Railway R&D at Monash

by

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Monash University – Railway Research Activity

- Had a relatively low activity base in Rail prior to 2000.

- In 2000, the railway research group from BHP-MRL relocated to the University to form “The Institute of Railway Technology” – IRT.

- Primary focus is to undertake applied research programs, fully funded by Industry. IRT’s vision is to be “The Premier Track and Vehicle Rail Applied Research Centre within Australia”.

- Over the period 2000-2003 Monash actively contributed to the development of Rail CRC and the management thereof.

- Monash is an active participant/node in the Rail CRC, with 6 project areas currently being undertaken. Some possible conflicts of interest (competition) exist between Rail CRC and Monash University (IRT).

- A team of over 30 people (academics, researchers and students) now have involvement in Rail R&D at Monash.
The Institute of Railway Technology

- Industry focused business unit within Monash University (all funding from applied research activities). Salaries, operating and capital costs are 100% funded by this Commercial R&D.
- Not funded by the university (IRT pays Infrastructure support costs).
- Technically oriented – civil, mechanical and materials engineers as well as technical staff (13 full time but with planned growth). Team based approach to R&D. All staff are 100% committed to Rail R&D.
- IRT supports the railway industry through our involvement with Rail CRC, RTSA and Standards Australia.
- IRT’s customer base includes railroads, service providers and suppliers to the railway industry.

Winner of 2002 Railway Industry Award
for “Excellence in Railway Research”
Institute of Railway Technology (Monash University)

- Successfully conducted railway research since 1972
  - Initially part of BHP Melbourne Research Laboratories (MRL)
  - Whilst at BHP undertook both internal and commercial R&D
  - Since January 2000 a financially independent business unit within Monash University continuing in similar disciplines

- Applied Research Focus
  - Primary objectives are to resolve operational and maintenance problems and to improve cost effectiveness
  - Ensure a safe operation (risk management)
  - Assess railway technology
IRT Customer Base

- Railway Operations within Australia (BHPB-IO, QR, ARTC, RIC, WestNet Rail, TransAdelaide, Toll)
- Mass Transit Systems in Asia (MTRC, SMRT, KCRC)
- Railways of Australia
- Department of Infrastructure
- SNIM (Africa)
- London Underground
- Tranz Rail
- Railway contractors
- Wide range of suppliers to the railway industry (Bradken, Thermit, Goninans, etc)
- BHP Steel / OneSteel
Capabilities and Expertise

Research expertise includes (strong Engineering emphasis):

- Vehicle-track dynamics (suspension design, track interaction)
- Wheel-rail interface management (profiling, maintenance)
- Rail, sleeper and track design
- Condition monitoring
- Generation and propagation of railway noise
- Instrumentation, electronics and mechanical testing
- Materials and product development
- Assessment of electrical power supplies
- Structural design and assessment / lightweight /composite construction
- Structural repair and lifing (bogies, car bodies, bridges)
- Vehicle and track maintenance (technical/economic modeling)
- High (and increased) axle loads
- NDT techniques

The activities of the Institute are focused heavily towards applied research
Project Areas

- Track design & performance: 14%
- Vehicle components (wheels, axles, bogies): 5%
- Rails & welds: Development & performance: 26%
- Steel sleeper development & performance: 11%
- Other (bridges, axle loads, etc): 6%
- Vehicle-track interaction: 27%
- Track & vehicle design & management tools: 4%
- Measurement systems: 2%
- Component testing & performance: 5%
Scope of BHPB-IO Research Program

What is the role of IRT? or Why do BHPB-IO do research?

- To reduce operating and capital costs of the railroad
- Maximize railroad capacity using existing resources
- Ensure a safe operation with an identified risk profile
- Provide a technical link between BHPB-IO and suppliers
- Assess technical issues as they arise (limited access to technical resources internally – typical now of railways in general)

Value is maximised due to the very detailed knowledge of the BHPB-IO operation, gained over 33 years. Confidence exists between the research body and the railroad operations. This is a key to success.

The stability of research organisations in general, contrasts with the typical profile within railroad bodies.
Tangible Benefits Achieved at BHPB Iron Ore

- BHPB-IO has estimated that the Institute's contribution has provided savings of approximately A$35m per annum in its operational costs.
- That research is an integral part of its armory in sustaining and improving its competitive advantage with increased axle loads and reduced haulage costs.
- Program was initially jointly funded between the then MNM and HI. HI management stopped this arrangement ~1990 due to possible conflict of interest. (sounds familiar!).

![Graph showing average axle load by ore source for BHP Iron Ore](image-url)
Major Program Results

- **BHPB-IO runs the highest axle load, heavy haul railroad in the world**, having increased axle loads from ~30 tonnes in the 1970’s to ~37 tonnes currently (using the original infrastructure).
- Railroad operating costs (per tonne.km) halved through the 1990’s.
- **Rail life has increased 4 fold**.
- Track lubrication has been discarded.
- The development of both flashbutt and aluminothermic welding processes for 37 tonne operation.
- **Hunting has virtually been eliminated from the BHPB-IO operation**.
- Wheel life has been extended from an initial 340,000 km through to ~2 million km. Wheel material and cleanliness specifications have been rewritten.
- **The Ore Car Repair Shop (OCRS) is a recognised world leader in the management of the fleet**.
- **Railroad bridges have been re-rated** from an initial design level of ~32 tonnes through to 40 tonnes. This was initially perceived as limiting increased axle loads.
- **IRT have developed instrumented vehicles** which now provide the next generation for planning track maintenance and assessing maintenance efficiency.
Hong Kong Experience – MTR Corporation

- One of the world’s most heavily utilised mass transit railways
- It provides a safe and reliable railway system to its daily patronage of 2.3 million passengers
- Annually, in excess of 800 million passengers and 45 MGT
Technical Improvements

• A structured suite of projects introduced between 1992 and 1995 (program initiated in 1989!)
  • modification of wheel and rail profiles to reduce wear, sub-surface defects and corrugations and noise
  • improvement of lubrication procedures by modifying the lubricant applied to reduce wear
  • improvement of rail pad characteristics to reduce the level of applied dynamic loading
  • improvements in rail maintenance procedures including rail grinding philosophy
  • improvements in wheel-rail related noise
Tangible Benefits Achieved at MTR

- 50% reduction in rail replacement volume
- 85% reduction in rail replaced due to shelling
- Holistic approach led to improved performance of wheels
  - 28% reduction in tread wear
  - 62% reduction in flange wear
- MTR is the benchmark that other mass transit railway systems are striving to achieve
- IRT have recently run training courses for track maintenance personnel to certify competency (rail grinding)

![MTR Rail Replacement Due to Shelling](chart1)

![MTR Wheel Wear Rates](chart2)
Directions / Issues

- To ensure a strong buy-in from Monash towards our Vision
- To break-down remaining barriers which inhibit the ‘Applied Research Model’ within Monash (sell the Model within the University – “to grow the pie”)
- To broaden from the successful applied research model to incorporate more traditional university disciplines
- To broaden our pool of resources by utilising the ‘knowledge-base’ of the University
- To broaden our customer base