspection services.

New and emerging technologies needed further testing and investment to prove their benefits, he said. Also, they needed the support of regulatory authorities. Mr Wolf said these devices eliminated the subjectivity of human inspection, improved the day-to-day reliability of inspection and could change "finders" into "fixers".

"The next challenge to increase the deployment of these devices is to justify capital expenditure through relief from costly mandated human inspection of track and equipment," he said. "Using automated detection data, the rail industry can move from reactive maintenance to preventive/predictive maintenance."

Another challenge facing every railway was what to do with all the data. Advances were needed in data warehousing and data mining to extract the maximum value from that data.

"And we need automated algorithms to interpret and analyse data. We can't have humans poring through terabytes of data."

Dr Stephen Marich, wrapping up the evening which carried his name, said many of the safety and monitoring systems that had been outlined during the lecture were developed 10–15 earlier and were only now coming into use.

He said the one issue that had not been covered was that of noise, which heavy haul did not need to be concerned about but urban rail did.

Closing the evening, Paul Daly, CEO of the Rail Industry Safety and Standards Board (RISSB), said people outside the rail industry had a perception that the industry was old-fashioned.

In fact, the industry was "at the cutting edge of technology use", he said.

Mr Daly said the challenge was that industry standards needed to keep pace with the new emerging technologies. T+S

Standards in the spotlight

THE FOLLOWING DAY, THE Institute of Railway Technology (IRT) hosted a workshop at Monash University exploring track maintenance standards.

The event featuring presentations by visiting international speaker Gary Wolf; Andy Webb from the Office of the National Rail Safety Regulator; Phillip Campbell OAM of the Australian Rail Track Corporation; and Graham Tew, IRT's research manager; and was chaired by Chris McKeown from the Victorian Government's Office of the Chief Investigator, Transport Safety.

The July–Septeber (21-3) issue of Track+Signal will carry a comprehensive report and photographs from the full-day workshop. T+S