Inquiry into Skills Shortage in the Rail Industry

Submission from Monash University, Engineering Faculty

MONASH UNIVERSITY

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Background to Monash University Submission
Monash University, the largest University in Australia and a member of the Group of Eight (Go8), is involved in a number of areas of research and teaching that feed into the rail industry. Of particular relevance are a number of centres which have activities of direct relevance to the rail industry, namely:

- The Institute of Railway Technology (IRT), Australia’s leading vehicle track and rail applied research institute,
- Monash University Accident Research Centre (MUARC), known internationally for its research into transport safety and
- The Institute of Transport Studies (ITS), The National Key Centre for Transport Management.

These centres provide focal points for the University’s capacity in the areas of engineering, accident research, human factors, logistics and transport planning which are of relevance to the rail industry. Each of those centres engage in collaborative and contract research for a diverse range of organizations in the transport sector. This means that there is an interactive, multidisciplinary environment for research and teaching, with close links with industry. The Monash academic and research capabilities span the rail industry, from passenger transit to heavy haul and freight. The team has already become involved in seeking ways to stimulate interest among students to work in the rail industry. Key staff working on the interface of research, education and the railway industry are in a position to observe trends in both recruitment and attrition rate and have provided input to the submission below. In this submission, the knowledge base and industry experience is explained, to demonstrate that there are ways in which to effectively expose students to the potential for interesting careers and personal development within the rail industry. This explanation includes some coverage of the areas of expertise within Monash, to demonstrate that the teaching and research skill base, and environment is already in place to address the skills shortage.

This submission specifically addresses point 4 of the guidelines for submission: "Whether there is any need for increased training opportunities at university and trade levels and, if so, how industry can stimulate student/user demand”.

Railway Industry and Skills Shortage
In the 2006 ARA\textsuperscript{1} report, the Changing Face of Rail, it was reported that the majority of the workforce in the railway industry is aged between 40 and 50 years. There have been some successful recent publicity and career initiatives leading to an increased numbers of rail professionals aged less that 25, but there has also been a high attrition rate in this younger group, leaving a major skills shortage in the mid-career age group of 25 to 40 years. The high turnover rate amongst new recruits in the railway industry is up to five times greater than any other industry group [ARA report, The Changing Face of Rail, 2006]. The Monash perspective regarding the causes of this attrition is consistent with those observed in earlier reports, including the report \textit{Engineering for Rail Sector Growth}, RTSA\textsuperscript{2}, Engineers Australia, 1999) and the report \textit{Railway Engineering Competency Profile} (RTSA, 1998). These are:

1. That younger employees perceive few opportunities to expand their knowledge base, there being a strong body of knowledge held by the more mature career staff, and little opportunity to gain high level skills and insight;

2. That there is a perception among younger employees that the industry is very low-tech and non-progressive;

3. That there is a perception that there is little investment in rail infra-structure, thus limiting necessary technology development, and potentially adversely affecting rail safety and accident prevention;

4. That there is a perception of inadequate integration of the rail industry into a broad transport planning and logistics framework;

5. That there is a lack of exposure to the diverse range of specialties that exist under the rail industry umbrella.

Strong partnership and interaction among Government, University and industry bodies could go a long way towards addressing these points, with partnerships recognizing the need for contributions of capability, capacity, finance and long term planning. The current submission argues that selected University courses should be supported in developing “rail industry specific” undergraduate electives, short courses and projects that are, directly related and linked to industries; and post graduate opportunities, by way of funded Doctoral positions. The goal would be to demonstrate that railway is an important transport mode in Australia and that significant opportunities exist within the rail industry for career development and that the rail industry is one in which there can be a vibrant research life. In short, that the sector can provide a stimulating career future. University courses at each level should have the direct involvement of industry

\textsuperscript{1} Australasian Railway Association

\textsuperscript{2} Railway Technical Society of Australasia
and deal directly with industry issues, to encourage ongoing input and dialogue regarding research and professional development in the rail industry.

**Railway Engineering Education in Australia – Current Status**

The Cooperative Research Centre for Railway Engineering and Technologies (previously Rail CRC) has developed railway engineering postgraduate courses. Monash University was one of the Universities that took part in the previous Rail CRC. Experienced personnel working within the Australian rail industry joined with Australian academia to develop postgraduate university programs to fast-track the careers of today’s newest rail industry recruits. These programs are now offered by distance education allowing rail personnel around Australia (and internationally) to learn on-the-job, mentored throughout by industry leaders.

Now, Rail Innovation Australia (RIA), the spin-off company of Rail CRC, has taken over the IP from the original Rail CRC and is planning to offer the railway engineering courses overseas, on a license or franchise basis.

There are Australian universities (See Appendix 2) currently offering postgraduate rail engineering programs by distance education. The four programs are all currently at different stages. Developed within the first Rail CRC, and jointly funded by the Federal Government, industry and universities, these programs aim to assist to reverse the increasing skills shortage in the railway industry.

It is a recommendation of this report that a more comprehensive, ongoing and interactive approach be sought to maintain the interest of younger career people in the rail industry and that a more innovative, research focused and progressive vision for the industry be developed.

**Potential paths forward in Reducing Rail Skills Shortage**

In the following paragraphs, we address points 1 to 5 listed above.

**Point1:** The Monash proposal pays particular attention to Victoria. We note that the railway related postgraduate courses currently offered are outside Victoria, and they are primarily made up of long term, course work-based programs. Short courses that would equip and motivate young engineering graduates within the industry with more specific rail-related skills and knowledge would be beneficial, to give a clear vision of a career path, and a more sustainable distribution of skill and knowledge base. Further, empowering and up-skilling younger employees would offset the apparent “knowledge ownership monopoly” of senior staff. A structured series of such courses and/or workshops, each of approximately two weeks in duration, funded by industry, and with government incentives of some kind (for example funding support to develop the required course material), could be organized to give the long term career development and training that appears to be lacking. Specific topic-based shorter workshops could also be organized. There is internally at Monash high expertise and
practical experience in discipline areas such as railway engineering, railway maintenance, structural engineering, corrosion, thermodynamics, welding technology, ultrasonic technology and so on. These would couple well with the more applied expertise from the specialist Monash based institutes as described below.

A series of short courses could earn students credits towards a recognized certification, providing incentive, motivation and status to the career roles in a manner that is not dependent on retirement of senior staff, and hence addressing point 1. These short courses would also provide direct and targeted access to a much broader program of professional development. In addition, providing some experience during the Bachelors degree in railway engineering (similar to structural and road transport electives) would encourage some graduates to become aware of industry opportunities and to become involved in the railway industry. It is our view that the short course learning method would be more effective than a full time undergraduate course, which would require recruitment at school level and specialization early on. It is also generally more attractive for students to have a fundamental, less specialized, first degree. Again, the upfront resource and financial investment is the major barrier to such initiatives, where Government investment would provide the missing momentum. The IRT has the management capability, industry requirements and contacts to organize such courses.

**Point 2: A perception among younger employees and students that the rail industry is very low tech and non-progressive**

During the Undergraduate years, we recommend that students have exposure to the varied, high tech and innovative aspects of the railway industry. At Monash, where there is a depth of supervisory experience and capability in the railway industry, this could be achieved by providing opportunities for student projects in the designated area, which could subsequently also lead to a greater interest in post graduate opportunities and careers in the railway industry.

Now that this submission has raised the profile of the skill shortage in the rail industry, and with support and encouragement from industry and government, Monash is in a position to implement plans to encourage greater exposure to the rail industry. For example, there are more than 200 final year projects in Mechanical Engineering each year. With the involvement of the IRT (see below) it would be possible to have more final year railway focused projects, ranging from pure industry projects to more fundamental but directed research for the rail industry. Industry interest and support for these projects would be very helpful and enabling, and bring the relevance directly back to the student.

There are also three design units in Monash undergraduate courses, where various case studies are taken and investigated in detail. It would be possible to add studies from the rail industry to these courses’ syllabuses. Similarly, undergraduate students are
required to complete a final year project in Professional Practice, and it would be possible to arrange for greater rail industry exposure through lectures delivered into this unit. The IRT also maintains close ties with The Railway Technical Society of Australasia, Engineers Australia, and seeks opportunities to promote railway careers at the Undergraduate level (see Appendix 3). This initiative is specifically designed to attract students into the railway industry at a higher degree or career level.

We believe that Government investment in the form of PhD scholarships would stimulate a research focus and a post doctoral entry into the rail industry that would stimulate more innovation, while also providing a strong message to young students that the industry is developing a strong and innovative knowledge base. Monash has strong capability in this area, but research scholarships are required, potentially from both industry and government. Lack of financial support is a major obstacle for aspiring higher degree students, and quite modest investment from industry or Government, in the form of high degree scholarships, could bring a new level of status and capability to the rail industry.

Monash has considered the role that a Masters Programs in Rail Skills could play. While Monash clearly has the knowledge base capability, there are substantial costs involved in setting up a Masters course, and it is unlikely that, at least in the early years, that there would be adequate fee returns to make this viable for the University. If Government and industry saw Masters Courses as a preferred path, Monash and other Universities would no doubt be able to participate with adequate external funding.

Point 3 – “...perception that there is little investment in infra-structure...”

Monash University is able to provide informed input into infrastructure planning, with researchers who have strong experience in infrastructure planning, research and teaching. An excellent path to dispelling that perception would be to expose students to the possibilities and have them be able to feed that back into industry. Not only would this contribute to the reduction of rail skills shortage, but it would also provide another path to drawing University expertise and knowledge into infrastructure planning. It would send a clear message of constructive action to the community.

Monash University, through IRT and with support from MUARC and ITS, will be able to use the expertise and practical knowledge that they have built up through long-term industry involvement. The University is therefore ideally positioned to develop short courses and project-based post graduate degrees which are relevant to the industry. It could also introduce elective subjects with relevant railway projects linked to the local railway industry needs which would enhance knowledge as well as enhance engagement of young graduates with the railway industry.

With support from the Victorian government and industry, Monash University would be in a position to offer the rail industry (local, national and international) these programs
which would enhance the careers of young professionals in one of the oldest Australian industries, which is now challenged by the need for rejuvenation and revival.

**Point 4: A perception of inadequate integration into broad transport planning and logistics framework**

The rail industry is key to industry logistics and public transport infrastructure. Aside from the matters that first come to mind in the areas of mechanical and civil engineering, students need to be introduced to the broader concepts. Monash has leading academics in the field of strategic transport policy, who are already addressing some of the gaps in public knowledge through academic programs. For example, relevant work of Professor Graham Currie and Associate Professor Geoff Rose of the Institute of Transport Studies (see Appendix1) includes:

- development of units in ‘Transport Planning and Policy’ and ‘Public Transport Planning’, which form part of the Monash Postgraduate Program in Transport and Traffic offered by distance education;

- industry training short courses targeting practicing professionals. These courses have been offered over the last 5 years in Melbourne, Sydney and Brisbane, and have also been offered internationally in Auckland and in Toronto, Canada.

Such courses demonstrate to industry that there is already strong activity and information available in the logistics and transport domain. The research activities of this one group alone demonstrate the active interest and progress in areas of:

- **Travel demand.** Research projects in this area are focused on: mobility management and travel behavior change, the role of information in influencing travel behavior, transport and land use interaction, disabled access and demand response to innovative transport modes and technologies;

- **Transport operations.** Research projects in this area are focused on: road based public transport, operations management, environmental impacts, intelligent transport systems and non-motorized transport;

- **Planning and management for transport and traffic.** Research projects in this area are focused on: road space and traffic management, investment appraisal and evaluation, demand management, and policy;

- **Public transport planning and management.** Research projects in this area are focused on: service planning and development, transport needs analysis, demand assessment and forecasting, rural and regional transport, mass transit and transport planning for special events.

**Point 5: Lack of exposure to the diverse range of specialties that exist under the rail industry umbrella.**
The rail industry embraces a lot of professional specialties, and it is important to consider the scope of this in relation to how Universities can address this. However, a University that can offer a comprehensive perspective to the Rail Industry would be an appropriate partner with Government and Industry to provide a coordinated approach to demonstrate the range of disciplines involved. Of key interest to policy makers, the public and students, is safety and comfort, since these are of direct relevance to the transport of people. An industry running passenger train services is, after all, in the business of transporting people, not just in the business of running trains. Human factors are an important aspect of this. Monash has considerable expertise in human factors, which would be included in short courses. The Monash University Accident Research Centre (MUARC), which is one of the world’s leading transportation and simulation research, consultancy, and training centers with significant human factors expertise. The Institute of Transport Studies at Monash University has considerable expertise in understanding how human factors affect ridership of railways and currently teaches an international industry short course covering these issues. Exposure of the rail industry via participation in short courses, higher degree or project work as previously described, gives a strong perspective on the human side of the rail industry. Taken in conjunction with the points discussed above, it demonstrates that it is possible to provide a view of the range of specialties that exist under the rail umbrella.
Appendix 1:

Institutes with academic research and teaching related to the rail industry at Monash University

The Institute of Railway Technology, Monash University

The Institute of Railway Technology (IRT) is a business unit within Monash University. IRT was established in January 2000 following the relocation of the Railway Engineering Group personnel from the Melbourne Research Laboratories (MRL) of BHP Billiton Pty Ltd (formerly BHP) to Monash University. The Institute commenced research activities in 1972 and has been able to draw on specialist skills in a wide range of disciplines and other laboratory and workshop facilities within Monash University, to position itself as an independent source of technical expertise for the railway industry. IRT now undertakes technology development, applied research and consulting activities, using project teams which are skilled and resourced depending on the nature of individual projects and the disciplines and expertise required.

The Institute of Railway Technology has an established track record in solving railway-related technical issues, and its solutions have been adopted by railway systems throughout the world. The Institute’s solutions are used by several heavy haul, freight, passenger and mass transit railway systems throughout the world, and are recognized by the International Heavy Haul Association as “best practice” in railway interface management.

The Institute has extensive experience in the assessment of vehicle and track performance through use of in-house simulation models and in-service instrumentation and monitoring. Aspects include development and implementation of wheel and rail profiles, wheel-rail lubrication procedures, defect assessments and wheel-rail maintenance procedures.

Some of the high profile research activities the Institute currently undertaking are as follows:

- Identification of key technical issues and technical/economic analysis in relation to the implementation of operational changes including axle loads, speed, cant etc;
- Resolving technical issues related to high rates of component deterioration in particular rail and wheel wear;
- Development, operation and data management for instrumentation systems to monitor axle loads, track condition and vehicle response including wayside detection systems (eg Wheel impact monitor, IOC, hunting car monitor, weighbridges...) to improve rail operations;
- Interruption and utilization of data from wayside protection systems and the subsequent recommendations to improve the rail operation
- Monitoring the performance of key components (wheels, rails, rail welds, etc) and maintenance activities associated with these components, and in particular all aspects related to the wheel-rail interface;
- Implementation of increased haulage capacity;
- Bridge rating and strengthening for current and proposed operations;
- Wheel/rail interface, including development and implementation of wheel and rail profiles, rail grinding procedures and wheel/rail lubrication;
- Performance of wheel and rail materials;
- Rail welding procedures;
- Ultrasonic testing requirements
- Specialized instrumentation tasks, including measurement of track and vehicle response parameters and wheel–rail related noise; and
- Extensive experience in track design and maintenance including the performance of steel sleepers under freight and heavy haul operations as well as rail selection.

The research and other technical activities undertaken by IRT for the railway industry are structured and funded either as single projects, or as a program of interlinked projects. Where activities are structured into a program, IRT personnel have extensive experience in the management and coordination of the program, in conjunction with the client organization. Their senior staff, and in particular their business manager, Ravi Ravitharan, are actively involved with Engineers Australia, and the development and promotion of rail industry careers (See Appendix 1 for a specific example) and they have conducted several practical training sessions within the railway industry.

Industry relationships via the Institute of Railway Technology

The Institute of Railway Technology has more than 80 international and Australian customers from the railway industry. The Institute’s long partnership with BHP Billiton Iron Ore (spanning thirty six years) providing technological advancements and cost reduction measures has helped BHPB Iron Ore to earn the reputation as a world leading heavy haul railway system.

IRT personnel are involved in key tasks for BHP Billiton, such as the development of technical specifications for key components (rails, wheels, other vehicle components), providing technical oversight of rail and wheel interface management, rail welding activities, technical interaction with key suppliers (rails, wheels, etc), and the provision and support of instrumentation systems that are used in a day-to-day operational role.

The Institute has significant experience in working with railway organizations in various parts of the world to resolve various technical issues as well as improve operational efficiencies and achieve operational targets. The approach taken in these activities is generally based on the successful model developed with the ongoing partnership with BHP Billiton Iron Ore.

IRT personnel were involved in railway research activities for Hamersley Iron (part of the Rio Tinto Group) from 1975 until the early 1990’s. More recently, IRT personnel have been
involved in the several key technical tasks of this organization (now known as Pilbara Iron Pty Ltd):

The Institute is also providing technical assistance to Laing O’Rourke with the construction of new railway track for the Fortescue Metals Group Ltd (FMG) iron ore project. IRT is providing technical support with the establishment of welding techniques and qualification of both flashbutt and aluminothermic welding procedures. In heavy haul operations welds are regarded as the weakest link in the track and establishment of appropriate welding technique to suit the operating environment is critical.

The Institute has a long-term partnership (more than 19 years) with Hong Kong’s MTR Corporation, one of the world’s most densely-utilised urban mass transit systems. The Institute of Railway Technology has conducted several studies to identify the causes of rail deterioration on MTR Corporation’s Urban Line tracks and to devise strategies to reduce the rate of deterioration. The technical improvements recommended through the modification of components and adoption of improved rail maintenance procedures provided substantial measurable benefits, including significant savings in operating and capital costs:

- Rail replaced due to gauge corner shelling reduced by 85% during the period annual gross tonnage (i.e. patronage) increased by approximately 10%;
- The life of rail has increased by up to 350%;
- The expenditure on rail replacement has reduced by over 50%;
- The performance of wheels has increased; the tread wear and flange wear of the wheels have reduced by 28% and 62% respectively.

More recent activities cover the development and application of modified rail profiles for the high speed Airport Line, and technical problem-solving within newly-constructed extensions to the Urban System.

The Institute has also been engaged by Hong Kong’s Kowloon Canton Railway Corporation (KCRC), initially in early 1990 to solve issues with the management of wheel and rail interface and the development of database to store track details and inventories. Since 2005, following the construction of new KCRC West Rail system, KCRC has engaged IRT to solve vibration issues with the new West Rail system and review and further refine and improve the interface conditions in the old East Rail system because of the changes in the operating environment including new rolling-stock and extensions to railway lines.

The Institute of Railway Technology has been assisting Singapore MRT Ltd (SMRT) to solve several rail defect issues and to minimise and/or eliminate rail deterioration including rail surface cracking and the development of corrugation in its urban railway network. In 1999, IRT conducted a detailed rail defect study investigating the causes of rail surface cracking and corrugations in its track. Singapore MRT has now implemented IRT’s recommendation to refine the wheel/rail interface characteristics and custom developed profiles to suit the operating conditions in Singapore MRT resulting with significant improvements with its rail condition.

The Institute of Railway Technology has conducted several investigations and provided technical assistance to ARTC on various aspects including rail management,
maintenance and performance related issues. IRT have issued several confidential reports. The team has also undertaken studies for several international clients, including Vale in Brazil, London Underground Tubelines, Malaysia Star system, New Zealand Tranz Rail and SNIM (Mauritania).

The Institute’s current activities include problem solving and research and development activities for operators and contractors in the railway industry, and manufacturers and suppliers of railway equipment and consumables, providing strong insights into the challenges and needs of today’s rail industry. Its activities include assessment of increased axle loads, assessment of cost reduction measures and benchmarking, vehicle/track dynamics, wheel/rail interaction, wheel/rail lubrication, rail/track/sleeper design, structural integrity of railway components, assessment of railway bridges, rail welds, railway related noise generation and propagation, technical & economic modeling, finite element modeling and analysis, track and vehicle instrumentation, laboratory and in-service (field) component testing (including non-destructive testing), material and product development, development of rail and steel sleepers, and maintenance strategies for rail and track.
Achievements of Institute of Railway Technology

Some of the Institute’s outstanding achievements are listed below:

- The Institute of Railway Technology was the winner of Monash University Vice-Chancellor’s Award for Excellence in Innovation & Collaboration in Research with Industry in 2008. The prestigious award was presented to the Institute for the innovative “instrumented ore car” project which uses instrumented revenue vehicle to plan and evaluate track maintenance in BHP Billiton’s busy iron ore line.

- The Institute of Railway Technology has also received honourable mention in “2008 RTSA Rail Engineering Industry Award” for the successful “instrumented ore car” project conducted for the BHP Billiton Iron Ore railway system.

- The Institute of Railway Technology was the winner of “2002 Rail Engineering Industry Award” for “Excellence in Railway Research”. The Institute of Engineers Australia’s Railway Technical Society of Australasia (RTSA) awarded this prestigious national award.

- Developed the process of Heat Treatment of Rails in Australia. Now heat-treated rails are used throughout Australia, especially in higher axle load lines.

- Instrumental in the development of Steel Sleepers. Now up to 500,000 steel sleepers are introduced annually in the railway systems in Australia.

- Pioneered profile grinding as part of rail maintenance. Now profile grinding has been adopted worldwide as a standard practice during rail grinding.

- Developed modified wheel and rail profiles for several heavy haul, freight, passenger and mass transit railway systems throughout the world to optimise wheel-rail interaction conditions. Initially modified wheel and rail profiles were developed for the heavy haul systems in the Pilbara.

- Developed, reviewed and enhanced engineering design and maintenance procedures for the Railway Industry. The Rail Selection Module and the Track Design and Maintenance Model are two popular technical/economic models developed by the Institute on behalf of Railways of Australia (ROA, now ARA). These models are still being extensively used by several railway systems in Australia (for example, QR, WestNetRail etc.).

- Actively involved in providing pro-active maintenance strategies for rails, wheels, welds and track. A Rail Management Model has been developed for MTR Corporation incorporating technical findings to assist with proactive maintenance and replacement of rails.

- The Institute has provided assistance to several railway systems with rail grinding procedures to facilitate the implementation of desired rail profiles, and maintenance of surface conditions to control rail surface damage (rolling contact fatigue).

- The Institute has conducted research activities with the aim of gaining a better understanding of material behaviour in wheel-rail contact (wear vs rolling contact fatigue). This has led to the development of improved rail and wheel materials (e.g. microalloyed wheels made by Comsteel, Australia).
• The Institute has conducted vehicle response assessment via instrumented track (hunting/asymmetric tracking). This resulted in the identification of specific vehicles which require maintenance to minimise any adverse damage to track infrastructure and to reduce the overall cost.

• The Institute has developed an automated wheel inspection facility (Wheel Impact Monitor - WIM) for the detection of wheel tread defects (eg skid flats). This product is currently marketed externally.

• The Institute has developed an instrumented vehicle system for real-time continuous assessment of track conditions under high axle load conditions. Recently that system has been adopted for heavy haul operations at BHPB Iron Ore in response to a need to identify track imperfections or track deteriorations and to improve track conditions. The system automatically downloads the data after each return trip and provides a report on track health.

• The Institute has developed techniques to instrument track and quantify track-loading conditions under a range of operating conditions (heavy haul/freight/passenger). This information is used in component design and to monitor the performance of track components (e.g. steel sleepers, rail welds).

• The Institute supports several railway systems with ultrasonic testing of their tracks. In many cases, IRT has developed or significantly contributed to develop the ultrasonic testing of rails within the railway system.

• Railway Industry recognised independent testing facility.

Track record of achievement:

As an example of how a University based institute can lead to strong academic and industry focused outcomes, the following list of Postgraduate and Final Year Projects that have involved IIR are included.

• The influence of composition on the microstructural response and mechanical properties of heat-affected zones of welds in pearlitic rail steels (2001)
  – Ross Parker (Materials Engineering)

• Defect Tolerance Levels in Aluminothermic Welds (2002)
  – David Tawfik (Mechanical Engineering)
  – Completed PhD

• Microstructure - Mechanical Property Relationships in High Strength Pearlitic Rail Steels of Relevance to Wear and Rolling Contact Fatigue Behaviour (2007)
  – Mina Hanna (Materials Engineering)
  – Winner of Inaugural RTSA Contact Mechanics Award

• The effect of wheel profile and track geometry irregularities on freight train and track dynamics (2006/2007)
  – UnggulWasiwitono (Mechanical Engineering)
  – Completed Masters Degree
 • Failure Modes in Railways (2007/2008 - in progress)
   - Kajan Kanagenthiran and Aymen Naseer Mohammed (Mechanical Engineering)
 • Effect of surface condition on web fatigue behaviour of rail flashbutt welds (2007/2008 - in progress)
   - Alexander Chen and Patrick van Raay (Mechanical Engineering)
 • Shear strain effects in rolling contact fatigue cracking of rail steels (2008 - new project)

Gerard Miller (Materials Engineering)

Monash University Accident Research Centre (MUARC)
The Monash University Accident Research Centre (MUARC) is one of the world’s leading transportation and simulation research, consultancy, and training centers. It is Australia’s largest independent injury prevention research establishment, with more than 70 research staff drawn from a wide range of academic disciplines including psychology, medicine, human factors, ergonomics, engineering, epidemiology, statistics, computing and education. Besides conducting applied contract research for a wide variety of Australian and international clients (including government departments of transport, safety associations, and private industry), the Centre has six professorial-level staff members who supervise a large number of postgraduate research students.

‘Human factors’ is the scientific study of interactions among humans and other elements of a system. Railway operations is one transportation system that can, and does, benefit significantly from directed studies in human factors and, at a minimum, some basic training in human factors for railway designers and engineers should be mandatory.

The Human Factors Team at MUARC specializes in transport-related human factors research and consultancy. Currently comprised of 15 scientists with backgrounds in human factors, experimental psychology, ergonomics, and computer science, it is one of the largest transportation human factors research teams in Australia. The areas of transport safety, intelligent transport systems (ITS), driver distraction, driver impairment, human error and human machine interfaces are just some of the very rapidly growing research areas studied by the team. The team also has expertise in the analysis of system safety in transportation, including road, rail and aviation.

Sound, theoretically-based models of system safety underpin the group’s research, which focuses on factors that shape and constrain operator behavior, and how broader task, environmental and organizational factors influence driving and/or operator task performance. Over the past 2 years, the team has been engaged to conduct human factors research across many safety-critical industries that cover...
surface transport (road, rail, tram), aviation, defence and the mining industry. Key to the research is the use of accepted, theoretically underpinned scientific methods to collect and analyse safety data, and the use of these data to provide evidence-based policy recommendations for clients.

The MUARC human factors team is well-positioned to participate in the development and instruction of a human factors component of a short course in railway operations and in supervising postgraduate-level students interested in a rail-related human factors research. Several team members have research experience conducting human factors studies relating specifically to the rail system, and others have prepared course material for, and taught, a full-year postgraduate level course in human factors (see course outline in the following table).

One particular rail-related area of research in which the human factors team has been involved is safety at rail level crossings. Human factors-related issues are believed to be a significant contributing factor in railway level crossing incidents. The behavior of motorists and pedestrians at level crossings, and the effect that the crossing design and surrounding environment has on this behavior, is not well understood. Understanding the human factors issues associated with catastrophic events involving both passenger and heavy vehicles in level crossing occurrences is of critical importance to the Australian rail industry to effectively develop and target countermeasures to reduce injury in this setting. Human factors-based analyses have been fundamental to achieving significant safety gains in other domains, and will add significantly to the establishment of a research and countermeasure development program for rail operations.

The team recently conducted a literature review of human factors safety issues at level crossings on behalf of VicRoads and Victoria’s Department of Transport. The purpose of the project was to summarise, analyse and interpret the existing state of knowledge regarding human factors risks at level crossings, to identify areas requiring further research, and to provide recommendations that can be practically applied to level crossing design in Australia and New Zealand. The team is currently conducting a corollary study using the MUARC driving simulator to examine driver behavior at traffic light-controlled vs. flashing light-controlled level crossings

**Team publications in rail-related human factors:**


**Institute of Transport Studies**

The Institute of Transport Studies (Monash) aims to progress transport knowledge and practice in sustainable transport to contribute to the prosperity and sustainability of industry and the wider community. Through the Department of Civil Engineering, they offer Postgraduate Programs in Transport and Traffic, and in Infrastructure Engineering and Management. Both of those programs are delivered by distance education and attract students from throughout Australia and overseas. They include a unit in public transport planning at the postgraduate level, one of the first in Australia. In addition the group offers short courses targeted at the public transport industry on the subject of planning methods. This includes specialist coverage of human factor influences on ridership of public transport.

ITS is also very active in a broad range of transport research projects. Current projects that have direct relevance to the rail industry are briefly described below.

**Exploring the impacts of the “free before 7” peak rail demand management policy**

This project reviews the state government’s policy of providing free rail fares for passengers travelling before 7 a.m. as a means of reducing peak loads on overloaded trains. It includes an independent assessment of existing evidence and a review of the
policy within the context of international research on rail pricing to manage overloading. It evaluates the program in terms of financial and economic impacts.

**Exploring the drivers of light rail route ridership – an international review**

This international project examines light rail route ridership in a number of international cities using empirical modeling to explore factors which act to explain levels of ridership. The project is a cooperative venture of Monash University and University College Dublin and examines light rail routes in Melbourne, Dublin, Toronto and many North American and European cities.

**A comparative assessment public transport trends in Australia, and North America**

A review of the public transport trends in three countries undertaken in association with Rutgers University, USA.

**The impacts of transit reliability and wait time for long headway services**

A review of theoretical research on the waiting time impact of headways and alternative service reliability has been completed and followed by primary data collection on wait times and reliability associated with Melbourne passenger rail services. Data was collected using magnetic ticket validation data and established one of the most robust models ever to test the theory associated with these issues. Results are to be reported at the 2007 Annual Meeting of the US Transportation Research Board and have been recommended for publication in Transportation Research Record.

**Developing public transport measures for road traffic congestion relief**

This project is examining the case for developing a measure which represents the congestion relief potential of urban public transport systems. The project includes transport modelling of the impacts of removing public transport systems on traffic congestion and a review of international evidence on congestion and transit impacts from city databases.

**Improving methodology’s to estimate the economic impacts of agglomeration economies in urban rail projects**

This project sponsored by the Land Transport Authority of Singapore is developing new methodologies for measuring the impact of business agglomeration economies associated with new urban rail projects on the economic performance of cities. The project involves the cooperation of the Centre for Policy Studies and the use of the ORANI economic modeling tool to estimate impacts of restricted rail capacity on Melbourne’s economy.

**A design response to urban passenger train ingress and egress occlusion and its relationship to public space, passenger comfort and utility**
This PhD project is focusing on the important dwell time delay problems being faced by overloaded Australian urban railways. It is a design research project where a review of the configuration of rail vehicle and platform configurations is to be assessed as part of tackling the problems identified.

**Reviewing the impacts of the Melbourne CBD parking levy**

A review of the impacts of the Melbourne CBD parking levy including modeling of travel demand impacts and a series of surveys of parking providers ranging from owners, owner lessees, operators and private sector employers.
Appendix 2

Courses at Australian Universities directed towards the rail industry
(not comprehensive)

1. CQUniversity - Rail Signalling Programs
   - Graduate Certificate, Graduate Diploma and Master of Railway Signalling
   - Recognized by IRSE
   - Receiving the strongest support from the industry
   - CQUniversity is accepting its 6th intake of signalling students in 2009 with record interest and enrolment in the course, totaling more than 70 students
   - In early 2009 Railway Signalling will conduct its fourth graduation ceremony, with 29 students receiving Graduate Diplomas in Railway Signalling and working within the industry with much greater knowledge and skills than when they commenced

2. CQUniversity - Rail Operations Management Programs
   - Graduate Certificate, Graduate Diploma and Master of Rail Operations Management
   - Approximately 20 enrolments

3. Wollongong - Railway Rolling Stock Programs
   - Graduate Certificate and Master of Rolling Stock Engineering
   - Early stages
   - Approximately 10 enrolments

4. Queensland University of Technology - Railway Infrastructure Programs
   - Graduate Certificate and Master of Engineering (Railway Infrastructure)
   - Earlier stages
   - Approximately 20 enrolments
Appendix 3

An example of an initiative through Engineers Australia to attract young people to the rail industry:

Invitation to Participate in the RTSA Meet the Railway People – Expo 2009

The Railways Technical Society of Australasia (RTSA) is planning to hold its first- Meet the Railway People Expo, aimed at undergraduate students (from years 1 to 4) from Victorian Universities. As a major partner in the railways industry, we are pleased to invite you to participate in this inaugural Expo.

As you are no doubt aware, the RTSA is the principal professional industry body promoting railway technology and management in Australasia. It stimulates professionals within the industry through technical symposiums, seminars, presentations and study tours in both Australia and New Zealand. The RTSA biennial CORE Conference is widely recognised as one of pre-eminence amongst the railway engineering conferences.

The RTSA represents professionals within the railway industry, with currently 1200 ordinary members and 18 corporate members.

As part of its ongoing commitment to the industry, the RTSA seeks to attract and retain the brightest undergraduate students in the railway industry. The RTSA Meet the Railway People Expo initiative is to showcase the industry participants and to highlight some of the opportunities that are available in the railway industry.

The Meet the Railway People Expo is a fantastic opportunity for you to promote your involvement in the railway industry and to communicate directly with high calibre graduates from leading Victorian Universities. Importantly, the Expo will provide an exclusive communication channel to promote undergraduate project opportunities, workplace internships, secondments and scholarship opportunities available within your organisations as well as providing a forum for networking and exploring partnership opportunities with academics from leading tertiary institutions.

The Meet the Railway People Expo is a half day event from 10am to 2pm on Saturday 12 September at the Engineering House, 21 Bedford Street, North Melbourne VIC 3051 (may move to a bigger venue). The Expo is a free event for both participating organizations and undergraduates. An Expo kit detailing all of the necessary information for your participation will be sent to you upon your acceptance of this invitation.

Thank you for taking the time to read this letter and to consider being a part of the Meet the Railway People Expo. I will be in touch with you soon but in the meantime, I am available to discuss any questions that you may have regarding the above Expo.
You can reach me by telephone at 0409556 811 or via email at ravi.ravitharan@eng.monash.edu.au
Appendix 4

Examples of short courses in rail related topics from overseas. These cover a range of different rail-related topics, including design, environmental aspects, metallurgy, mechanical engineering, human factors engineering (amongst others).

1. Human Factors Engineering offered by the Michigan Engineering Centre for Professional Development & the University of Michigan Transportation Research Institute (UMTRI). It is a 10-day course, divided into two one-week segments (Human Factor Concepts and Human-Computer Interaction). Students can register for either, or both, weeks. The course is held during the summer, and has been running now for 50 years. The cost is $4800 US for both weeks ([http://www.umich.edu/~driving/shortcourse/index.html](http://www.umich.edu/~driving/shortcourse/index.html)).

2. The Society of Automotive Engineers (SAE) also offers 0.5 to 4 day long seminars. 2 days typically costs about $1200 US. ([http://www.sae.org/events/training/seminars/](http://www.sae.org/events/training/seminars/))

3. U.S. Dept. of Transportation - Federal Transit Administration offers two transit rail courses, but this organisation supplies training only to US transit agencies


5. Something called the Railway Educational Bureau does "distance training courses for skilled laborers working in the rail industry", but this is only for US citizens, as far as I can tell ([http://www.railwayeducationalbureau.com/workshops/index.html](http://www.railwayeducationalbureau.com/workshops/index.html))

6. San Bernadino Valley College has a Railroad training program, and currently offers 2 courses ("Railroad Operations" and "Railroad Safety, Quality & Environment"). I believe that these are only open to students from the college. ([http://www.valleycollege.edu/eSchedule/Online/Schedule/V/2009SP/Rail.html](http://www.valleycollege.edu/eSchedule/Online/Schedule/V/2009SP/Rail.html))

7. The University of Wisconsin - Madison's Department of Engineering Professional Development offers a variety of short courses in railroad engineering. These cost $995 for two days. It would be nice if Monash could offer a course comprised of most of these, plus HF, and more... ([http://epdweb.engr.wisc.edu/Courses/index.lasso?myRegion=Civil%20and%20Environmental%20Engineering&myRegionHead=R-02##RailroadEngineering](http://epdweb.engr.wisc.edu/Courses/index.lasso?myRegion=Civil%20and%20Environmental%20Engineering&myRegionHead=R-02##RailroadEngineering))

8. The Rail Transportation Program at Michigan Technological University offers an "International Summer Program in Railroad Engineering". It runs for 5 weeks total, 2 weeks are spent in Michigan and 3 weeks in Tampere, Finland. As far as I can tell, it is only offered to Michigan Tech. students. The cost is about $2400 US plus air fares. It appears to offer a lot of 'hands-on' training, which would be great for a short course ([http://www.cee.mtu.edu/railroad/2009/2009_railroad_finland_flyer.pdf](http://www.cee.mtu.edu/railroad/2009/2009_railroad_finland_flyer.pdf))

9. Finally, the National Transportation Research Board (NTSB) in the US also offers a number of short courses at their Training Center. They offer a 4-day Human Factors series (cost is about $1500 US), plus a specialised 1.5 day course in Rail Accident Investigation Orientation (cost is $500). ([http://www.ntsb.gov/TC/sched_courses.htm](http://www.ntsb.gov/TC/sched_courses.htm))