

# Transforming Australia's rail industry



UNIVERSITY  
OF WOLLONGONG  
AUSTRALIA



*Distinguished Professor Buddhima Indraratna, pictured with the Rail Track Process Simulation Apparatus in the SMART Infrastructure Facility.*

**The University of Wollongong (UOW) is leading the way in research and training that provides solutions to deliver increased rail speed and more efficient freight services nationally and internationally.**

The Australian rail transport network is the sixth largest in the world. This poses significant challenges in the fields of engineering and advanced manufacturing to design, construct and maintain efficient infrastructure.

The maintenance of existing railways, along with the development of heavy haul networks with increased speed and axle loads can benefit the national economy by increased productivity, particularly in mining and agriculture industries. Commuter transport can also be improved with new materials, advanced manufacturing, and innovative design and construction.

Australia's rail industry requires more skilled technologists to meet the needs of the rail sector during this transformation. Rail engineering and manufacturing is expected to grow significantly in Australia over the next 20 years, with enormous increases already seen in the United States, China, Japan and India.

The Centre for Geomechanics and Railway Engineering (GRE) was established at UOW more than a decade ago and it is one of the three nodes forming the Australian Research Council (ARC) Centre of Excellence for Geotechnical Science and Engineering.

Building on the impact GRE has already made in rail geotechnics, the ARC recently funded a new training centre at UOW to equip the next generation of engineers with the knowledge and skills imperative to maintain and upgrade Australia's rail network.

## ADVANCED KNOWLEDGE AND PRACTICE SKILLS

The Australian Research Council (ARC) Industrial Transformation Training Centre for Advanced Technologies in Rail Track Infrastructure (ITTC-Rail) is the first rail training centre to be funded by the ARC.

ITTC-Rail has received \$3.9 million in ARC funding for the Centre to commence in 2018, while UOW has contributed \$1.03 million. Another \$1.8 million has been contributed from partner organisations. About 20 PhD students will be trained at the Centre over four years.

Distinguished Professor Buddhima Indraratna, from UOW's Faculty of Engineering and Information Sciences, is the Centre Director. He is also the Founding Director of CGRE. ITTC-Rail is a collaboration among UOW, Swinburne University of Technology, Queensland University of Technology, Curtin University, University of Sydney, University of Newcastle, University of Queensland and Western Sydney University, together with partner organisations including the Australasian Centre for Rail Innovation, Metro Trains Melbourne, Bridgestone Corporation, Snowy Mountains Engineering Corp, Innovative Technology Beijing, China Railway Eryuan Engineering Group, ECOFLEX, Geofrontiers, Polyfabrics, NuRock, and Elasto-Plastic Concrete.

The Centre's key aims include:

- Creating innovative engineering solutions and products to provide solutions to major railway challenges that can enhance railway performance and extend infrastructure longevity.
- Developing a skilled professional workforce through a series of R&D, and training programs carried out in partnership with participants from all sectors of the rail industry. This will address the future technological requirements of the industry by rejuvenating higher degree training.
- Advancing fabrication techniques and more resilient product development. The greatest challenge in cost-effective and long-lasting rail infrastructure is track degradation.
- Developing and implementing strategies to commercialise manufacturing, engineering and design innovations to help grow construction and manufacturing businesses servicing the rail industry.
- Assisting in reforming technical standards and regulations.
- Improving global competitiveness and position the country as a global R&D leader in rail engineering.

## CREATING A UNIFIED NETWORK

One of the aims of the ITTC-Rail is the creation of a unified network across rail industry, academia and public/private bodies servicing the rail industry.

The consortium of research providers includes eight universities spanning four states, along with national and international partner organisations.

ITTC-Rail already has well-established relations with overseas R&D sectors of the rail and pavement industry, track component suppliers and many academic institutions involved in rail research.

These links will be critical for establishing the Centre as an internationally-renowned research training centre and a prominent source of high-calibre PhD graduates.

## TRAINING, INNOVATION AND IMPACT

ITTC-Rail is a unique national centre for doctoral and postdoctoral training innovation, and its research outcomes are focused on rail industry transformation.

Industry-driven collaborative research at ITTC-Rail will enhance track infrastructure expertise, embrace new technologies throughout the integrated supply chain, and help construct tracks for increased safety, stability and longevity. These tracks will accommodate increased axle loads and higher train speeds.

Interacting with the Advanced Manufacturing Growth Centre, ITTC-Rail offers a one-stop shop for the training of young innovators.

The Centre's four integrated research programs are:

- Track dynamics, advanced simulation and design innovation. This includes mitigating destabilising forces via mud hole and mud pumping alleviation; improving life span of critical track components; digital designs for safer level crossings; design software for higher axle loads and speeds.
- Materials selection and construction processes. This includes improved steel and concrete components; smart sleepers; novel manufacturing processes adopting 3D printing.
- Sustainable rail infrastructure using recycled and non-traditional materials. This includes vibration mitigation and damage control through recycled tyre products; innovative subculture stabilisation methods.
- Health monitoring, safety and reliability. This includes real-time track monitoring; digital simulation of track components; field data analysis and performance validation.

ITTC-Rail will provide significant economic and social impact. The total predicted value generated through Centre operations every year is \$4 million, which includes the reduced upkeep costs for Australia's rail network. The Centre will also place up to 20 HDR students in industry every year.

## PROVEN TRACK RECORD

The Centre for Geomechanics & Rail Engineering (GRE) was established under the leadership of Prof Indraratna in 2000. It is part of the ARC Centre of Excellence for Geotechnical Science and Engineering, together with the universities of Newcastle and Western Australia.

The GRE is equipped with seven state-of-the-art testing laboratories and an iconic Rail Laboratory that service the rail industry. These labs form an integral part of UOW's SMART Infrastructure Facility, which is one of the largest research institutions in the world dedicated to helping governments and businesses better plan for the future.

The GRE is an outstanding source of high-calibre PhD graduates and has been acclaimed by Engineers Australia as one of the most prominent bases for rail geotechnics in the world.

Among recent projects, Prof Indraratna and his team have been examining the factors that cause mud pumping on rail lines. Mud pumping occurs particularly in areas where the ground is waterlogged. It causes millions of dollars of damage to Australia's rail network every year and increases the risk of derailment. A pending international patent includes the use of recycled rubber tyres infilled with waste materials as a "shock absorbing" layer for minimising the degradation of track components.

Research-driven innovations that have been used to improve industry practices include the development of a landfill comprising recycled materials for reclamation work at Port Kembla, one of the busiest commercial harbours in New South Wales. Prefabricated vertical drains have also been developed to improve rail track stability, in addition to design software for rail tracks. These new developments have already been put to practice and tested in real-life conditions in Bulli, Sandgate, Singleton and Ballina.

## INDUSTRY ENGAGEMENT AND MENTORING

The industry partners of ITTC-Rail have experienced staff to guide PhD students, especially during their one-year placement in industry. Advanced post-graduate courses and professional development workshops will be developed at participating universities.

Prof Indraratna has a long established and successful history of collaboration with industry. Along with broad industry engagement, he has an outstanding record in mentoring. In the past 20 years, Prof Indraratna has supervised more than 60 PhD students to completion. Many of these graduates now hold positions of influence in industry and academia.

Prof Indraratna and fellow researchers have been honoured with numerous awards for their work.

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