Attention surges for turnout lecture

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The audience was welcomed by Professor Mohan Krishnamoorthy, pro vice-chancellor of industry partnerships at Monash University and a professor of operations research in the mechanical and aerospace engineering department at the University of Sydney. In his comments Professor Krishnamoorthy reflected on a favourite pastime during his childhood in India, where his family lived close to a large railway crossing; listening for the whistle of the approaching Madras-Bangalore train every morning, then waving to the passengers and driver, or counting the wagons of freight trains carrying cattle, coal or grains as they passed. "Why are people so fascinated by trains?" he asked. "As children, most of us had a fascination with trains, and for most of us in this room this fascination has continued on into adulthood."

That interest eventually led him to work in scheduling in his early career life. As pro-vice-chancellor he assists in cross-faculty and cross-campus engagement with industries including rail. "Anything to do with trains is immediately exciting and invigorating," he said.

He said industry partnerships were "vital to Australian universities today" and as part of that RIT was "a compelling and strong front door to Monash's engagement with industry - it is THE door." Monash University had campuses in South Africa, Malaysia, India and, most recently, China. Professor Krishnamoorthy said, along with a study centre in Italy, and had unveiled a new strategic plan just last year.

"RIT has grown to be one of the university's most successful business units. Today it is the premier applied track and vehicle research facility in Australia."

He pointed to projected investment of more than $500 billion by India, China, Brazil and Middle Eastern countries alone over the next three to five years as evidence of rail's ascendant world. "Already 25 per cent of RIT's customers are international," Professor Krishnamoorthy said, adding that demand for such partnerships was likely to expand rapidly.

He concluded: "So, through the work of RIT and other institutions, the plethora of young people who rush out tolevel crossings to see trains chug past is in good form to look forward to much more advanced technology developments in railway engineering that result in safer and more cost-effectively and efficiently maintained tracks."

Adam Morris, chair of the Railway Technical Society of Australasia's Victoria-Tasmania chapter, introduced the evening's keynote speaker.

In welcoming Professor Kassa, Mr Morris also delivered a potted biography of the man in whose honour the lecture was named: Dr Marich.

He said Dr Marich had spent more than 40 years in railway engineering and research, particularly in relation to the rail-wheel interface. He had found a key in enabling the activities in the Pilbara region of Western Australia to handle 40-tonne axle-load. His key work and a contribution to the Australian economy that could be measured in "billions of dollars" had been features in his induction into the International heavy-haul rail hall of fame and the naming of the lecture in his honour, Mr Morris said.

Professor Kassa is attached to the Department of Civil and Transport Engineering within the Faculty of Engineering Science and Technology at the Norwegian University of Science and Technology (NTNU). He is also a professor at the Norwegian University of Science and Technology (NTNU) and a director of the Institute for Rail and Urban Transport.

"NTNU has 13 campuses just in Trondheim," he said, "and is the largest university in Norway and most probably all of Scandinavia. It is also represented in Gjovik and Ålesund. "One of our residents in Trondheim is a student and one in three is connected to the university." He said more than 80 per cent of Norway's engineers were educated at NTNU.

"Annually we have about 360 doctoral graduates, and in 2014 we had two colleagues from the mechanical faculty who received the Nobel Prize."

The university was founded in 1910, its first railway professor was appointed at that time.

Professor Kassa said he had spent the previous four weeks at RIT working on various projects, during which time his eyes had been opened to the extreme tonnages moved by rail in Australia. "In Europe when we say heavy we mean a maximum of 25t or 35t axle-load - that's in Sweden or Norway," he said. "Here you are talking 60t axle-load."

He said the other contrast he had noted between the continents was in temperature. "In Australia, it is up to 16°C minus and when I arrived in Melbourne it was plus 20°C.

Professor Kassa said he had been concerned about the potential for reducing turnout failure through modifying track gauge and/ or stiffness, based on analysis of failures in Belgium, Italy, the Netherlands, the UK, Sweden and France. Of those six countries, Belgium had the highest density of turns with 1.88 turnovers per kilometre of track, he said. At the other end of the spectrum, in France there was only 0.4 of a turnover per kilometre.

He said his recent work on turnouts examined both "fixed" and "swinging" crossings.

Research conducted in Europe had revealed several triggers for turnout failure, Professor Kassa said. Most commonly, defects were caused by fracture, railhead cracks, plastic deformation or 'lifting', wear, switch-breakage, contact-rolling fatigue and surface damage on both fixed and swing-type crossings, ice falling from moving trains onto tracks - a frequent obstruction in northern Europe - was not something Australian railway engineers needed to consider, he said.

Professor Kassa said remedies ranged from the reducing the number of turnout - on a network "If you don't have any turnouts then you don't have any problems, but that will be at the cost of losing flexibility and will affect capacity" - to using more durable and advanced materials. Preventative rather than corrective maintenance was effective, as was optimising track geometry (layout), support stiffness (structure) and rail pro-
files. "More than 40pc of failure modes are related to rail mechanical and track geometry failures," he said.

His research had shown that while several variations had been examined, widening the track gauge by 12mm produced the greatest performance increase, Professor said. These benefits included a "very significant reduction of wear and rolling-contact fatigue indices along the switch panel". This was consistent in both facing and trailing moves for the through route.

"Reducing the stiffness variation along the switch panel also seems to improve turnout performance," he said. "A considerable reduction in wear is obtained when both the rail-pad stiffness and under-sleeper-pad stiffness are optimised."

Professor Kassa concluded by saying that although the technology of turnouts was very old, the same principles continued to apply. "Often, most of the problems are associated with the varying rail profile guiding the wheel from one track to another," he said. "There has been some advancements in the design of S and Cs but in not a sense that the production of turnout components and their operation are different from the traditional design.

"There is huge potential for innovation in turnouts: a new concept that requires no change in rail profile and that uses a uniform rail cross-section both at the switch and in the crossing zones with a mechatronic system. The components will have active systems which actively communicate with the approaching train and adjust according to the route to be followed. They will be modular and prefabricated with inbuilt sensors and identification tags that are easily readable by passing trains and inspection vehicles. This will enable fast replacement of defective parts and reduce maintenance time."

Dr Marich responded to Professor Kassa's presentation by joking that he was not, in fact, dead - that while the lecture was named in his honour, it was not a memorial.

Lightheartedly, he went on to say "the best type of turnout is the one that's not there at all - just take all the turnouts away and you'll see then that you have a nice continuous structure."

"That's not reality, though," he said, "so we're left with thousands of turnouts."

He said he was particularly impressed by the two things which promised considerable benefits within a relatively short period of time: gauge widening - which he could imagine would be introduced within the next 10 years - and stiffness control. He said the concept of "meccano-style modular construction" would take much longer to become reality and might be presented 30-40 years into the future "in the 50th Stephen Marich lecture".

In closing the session, Graham Tew, principal research fellow in the Faculty of Engineering at Monash and a former director of IRT, said he had not been optimistic when two years earlier the proposal for a lecture on rail engineering had first been raised. However, the night's attendance had jumped from 100 in 2015 to 180 this year, he said, representing "I would guess, 50-plus organisations". "Maybe the railway people are just so poor that as soon as you put on free food they're going to show up anyway," he said.

More seriously, he thanked Mr Ravitharan and his executive assistant, Connie Glover, for their organisation of the event.

Referring to Professor Kassa's standing in Norway, he said: "I don't believe that anywhere in Australia we have a professor of railway engineering."

Mr Tew said research such as Professor Kassa's was particularly relevant to the day-to-day operations of industry. "Working in the applied world in which we do, we all know that the answer was required yesterday."