Vision
To assist the Australian rail manufacturing sector to develop industry-led R&D solutions to industry-identified challenges, to encourage innovation and to foster increased engagement in the global supply chain.

Mission
To assist the rail manufacturing supply chain to develop new technologies and products to increase productivity and play a key part in attracting and supporting the next generation of highly qualified engineers and scientists to bring their skills and talent to the rail industry.

Strategic Intent
To foster, sponsor and direct collaborative research and commercialisation partnerships between key stakeholders in the rail manufacturing sector.

Contents
The year in review 4
About the Rail Manufacturing CRC 6
Executive summary
Achievements 8
Risks and impediments 10
End-user environment 10
Impacts 11
Research
Performance against activities 13
Education and training 18
SME engagement 22
Results
Utilisation and commercialisation 24
Intellectual property management 25
Communications 26
Resources
Governance 28
Board 30
Committees 32
Management team 34
Participants 36
Collaboration 38
Financial management 40
Performance review 42
Glossary of terms 43
The year in review

The past 12 months have been significant for the Rail Manufacturing CRC. As one of the key industry-led Australian rail research initiatives, the Centre has much to be proud of as we continue to build momentum to benefit our participants and the rail industry as a whole.

Shift towards passenger rail

The 2015–16 Financial Year was one of growing optimism for Australian rail manufacturing. Changes within the Australian economy, including the reduction in ore and coal prices, has resulted in a shift in focus by much of the industry to passenger rail. As such, the Rail Manufacturing CRC’s priorities have also shifted to support projects that are increasingly passenger rail-related.

Many significant passenger rail projects have recently been announced by State Governments, with over $45 billion of investment committed across the next five years. Projects include large scale initiatives such as Sydney’s North West Rail Link, the CBD and Parramatta Light Rail projects, Melbourne’s Metro twin rail tunnel and removal of 50 level crossings, and the manufacturing of Brisbane’s new generation train rollingstock.

These commitments will provide ongoing and sustainable work for the foreseeable future and will support manufacturers with a much-needed stable pipeline of work that will assist industry in its long-term planning and innovation strategies.

To complement the increased value of passenger rail projects, a number of local companies have been part of successful consortia that have tendered on Australian rail projects. This will lead to many rail industry participants reassessing their research and development priorities.

Subsequently, the Rail Manufacturing CRC has had to reassess the viability of a number of heavy haul related projects, while further bolstering its passenger rail efforts through the development of new projects with current and new participant organisations. New participants to the Centre in 2015–16 included Tyre Stewardship Australia and the Australasian Centre for Rail Innovation (ACRI), along with the very recent signing of UGL Rail Services in September 2016.

The Rail Manufacturing CRC has also been proactive in engaging with the Advanced Manufacturing Growth Centre (AMGC), a Commonwealth Government-backed initiative aimed at coordinating industry-led approaches to drive innovation, productivity and competitiveness. The Centre and AMGC are working together to develop a memorandum of understanding for collaboration between the two organisations.

The Rail Manufacturing CRC’s efforts to reassess its project portfolio and to engage with AMGC were noted at the Centre’s first year performance review (more on page 42) undertaken by the CRC Advisory Committee, which advised it was pleased to see these issues being proactively addressed. The Committee also noted that it would continue to monitor the Centre’s implementation of its passenger rail focussed strategy and its ongoing engagement with AMGC.

Collaborating with Centre participants

Current market conditions will always impact on the ability of our participants to maintain an ongoing and long-term level of support to key future-thinking rail projects.

In the past year, the ongoing decline in commodity prices and its direct impact on heavy haul procurement and the occurrence of mergers, acquisitions and business restructures has led to many rail industry participants reassessing their research and development priorities.

Notwithstanding and not surprisingly, the Committee advised see these issues being proactively addressed. The Committee also noted that it would continue to monitor the Centre’s implementation of its passenger rail focussed strategy and its ongoing engagement with AMGC.

With these changes in focus, we’ve seen real benefit and success in working closely with these participants to rescue projects where necessary to better fit their organisation’s current needs and future requirements. Not only has this ensured projects will continue, it has also secured long term support and financial commitment to the Rail Manufacturing CRC, where a number of projects are already proving successful, including:

» Airline-RMIT led project (R3.6.1) which is providing initial air quality modelling outcomes for its industry participant.

» ongong CRRC-CSIRO led projects (R1.3.1 to 1.3.3) providing insights into new power storage technologies

» OneSteel-Monash led project (R2.4.3) which has developed better material assessment techniques for rail and sleepers

» Downer-UTS led project (R5.1.2) to develop passenger behaviour monitoring technologies that are gaining interest from a number of operators, companies and state governments.

» Bombardier-UQ project (R2.3.2) which is providing Bombardier with models to predict and assess its maintenance procedures.

The importance of research and education

The rail manufacturing sector is highly competitive and increasingly global. With a significant increase in domestic demand scheduled over the next ten years, the sector will have a greater capacity to explore innovative technologies that will build and grow manufacturing know-how and develop key domains of rail expertise to help industry to compete in niche global markets.

Our research partners have invested heavily in building new capabilities to support industry participants in current and potential projects. The Rail Manufacturing CRC will continue to support and co-fund activities that will assist the sector to realise these goals. Moreover, the Centre will continue to promote collaborative research and provide an industry-focused body that can help facilitate these innovative outcomes.

During the year, a number of new initiatives were undertaken, including the Rail Manufacturing CRC Innovation Gateway Program call for new project proposals, the Rail Manufacturing CRC PhD Scholarship Program, which will result in up to 15 PhD students undertaking rail-related projects in the coming year, and the Rail Manufacturing CRC Postgraduate Internship Program, which will see a number of students undertake work placement with our industry participants in 2016–17.

The Centre will continue to promote its student programs to help ensure the next generation of research-ready rail manufacturing post graduates are available and seeking to work in the rail sector. With the current percentage of rail employees with post graduate qualifications estimated at less than 1 per cent, it’s a core priority to provide quality post graduates to the industry.

Thanks for our staff and supporters

On behalf of the Rail Manufacturing CRC, we would like to thank our Essential Participants, Other Participants, Third Party Participants and the Federal Government’s Business Cooperative Research Centres Programme for supporting the Centre over its initial two years of operation.

Thanks to our key stakeholders for their ongoing support and commitment to our projects and overarching research themes, and recognition also goes to the valuable ongoing inputs and guidance received by industry associations over the year, including the Australasian Railway Association and the Advanced Manufacturing Growth Centre.

Thank you to the Centre’s Directors and the entire Rail Manufacturing CRC Management team for their ongoing commitment to the organisation and the rail manufacturing sector. As a team, we look forward to continuing to deliver real benefit to the Australian rail industry over the coming years.

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The Rail Manufacturing Cooperative Research Centre (CRC) drives the development of new products, technologies and supply chain networks to enhance the competitiveness of Australia’s rail manufacturing capability.

Jointly funded by the Australian Government and Industry, the Rail Manufacturing CRC co-funds and manages collaborative research and commercialisation partnerships between key stakeholders, including rail manufacturing multinationals, innovative small-to-medium enterprises, leading research and development providers, industry peak bodies, and Federal and State Governments.

The Rail Manufacturing CRC, established in 2014 and will operate for a period of six years, is funded by the Business Cooperative Research Centres Programme of the Australian Government’s Department of Industry, Innovation and Science. By turning research-based industry solutions into timely market innovations and products, the Rail Manufacturing CRC will support the development of technologies that will lead to new opportunities for Australian manufacturers.

About the Rail Manufacturing CRC

The strategic direction for Australian rail manufacturing was outlined in the On Track to 2040 – Preparing the Australian Rail Supply Industry for Challenges and Growth Roadmap.

Commissioned by the former Department of Innovation Industry Science and Research (DIISR), through the Rail Supplier Advocate, the On Track to 2040 rail manufacturing roadmap was developed through intensive collaboration between industry stakeholders, government and the higher education and research sectors. It represents the consensus view of 210 industry participants from 110 organisations on the strategic pathway towards industry growth and sustainability.

The roadmap identified the need for a collaborative research entity dedicated to an innovation agenda for rail manufacturing, with the bid for the Rail Manufacturing CRC a direct consequence of this industry consensus.

The roadmap identified three key opportunities – Power and Propulsion, Materials and Manufacturing, and Monitoring and Management – which have been used as directives for the Rail Manufacturing CRC’s subsequent research strategy project themes. More on these themes features on page 12.

Source: A profile of the Australian Rail Manufacturing Industry, ACSI, Tasmania for the Department of Industry, Innovation and Science, July 2011.

Australian rail industry snapshot

1st tram network

150 years

$4.2 billion revenue

330 suppliers

15,000 employees

The 6th largest rail network worldwide – with 42,262 km of track

On Track to 2040 Roadmap

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Executive summary

Achievements

Research and collaboration

In its second year, the Rail Manufacturing CRC’s research program has made solid progress across most projects contracted in the previous reporting period. The high degree of end-user collaboration within these projects at such an early stage is particularly pleasing, especially when considering the future benefit to the Australian rail industry.

The development of onboard energy systems for rail progressed well during the year with strong collaboration between CSIRO and China Railway Rolling Stock Corporation (CRRC) researchers. This has been supported by regular visits and communication between the two organisations to ensure optimum collaboration occurs.

With a focus in the rail industry on value-added service, a number of Rail Manufacturing CRC projects have benefited from industry organisations sharing systems data for research. Project R2.3.1 - axle bearing maintenance - benefitted with Industry organisations sharing systems data for research. Bombardier supplying parts to the University of Queensland for analysis, while the development of analytical tests for air-conditioning component durability benefited from the input of Sigma Air Conditioning supplying expertise and direction to Project R2.3.1.

In the field of computer simulation and modelling, the University of Technology Sydney (UTS) is well advanced on Project R3.1.2, which is championed by Downer and has benefitted from industry organisations sharing systems data for research. Project R2.3.2 - axle bearing maintenance - benefitted with Industry organisations sharing systems data for research.

In the past year, the development of new projects was a priority. To identify new project ideas, the Rail Manufacturing CRC announced a funding round of Gateway Projects in March 2015. Out of the project proposals received, three projects were identified for further contract discussions and are expected to be initiated in the 2016–17 Financial Year.

The Centre is also continuing to communicate the importance of innovation by partnering with key industry organisations, such as the Department of Industry, Innovation and Science, the Industry Capability Network (ICN), the Australasian Railway Association (ARA), Austrade, and various state governments and departments. Promoting the importance of turning research-based industry solutions into timely market innovations, the Rail Manufacturing CRC has been involved in the following forums in the past 12 months:

- ARA & ICN 2016 Rail Suppliers Industry Briefings in Perth, Sydney and Melbourne
- AustRail 2015 - the pre-eminent rail industry conference
- Victorian Government Transport Discussion Roundtables
- Australasian Railway Association networking events
- Meetings with SMEs and major rail sector companies.

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- Meetings with SMEs and major rail sector companies.

Commercialisation and utilisation

The Rail Manufacturing CRC’s model for commercialisation and utilisation was developed in close consultation with its Essential and Other Participants, where the overarching principle is to support and facilitate industry-led research outcomes in an independent manner.

As all projects currently being undertaken are in the initial phases of R&D, the commercialisation and utilisation activities are at an early stage. However, all current projects have defined commercial outcomes, and commercial and intellectual property terms have been agreed via contractual arrangements prior to the projects beginning. To date, Utilisation Plans have been developed for relevant projects to advance the strategies for commercialisation and refine potential market opportunities.

Education and training

A focus for the Rail Manufacturing CRC is ensuring its education and training approach remains a priority as the Centre continues to grow and deliver.

It is vital to provide postgraduate students with an extensive training and education experience to enhance their employment prospects following graduation.

The Rail Manufacturing CRC is currently supporting five PhD students and one Master’s student in 2015–16. These students are working on industry projects aligned to the objectives of the associated Industry Participant organisations – with profiles on three of these students featured on pages 20–21.

In the coming year due to two new funding initiatives announced in 2015–16, in addition to more students commencing on new industry projects. These activities are expected to result in the Rail Manufacturing CRC meeting its target of supporting 30 PhD students in the life of the Centre, as outlined in the Commonwealth Milestones.

“With a focus in the rail industry on value-added service, a number of Rail Manufacturing CRC projects have benefited from Industry organisations sharing systems data for research.”
Risks and impediments

The Rail Manufacturing CRC continues to work with its current and prospective participants to develop projects that will have significant impact for the organisations involved, as well as the rail manufacturing industry as a whole.

However, the Centre has been affected by two key factors since its inception – the downturn in commodity prices that led to a decrease in heavy haul manufacturing demand, and a number of mergers and restructures that have occurred within some of our participant organisations. This has led to the delay or cancellation of a number of initial projects that were due to start in 2014–15. Subsequently, a number of the initial Commonwealth Milestones were modified as a result of these factors. The Rail Manufacturing CRC has sought to mitigate the risks associated with these economic and corporate issues by:

- growing the Centre by increasing its number of industry participants
- developing new projects with its current and potential participants
- increasing its focus on passenger rail projects
- increasing its engagement with the postgraduate community via specialised competitive grants
- working with industry peak bodies, such as the Australasian Railway Association, to engage and inform the rail manufacturing industry through forums and industry groups.

On the positive side is the increase in investment by Australia’s state governments in passenger rail. This activity has enabled the Centre to develop a number of new projects with both new and prospective participants that will commence in 2016–17. As part of the Rail Manufacturing CRC’s first year performance review, the CRC Advisory Committee advised it was pleased to see these issues being proactively addressed. Furthermore, the Committee will continue to monitor the Centre’s implementation of its passenger rail focussed strategy and its engagement with the Advanced Manufacturing Growth Centre.

As per the Rail Manufacturing CRC’s obligations under the Commonwealth Agreement, the Centre must continue to successfully implement its reform agenda and achieve its commitments to ensure the Commonwealth Government’s ongoing financial commitment.

End-user environment

According to the Australasian Railway Association (ARA), the coming decades represent a ‘golden age’ for rail. This has particularly been shown in the last 12 months, with a substantial increase in funding for rail projects across Australia, predominately in passenger rail.

This investment is creating significant opportunities for the local rail manufacturing industry, providing ongoing and sustainable work for Australian manufacturers that assists industry in its long term planning and innovation strategies. As mentioned earlier, this is highlighted in the Victorian Government’s initiative to link opportunities for local industry to its major acquisitions, strengthening the incentive for global organisations to set up an Australian presence.

The Rail Manufacturing CRC’s research strategy is strongly aligned to the On Track to 2040 – Preparing the Australian Rail Supply Industry for Challenges and Growth Roadmap, mapping the future needs of the rail manufacturing sector in Australia to enhance industry growth and sustainability.

The roadmap was developed in 2012 through intensive collaboration between industry stakeholders, government and the higher education/research sectors, containing the views of 210 industry participants from 110 organisations.

The Centre is confident that by pursuing the priorities identified in the roadmap, its strategic direction is aligned to the rail manufacturing sector and all projects undertaken will be of direct benefit and interest to end-users.

“...this investment is creating significant opportunities for the local rail manufacturing industry, providing ongoing and sustainable work for Australian manufacturers that assists industry in its long term planning and innovation strategies.”

Impacts

The Rail Manufacturing CRC has been active in developing new projects during the year, with the launch of the Centre’s Gateway Innovation Projects calling for expressions of interest in research areas within the Centre’s three research themes. After initial review, three of the proposals submitted were selected to move forward as projects for Board approval. These projects are expected to be contracted in 2016–17. Not only will these projects deliver key outcomes for our industry participants, they will also add 5 PhD students to the CRC’s PhD program.

A number of outputs from current projects are looking promising, with end-user involvement in trials resulting in increased confidence of potential commercialisation. However, the voluntary administration of Arrium has affected the timing and certainty of impacts from Project R2.4.1 - Advanced Steel Development for Rail and Sleepers, which involves OneSteel, an Arrium company. Furthermore, changes within the Australian economy, including the reduction in ore and coal prices, has resulted in a shift in focus by much of the industry to passenger rail. As such, the Rail Manufacturing CRC’s priorities have also shifted to support projects that are increasingly passenger rail-related.
In the past 12 months, the Rail Manufacturing CRC’s Research Program, which incorporates the three research themes of Power and Propulsion, Materials and Manufacturing and Design, Modelling and Simulation, has made solid progress during the reporting period.

In summary:

**Program 1 – Power and Propulsion**

A project to develop a prototype energy management system (EMS) using commercially available capacitors or batteries for a catenary-free electric tram system progressed at CSIRO and is complementary to the development of energy storage devices. The energy management system is required to enable the application of supercapacitors for catenary-free trams that is safe and reliable. This approach has many benefits, the most significant of which is the elimination of overhead wires to power the tram, which can be expensive to install and an ongoing maintenance item.

Instead, a catenary-free system requires an on-board energy storage system with high enough energy density to travel between stations and, just as importantly, high enough power density, in the order of several MW, to enable rapid charging and then acceleration of the tram from the stop.

The first stage of development of the EMS in Project R1.3.1 progressed well during the year thanks to strong collaboration between CSIRO and CRRC researchers. This information sharing has enabled system architecture development for cell balancing, charge/discharge, and communications between the on-board system and the platform.

Ultimately, it is envisaged that the commercial cells used in the system will be replaced by cells specifically developed at CSIRO in the related project, Project R1.3.3, as these cells have appropriate energy and power density, and cycle life.

Another project undertaken by Deakin University for Simplex Factory Automation is studying the use of propulsion systems for rail applications. The Centre is concerned about the progress of this project, with a review underway to determine how to proceed.
Research – continued

Program 2 – Materials and Manufacturing

Three projects within this research theme involve the durability analysis of critical rail componentry, with the aim of understanding and improving maintenance periodicity and rail performance.

The development of accelerated durability testing of rail components at CSIRO in Project R2.3.1 will enable Sigma Air Conditioning to validate the high reliability requirements of equipment in a range of environments. Progress during the reporting period saw a comprehensive review completed, with the design and focus of the project developed to best benefit end-user requirements.

In Project R2.3.2, research being undertaken at the University of Queensland (UQ) could potentially reduce significant maintenance and overhaul requirements. Using mechanics-based modelling, UQ researchers are developing and testing a new optimised predictive maintenance system for bearings. Partnering with Bombardier Transportation, the project aims to develop a predictive maintenance system. Progress during the reporting period was enhanced by the close involvement of Bombardier supplying parts for the project, and the participation of two PhD students.

In Project R2.4.1, the assessment of fatigue performance on railway sleepers at Monash University without the need for a time-consuming full-scale fatigue test has enabled OneSteel to more fully understand the stress/strain characteristics of the sleepers. This will ultimately inform future manufacturing processes. The Monash facility is a unique purpose-built test environment that uses non-contact infra-red stress analysis to validate and measure the full field 3D stresses and fatigue performance under load. By measuring surface temperatures during loading, the stress distribution and fatigue hot spots over the entire structure can be determined and measured.

As well as utilising the Monash facility for laboratory testing, progress during the reporting period included field track testing on railway lines in Whyalla to gather key data.

Program 3 – Design, Modelling and Simulation

This Program focuses on the use of design and simulation techniques to model operations to develop more efficient processes and equipment solutions to reduce the use of resources, increase efficiency and extend asset life of rail systems. This program covers automated health monitoring, advanced data analysis and information systems, advanced operations management systems, and energy use management tools.

Within this research theme, University of Technology Sydney’s PhD students are well advanced on Project R3.1.2, which is championed by Downer. The project concerns passenger behaviour, train operations diagnostics and a vehicle monitoring system.

The project goal is to improve passenger rail service reliability at stations and assist in increasing overall service numbers per hour. The project also aims to provide information to passengers through their smartphones to assist them in managing train journeys. The outcome of the project will be the development of an autonomous system capable of sensing and interpreting passenger behaviour and train events to monitor the movement of passengers on and off trains.

In Project R3.6.1, RMIT University and Airlinx are collaborating on the use of computational fluid dynamics to create simulated models to help develop and design improved ventilation systems. As a testament to the strength of the partnership, an experimental test rig has been built at Airlinx to measure the performance of various ventilation systems that will help to validate computer-simulated models developed at RMIT.
Rail Manufacturing CRC Projects underway during reporting period

<table>
<thead>
<tr>
<th>Program</th>
<th>Project number</th>
<th>Project</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program 1</td>
<td>R1.2.1</td>
<td>Propulsion of Intelligent Magnetically Levitated Track-Vehicle</td>
<td>Simplex / Deakin</td>
</tr>
<tr>
<td>Program 1</td>
<td>R1.3.1</td>
<td>Supercapacitor Energy Management System</td>
<td>CRRC / CSIRO</td>
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<tr>
<td>Program 1</td>
<td>R1.3.2</td>
<td>Supercapacitor Development and Scale up for Manufacture</td>
<td>CRRC / CSIRO</td>
</tr>
<tr>
<td>Program 1</td>
<td>R1.3.3</td>
<td>High Energy Supercapacitor Development</td>
<td>CRRC / CSIRO</td>
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<tr>
<td>Program 2</td>
<td>R2.3.2</td>
<td>Axle bearing Maintenance Optimisation</td>
<td>Bombardier / UQ</td>
</tr>
<tr>
<td>Program 2</td>
<td>R2.4.1</td>
<td>Advanced Steel Development for Rail-sleepers</td>
<td>OneSteel / Monash</td>
</tr>
<tr>
<td>Program 2</td>
<td>R2.4.2</td>
<td>Review of performance and design constraints completed</td>
<td></td>
</tr>
<tr>
<td>Program 2</td>
<td>R2.4.3</td>
<td>Define IP strategy (patents/know-how/designs/software)</td>
<td></td>
</tr>
<tr>
<td>Program 2</td>
<td>R2.7.2</td>
<td>Commencement of 3 PhD students</td>
<td></td>
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<tr>
<td>Program 3</td>
<td>R3.1.2</td>
<td>Integrated Passenger Behaviour, Train Operations Diagnostics and Vehicle Condition Monitoring System</td>
<td>Downer / UTS</td>
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<tr>
<td>Program 3</td>
<td>R3.6.1</td>
<td>Experimental and computational study on the key ventilation issues affecting air quality and thermal comfort in train cabins</td>
<td>Arline / BMT</td>
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Commonwealth Milestone status at 30 June 2016

<table>
<thead>
<tr>
<th>Number</th>
<th>Milestone</th>
<th>Due Date</th>
<th>Status</th>
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</thead>
<tbody>
<tr>
<td>R1.2.1</td>
<td>Report approved for feasibility study for locomotives including patent and literature landscape, performance benchmark and confirm approach in terms of technical and economic feasibility</td>
<td>30 Jun 2016</td>
<td>Achieved</td>
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<tr>
<td>R1.3.1</td>
<td>Report approved for feasibility study for advanced energy storage systems including patent and literature landscape, performance benchmark and confirm approach in terms of technical and economic feasibility</td>
<td>30 Jun 2016</td>
<td>Achieved</td>
</tr>
<tr>
<td>R1.6.1</td>
<td>Commencement of 1 PhD student</td>
<td>30 Jun 2016</td>
<td>Achieved</td>
</tr>
<tr>
<td>R2.4.1</td>
<td>Report approved for feasibility study for steel development for rail-sleepers including patent and literature landscape, performance benchmark and confirm approach in terms of technical and economic feasibility</td>
<td>30 Dec 2015</td>
<td>Achieved</td>
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<tr>
<td>R2.4.2</td>
<td>Review of performance and design constraints completed</td>
<td>30 Jun 2016</td>
<td>Achieved</td>
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<tr>
<td>R2.4.3</td>
<td>Define IP strategy (patents/know-how/designs/software)</td>
<td>30 Jun 2016</td>
<td>Achieved</td>
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<tr>
<td>R2.7.2</td>
<td>Commencement of 3 PhD students</td>
<td>30 Jun 2016</td>
<td>In progress 1 PhD commenced</td>
</tr>
<tr>
<td>R3.2.2</td>
<td>Journal articles and/or patents published for advanced detection technologies for rail applications</td>
<td>30 Jun 2016</td>
<td>Achieved</td>
</tr>
<tr>
<td>R3.6.2</td>
<td>Review of performance and design constraints completed</td>
<td>30 Jun 2016</td>
<td>Achieved</td>
</tr>
<tr>
<td>R3.7.2</td>
<td>Commencement of 3 PhD students</td>
<td>30 Jun 2016</td>
<td>In progress 1 PhD commenced</td>
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</table>

Publications list in 2015–16:

The Rail Manufacturing CRC had two journal articles and five conference papers published:

**Articles in Scholarly Refereed Journals**


**Full Written Conference Paper – Refereed Proceedings**


A focus for the Rail Manufacturing CRC is ensuring its education and training approach remains a priority as the Centre continues to grow and deliver.

It is vital to provide postgraduate students with an extensive training and education experience to enhance their employment prospects following graduation, in part due to developing the skills needed to utilise research outputs and produce world-leading end-user centric solutions during their Master’s and PhD studies.

The Rail Manufacturing CRC is currently supporting five PhD students and one Master’s student in 2015–16 – profiles on three of these students feature on pages 20 to 21. The students are now working on industry projects, with their PhD topics strategically aligned to the objectives of the relevant Industry Participant organisation.

The Centre achieved the commencement of one PhD student as per milestone R1.6.1. For milestone R2.7.2, there was one new PhD student (against a target of 3) and in milestone R3.7.2, there was also one new PhD student (against a target of 3).

To increase these numbers, the Rail Manufacturing CRC worked with industry and universities to announce two new funding initiatives in 2015–16 - the Rail Manufacturing CRC PhD Scholarship Program and the Rail Manufacturing CRC Postgraduate Internship Program.

The PhD Scholarship Program has secured funding for up to 15 PhD projects that will be initiated in 2016–17, while the Postgraduate Internship Program is being developed in partnership with our industry participants to place postgraduate students into industry for 3-6 month periods, also to begin in the coming year.

It is also envisaged that a number of additional students will commence as part of our standard project portfolio. Therefore the number of total PhD students within the Rail Manufacturing CRC is expected to meet the required 30 PhD students outlined in the Commonwealth Milestones for the life of the Centre.

<table>
<thead>
<tr>
<th>Name</th>
<th>Commencement date</th>
<th>Research Programme</th>
<th>Project theme</th>
<th>Project title</th>
<th>Degree</th>
<th>Research Organisation</th>
<th>Expected Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cameron Milne</td>
<td>12/01/2015</td>
<td>RMCRC Project R2.3.2: Axle-bearing Maintenance Optimisation</td>
<td>Materials and Manufacturing</td>
<td>PhD UQ / Bombardier Project</td>
<td>PhD UQ</td>
<td>12/01/2018</td>
<td></td>
</tr>
<tr>
<td>Alexander Virgona</td>
<td>29/08/2014</td>
<td>RMCRC Project R3.1.2: Integrated passenger behaviour, train operations diagnostics and vehicle condition monitoring system</td>
<td>Design Modelling and Simulation</td>
<td>PhD UTS / Downer EDI Rail</td>
<td>PhD UTS</td>
<td>29/08/2018</td>
<td></td>
</tr>
<tr>
<td>Julien Collart</td>
<td>5/02/2015</td>
<td>RMCRC Project R3.1.2: Integrated passenger behaviour, train operations diagnostics and vehicle condition monitoring system</td>
<td>Design Modelling and Simulation</td>
<td>PhD UTS / Downer EDI Rail</td>
<td>PhD UTS</td>
<td>02/02/2019</td>
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<tr>
<td>Matthew Pozzebon</td>
<td>28/04/2016</td>
<td>RMCRC Project R2.3.2: Axle-bearing Maintenance Optimisation</td>
<td>Materials and Manufacturing</td>
<td>PhD UQ / Bombardier Project</td>
<td>PhD UQ</td>
<td>28/04/2019</td>
<td></td>
</tr>
<tr>
<td>Zhang Yin</td>
<td>20/06/2016</td>
<td>RMCRC Project R3.3.3: High Energy Supercapacitor Development</td>
<td>Power and Propulsion</td>
<td>PhD QUT / CRRC</td>
<td>PhD QUT</td>
<td>31/12/2019</td>
<td></td>
</tr>
<tr>
<td>Osama Binj</td>
<td>8/07/2014</td>
<td>RMCRC Project R2.4.1: Advanced Steel Development for Rail and Sleepers</td>
<td>Materials and Manufacturing</td>
<td>MSc Monash / OneSteel Project</td>
<td>MSc Monash</td>
<td>31/12/2019</td>
<td></td>
</tr>
</tbody>
</table>

"The students are now working on industry projects, with their PhD topics strategically aligned to the objectives of the relevant Industry Participant organisation."
Zhang Yin – PhD Student

**Project R1.3.3 – High energy supercapacitor development**

CHINA RAILWAY ROLLING STOCK CORPORATION AND CSIRO

Zhang Yin began her PhD in May 2016 on the High energy supercapacitor development project, which is being delivered by CSIRO and Industry Participant China Railway Rolling Stock Corporation (CRRC).

This project is focused around investigating the use of supercapacitors as a high energy power storage device for light rail. After completing her undergraduate studies in Materials science and engineering at Chongqing University, Yin was interested to work in rail given it’s an extremely efficient and energy saving method of public transportation that’s blossoming in China. She began work at CRRC as a Research and Development Engineer over 12 months ago.

Since that time, CRRC identified the opportunity for Yin to complete her PhD studies with the Queensland University of Technology (QUT), who had a pre-existing working relationship with CSIRO. At QUT, a focus area is battery technology (including processing powders to make batteries), which is a key input into the current CSIRO / CRRC project.

By having a CRRC employee completing her PhD and actively working on this project, this provides real information sharing and cross-collaboration opportunities for QUT, CRRC, and CSIRO.

Yin’s PhD studies are providing her with many new learning opportunities that she previously had no experience in, including synthesis strategies of nano-materials, electrochemical theories and test methods.

Following the completion of her PhD, Yin is planning to return to CRRC to continue developing new generation storage devices, where she’s hoping to further embed those research strategies into tangible commercial outcomes.

Matthew Pozzebon – PhD Student

**Project R2.3.2 – Axle bearing maintenance optimisation**

BOMBARDIER AND UNIVERSITY OF QUEENSLAND

Beginning his PhD at the University of Queensland (UQ) in April 2016, Matthew’s research is examining methods to model and predict lubrication needs for the maintenance of axle bearings in train rollingstock, a project which involves Essential Participant Bombardier.

The ultimate goal of this project is to develop a tool capable of determining an ideal maintenance timeframe for the axle bearings, which would in turn reduce operational costs.

After completing undergraduate studies in Engineering (Mechanical) and Science (Mathematics) at UQ, Matthew worked as a Maintenance Engineer in a Hunter Valley coal mine for three years. He then chose to focus his attention on rail research as it offered him the opportunity to apply technical skills and knowledge to interesting problems, while also seeing a tangible impact on real world scenarios.

One of the main challenges he’s identified so far is the ability to experimentally validate the predictive models. Lubricant films are usually measured on the micro or nanometre scale and measuring these when the contact surfaces are contained within the axle bearings is anticipated to be quite difficult.

University isn’t Matthew’s only focus, he’s also heavily involved in Fullbore Target Rifle shooting which takes up a considerable portion of his free time. As a member of both the Queensland and Australian teams, he has had the opportunity to compete at national and international levels.

Since beginning his PhD in April, Matthew has already significantly expanded his understanding of lubrication and contact mechanics. Over the duration of his PhD, which he hopes to finish by 2019, Matthew expects to learn extensively about grease, its behaviour, how it changes over time and much more.

Osama Brinji – Master’s Student

**Project R2.4.1 – Advanced steel development for rail and sleepers**

ONESTEEL AND MONASH UNIVERSITY

Working with Professor Wing Chiu at Monash University’s Clayton campus, Osama Brinji began his Master’s program within the University’s Mechanical and Aerospace faculty in July 2014 in a Rail Manufacturing CRC project with OneSteel as the Industry Participant.

For his studies, Osama has been actively involved in the investigation of the mechanical behavior of the railway ballast, the trackbed on which railway sleepers are laid. This project is specifically reviewing the performance of railway sleepers made from steel, rather than the more traditional wooden or concrete sleepers used.

After graduating with a Bachelor of Science in Mechanical Engineering at King Abdul-Aziz University, Osama’s work during his Master’s has involved studying the interaction between the steel sleeper and the ballast – investigating how the ballast responds and whether the steel sleeper keeps its form under pressure. The depth and thickness of the steel sleeper was also varied to see the impacts this had on the ballast.

Born in Saudi Arabia, Osama is especially interested in this research as rail is still a developing transportation means at home, where numerous major railway projects have launched in recent years. Personally, it’s also been a great opportunity for him to work with the Monash University and OneSteel teams to further develop his experience in teamwork, planning and organisation.

Apart from the knowledge in rail he has honed, Osama also feels he has enhanced his communication, research and analytical skills, all of which will help him when studying for his PhD at Monash University, which he plans to begin following the conclusion of his Master’s in September 2016.
In the rail industry, small-to-medium enterprises (SMEs) comprise of 85 per cent of rail manufacturing and maintenance companies, so in the context of a devolved manufacturing supply chain, they are an important element. Recognising the importance of SMEs to rail manufacturing, the Rail Manufacturing CRC has SMEs committed as industry participants, while also more broadly fostering engagement with SMEs through alliances, partnerships and joint ventures.

Given not all SMEs have the capacity or financial means to become participants in the Centre’s programs, the Rail Manufacturing CRC looks at each program to see how SMEs can be incorporated. Engagement with SMEs by the Centre was achieved by the following activities in 2015–16:

» Participation in one of the Centre’s three program themes (outlined on pages 12 to 17)
» Direct engagement with the Centre’s CEO and key staff through participation in rail industry events and forums – including AusIndustry and Austrade events, and Australasian Railway Association and State Government forums
» Regular communication about the Centre’s activities and progress through the Rail Manufacturing CRC’s Communications Strategy, including monthly email newsletters, website and social media updates, and face-to-face Participant Forums.

During the reporting period, the Rail Manufacturing CRC had four SMEs participating with the Centre in ongoing projects - Airlinx Heating and Cooling Pty Ltd, Tyre Stewardship Australia Ltd, the Australian Centre for Rail Innovation (ACRI) Ltd, and Simplex Factory Automation Pty Ltd.

During the reporting period, the Rail Manufacturing CRC has also been in direct contact with a number of other SMEs and is actively working with these entities to develop potential future projects.

Furthermore, during our ongoing R&D consultations, the Rail Manufacturing CRC has also been able to identify and match business-to-business opportunities for a number of SMEs through our awareness of participant needs and SME capabilities.

This emphasises the benefit of collaborative networks that the Rail Manufacturing CRC is creating and highlights the additional capacity for the Centre to assist in integrating the broader rail manufacturing supply chain.

“Recognising the importance of SMEs to rail manufacturing, the Rail Manufacturing CRC has SMEs committed as industry participants, while also more broadly fostering engagement with SMEs through alliances, partnerships and joint ventures.”
The Rail Manufacturing CRC's model for commercialisation and utilisation was developed in close consultation with its industry and research participants, where the overarching principle is to support and facilitate industry-led research outcomes in an independent manner. This model is tailored to each project and is dependent on factors such as the:

- capacity of the participants to use and commercialise project outcomes
- research and commercial inputs to the project
- benefit to Australia
- contributions of parties to intellectual property
- commercial viability of the research outcomes.

The model used limits the number of organisations seeking input into commercial decisions and ensures that the Centre’s participants investing in the project receive benefit from any commercial returns. This model ensures the Rail Manufacturing CRC has an independent role in project decision making.

Before projects commence, all commercial outcomes and intellectual property terms and conditions are determined through transparent and upfront contractual negotiations, which limits any potential IP legacy issues in future years.

As of June 2016, research outputs have been the key focus, however the input from end-users has given the Centre greater confidence in the ability of the research outputs to be commercialised.

In summary, the Utilisation Plans developed during the reporting period for relevant projects have resulted in all Utilisation milestones being completed.

### Intellectual property management

Rail Manufacturing CRC Ltd is a company limited by guarantee, hence it has members rather than shareholders.

The Centre’s strategy is to transfer its technologies in the most efficient and effective manner to the rail industry and, in particular, to its rail company members. The Rail Manufacturing CRC does not seek to own intellectual property nor seek royalties from the technology it develops. Instead, the Rail Manufacturing CRC seeks to ensure that the technologies its projects deliver will provide the maximum benefit to project partners.

Upon completion of projects, the Rail Manufacturing CRC does not take a stake in project intellectual property. Ownership and use of the project intellectual property is defined during the development of individual project agreements between the respective project participants, ensuring that the process is transparent and beneficial to all participants.
Communications

In accordance with the Rail Manufacturing CRC’s Communications Policy and Social Media Policy, and the CRC Programme’s Commonwealth Funding Agreement, the Centre undertakes ongoing communications activities to promote its work underway and transfer knowledge to end-users.

To manage this responsibility, the Rail Manufacturing CRC has appointed a Communications Manager (currently 0.6 FTE) to engage with internal and external stakeholders to communicate the Centre’s strategic direction and project activities, share Australian and International rail industry news, and promote participant organisations’ key successes and achievements.

Communication strategy

The strategy is to:

- provide internal and external stakeholders with timely, consistent and understandable communications about the Rail Manufacturing CRC’s direction and activities
- maintain strong and collaborative relationships with the Centre’s Participant organisations and key external stakeholders through face-to-face and online engagement
- continually evaluate the approach and communication channels used via surveys, feedback, website analytics, social media engagement and newsletter readership.

The communications function has two key audiences – internal and external.

Internal communications is focused on communicating with the Centre’s Essential and Other Participant organisations, and the Federal Government’s Business Cooperative Research Centres (CRC) Programme (hosted in the Department of Industry, Innovation and Science). As part of this, the Rail Manufacturing CRC will:

- provide timely communications to ensure staff, students and industry participants are aware of the Centre’s programs, activities, results and outcomes
- support effective interaction across Participant organisations to encourage cross-collaboration and information sharing
- promote key rail manufacturing industry news.

In the past year, internal communication activities have included the delivery of a monthly email newsletter to over 430 subscribers (and climbing), a well-received communications channel that achieves an open rate of on average 42.5 per cent over the 11 editions published in 2015–16. Another focus has been hosting recurring Industry and Research Participant forums, where session inputs and outputs have been aligned to participant organisations’ strategic drivers and the Centre’s key research theme areas.

External communications is focused on communicating with all other interested or related parties, which includes representatives working in rail manufacturing, transport, research, State and Federal Governments, and the Australian general public. As part of this, the Rail Manufacturing CRC will:

- promote a positive outlook for the Australian rail manufacturing sector by sharing general news, key project updates and Rail Manufacturing CRC successes
- raise the profile of the Rail Manufacturing CRC to encourage future project and participant opportunities with new organisations, students and researchers
- encourage representatives from other industries to apply their skills to the challenges faced in rail manufacturing.

In the past year, external communication activities have included the ongoing management of the Rail Manufacturing CRC website (http://www.rmcrc.com.au), the establishment and ongoing management of social media channels (more to follow), the identification of media engagement opportunities in specialist and mainstream Australian media outlets, and regular participation in Australian industry events.

Social media approach

In accordance with the Rail Manufacturing CRC’s Social Media Policy, the Centre seeks to use a variety of social media channels to engage with stakeholders and promote latest news, project updates and key successes.

In particular, the Rail Manufacturing CRC has focused its efforts predominantly on using Twitter and LinkedIn, with a less active Facebook account also in existence, to promote latest news from both within the Centre and communicate updates from Participant organisations.

The Rail Manufacturing CRC is continually monitoring the organisations and individuals it follows via social media to ensure the right groups are being engaged with, and subsequently also encouraging those users to follow the Centre’s accounts.

The Rail Manufacturing CRC is also planning to continually review new social media channels to determine which best align to the style and type of information that the Centre is looking to communicate.
Governance

Directors’ Meetings


During the year ended 30 June 2016, the number of Board meetings held while each Director was in office, and the number attended by each Director, was as follows:

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Key skills</th>
<th>Independent / Organisation</th>
<th>Appointed (Resigned)</th>
<th>A</th>
<th>B</th>
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<tbody>
<tr>
<td>Current Directors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paul Johnson</td>
<td>Chair</td>
<td>Executive management, R&amp;D, engineering, business administration, transport industry expertise, experience as a non-executive director</td>
<td>Independent</td>
<td>31/10/2014 (31/10/2015)</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Bronwyn Constance</td>
<td>Independent Director</td>
<td>Financial management, business administration, manufacturing industry administration, experience as a non-executive director</td>
<td>Independent</td>
<td>31/10/2014 (31/10/2015)</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Stuart Thomson</td>
<td>Executive Director (CEO)</td>
<td>Business administration, executive management, IP, commercialisation, R&amp;D, experience as an executive director</td>
<td>Rail Manufacturing CRC</td>
<td>20/03/2015</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Stuart Inglis</td>
<td>Industry Nominee</td>
<td>Executive business administration, engineering expertise, manufacturing industry administration</td>
<td>Bombardier Transportation Australia</td>
<td>14/01/2015</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Michael Miller</td>
<td>Industry Nominee</td>
<td>Financial management, business administration, manufacturing industry administration, IT</td>
<td>Downer EDI Rail</td>
<td>14/01/2015</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Grant Stanley</td>
<td>Research Nominee</td>
<td>R&amp;D, commercialisation, higher education expertise, experience as a non-executive director</td>
<td>Central Queensland University</td>
<td>14/04/2016</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Former Directors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theunis Victor</td>
<td>Industry Nominee</td>
<td>Engineering, executive business administration, manufacturing industry administration</td>
<td>OneSteel Manufacturing</td>
<td>31/10/2014 (30/6/2016)</td>
<td>7</td>
<td>1</td>
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<tr>
<td>David Wynd</td>
<td>Industry Nominee</td>
<td>Executive business administration, engineering expertise, manufacturing industry administration</td>
<td>Fawley Transport Australia</td>
<td>26/06/2014 (28/6/2016)</td>
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<tr>
<td>Bruce When</td>
<td>Research Nominee</td>
<td>R&amp;D, commercialisation, higher education expertise, experience as a non-executive director</td>
<td>Swinburne University</td>
<td>31/10/2014 (31/12/2013)</td>
<td>3</td>
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<tr>
<td>Timothy Bentley</td>
<td>Industry Nominee</td>
<td>Executive business administration, engineering expertise, manufacturing industry administration</td>
<td>Downer EDI Rail</td>
<td>31/10/2014 (4/8/2015)</td>
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</table>

A = Number of meetings held while the Director held office
B = Number of meetings attended

The Board is responsible to its members and participants for the company’s performance. The Board’s election, composition, function and responsibilities are set out in the Company’s Constitution and in the Participants Agreement.

The filling of casual director vacancies is the responsibility of the Remuneration and Nominations Board Committee as follows:

- **Nominee directors** - nominations are sought from the relevant Industry or research Essential Participants (EPs), such that only Industry EPs may nominate candidates to replace industry nominee directors and only research EPs may nominate candidates to replace research nominee directors. Likewise, voting is by nominee type EP only.
- **Independent directors** - nominations are sought from suitable candidates, always keeping in mind the need to ensure that, collectively, the directors have skills and experience across a constitutionally established minimum set of fields.

The Board sets the Rail Manufacturing CRC company strategy and performance targets, it reviews and approves all company policies and it oversees the implementation of procedures to ensure that the Management team meets the Board’s objectives. The Board meets at least quarterly for scheduled meetings.

The Company’s Constitution requires that the Board include:

- up to four persons elected by a vote of the Industry Essential Participants
- one person elected by a vote of the Research Essential Participants
- up to three independent non-executive directors elected by a vote of Essential Participants
- the CEO.

The Chair is an independent director.
EXPERIENCE AND EXPERTISE:

After 22 years in the Royal Australian Navy as an Aircraft Artificer and an Engineering Officer, Paul joined General Electric (USA) as the Australian Manager of Business Development. He was later assigned to Singapore as the AUSG companies Regional Director for Business Development and in 1994 was promoted to regional President for South Asia and Australia. In May 2003, Paul was appointed as Managing Director and CEO of Lockheed Martin Australia, while also acting as Chairman of the Australian Industry Group’s Defence Industry Executive Council.

After retiring from Lockheed Martin in July 2011, Paul is currently a director on the Boards of a number of institutions including the Air Force Board, the South Australian Government’s Defence Advisory Board and the Board of Aerospace Australia Ltd (Aviation Australia). He was awarded the MBE in 1980 in recognition of his contribution to the advancement of Naval Aircraft Engineering and is a Member of the Australian Institute of Company Directors.
Committees

Audit and Risk Board Committee
The Audit and Risk Board Committee (ARBC) is a sub-committee of the Board which reviews and provides recommendations to the Board on financial reporting, statutory audit functions, internal control functions, risk management, compliance and governance. The ARBC is chaired by an independent non-executive director and its membership includes an industry representative director and a research provider representative director.

The Committee met on six occasions in 2015–16. The current ARBC members are:
» Bronwyn Constance (Chair)
» Grant Stanley (research representative member)
» Michael Miller (industry representative member).

Research and Development Board Committee
The Research and Development Board Committee (RDBC) is a subcommittee of the Board which reviews and provides recommendations to the Board on project proposals and project progress and expenditure. Membership of the RDBC consists of an independent, non-executive director as Chair and a research representative director.

The RDBC met once in 2015–16. The current RDBC members are:
» Paul Johnson (Chair)
» Stuart Thomson (Managing Director)
» Grant Stanley (research representative member).

Remuneration and Nominations Board Committee
The purpose of the Remuneration and Nominations Board Committee (RNBC) is to assess nominations for the Board, and to review remuneration of the Centre’s Management and Independent Directors. The RNBC is chaired by an independent non-executive director and its membership includes an industry representative director and a research representative director.

The RNBC did not meet during the year, as all remuneration and director nomination issues were handled by the full Board. The current RNBC members are:
» Paul Johnson (Chair)
» Grant Stanley (research representative)
» Michael Miller (industry representative member).

Research and Development Management Committee
The Research and Development Management Committee (RDMC) provides advice to the CEO on technical research areas and meets quarterly to discuss the Rail Manufacturing CRC’s project portfolio with the appropriate research provider and industry representatives.

The RDMC met four times in 2015–16. The current RDMC members are:
» Larry Jordan (Chair, RMCRC Research Director)
» Colin Cole (CQU, RMCRC Program Leader)
» Gary Savage (CSIRO, RMCRC Program Leader)
» Stuart Thomson (RMCRC CEO).
Management team

Dr Stuart Thomson
BSc, BSc(Hons), PhD, OCTAP, GAICD
Chief Executive Officer
Since April 2015.

Dr Larry Jordan
BSc, MSC, PhD
Research Director
Since August 2015.

Shelley Bresick
ASGC Dr.
Business Manager
Since September 2015.

Glenn Raines
B.Bus, CPA
Company Secretary and Financial Controller
Since August 2015.

Katie Rizzo
B.A, CHA
Communications Manager
Since June 2016.

Prof Colin Cole
BEng, MEng, PhD
Program Leader
Since April 2015.

Gary Savage
BAppSci
Program Leader
Since April 2015.

Experience and Expertise:
Stuart has extensive experience in leading strategic research and development programs in both government and commercial organisations, having held senior management positions in the private and public sectors. His past roles have included technical development roles in manufacturing companies, Chief Operating Officer and Director of Research roles at CRC: Mining, and the Executive Director of the Grapes and Wine Research and Development Corporation.

Experience and Expertise:
With a background in materials science and experience in research, including electrochemical sensors, fuel cells and materials durability, Larry has worked in building construction, nanotechnology and automotive industries. Larry’s past roles include Research Manager at the Advanced Manufacturing CRC and Chief Scientist at General Motors Holden.

Experience and Expertise:
Shelley is responsible for the financial project management for the Rail Manufacturing CRC, ensuring achievement of reporting, securing funding from the Federal Government, and managing external grants and milestone payments. She also manages the Centre’s Payroll, Accounts Payable and Receivable functions, Executive and Board administration, office management and organisational safety. Shelley previously worked as Finance Manager for the Dairy CRC and the Advanced Manufacturing CRC.

Experience and Expertise:
Prior to joining the Rail Manufacturing CRC, Glenn worked in energy R&D and manufacturing (solid oxide fuel cells), commercial construction and engineering education (TAFE) and retail (books) sectors. He has extensive, hands-on experience in managing internal and external financial reporting and statutory compliance for private and both listed and non-listed public companies.

Experience and Expertise:
Katie is responsible for managing the communications function for the Rail Manufacturing CRC, which includes marketing, media engagement, event management and internal communications activities. Prior to joining the Centre, she worked in corporate communications, marketing and online communications roles across a number of sectors, including manufacturing, telecommunications, banking, energy and water.

Experience and Expertise:
Colin is the Director of the Centre for Railway Engineering (CRE) and also currently serves as a Program Leader in the Rail Manufacturing CRC. His work history in the railway engineering started in 1984 in Queensland Railways, and he’s spent the past 22 years working in railway research. Colin’s PhD thesis was on Longitudinal Train Dynamics, and he has also completed 20 rail research projects related to train dynamics, simulation and development of on-board intelligent systems and devices. He has published over 100 technical papers, one book, two book chapters and two patents.

Experience and Expertise:
Gary has research interests in high pressure die casting, magnesium and aluminium casting, and most recently 3D sand printing. Gary has extensive experience in developing and commercialising technologies through industry-led research. He was a Program Manager within the CAST CRC for over 20 years and now works as Program Leader in the Rail Manufacturing CRC.

Name* Organisation Position title Time committed
Dr Stuart Thomson Rail Manufacturing CRC Managing Director and CEO 100%
Dr Larry Jordan Rail Manufacturing CRC Research Director 100%
Shelley Bresick Rail Manufacturing CRC Business Manager 80%
Glenn Raines Rail Manufacturing CRC Financial Controller and Company Secretary 80%
Katie Rizzo Rail Manufacturing CRC Communications Manager 80%
Prof Colin Cole Rail Manufacturing CRC / CSIRO University Program Leader 51%
Gary Savage Rail Manufacturing CRC / CSIRO Program Leader 51%

* Employees during this period also included
Tony Cearns as Business Development Manager (May 2015 to March 2016), and
Jane Hodgins as Communications Manager (August 2015 to May 2016).
### Essential Participants

<table>
<thead>
<tr>
<th>Participant name</th>
<th>Participant type</th>
<th>ABN</th>
<th>Organisation type</th>
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<tbody>
<tr>
<td>Bombardier Transportation Australia Pty Ltd</td>
<td>Essential</td>
<td>73 010 699 804</td>
<td>Industry</td>
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<tr>
<td>Central Queensland University</td>
<td>Essential</td>
<td>79 181 203 288</td>
<td>Research</td>
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<td>China Railway Rolling Stock Corporation (CRRC)</td>
<td>Essential</td>
<td>41 687 139 230</td>
<td>Industry</td>
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<td>CSIRO</td>
<td>Essential</td>
<td>44 687 139 230</td>
<td>Government</td>
</tr>
<tr>
<td>Deakin University</td>
<td>Essential</td>
<td>56 721 584 203</td>
<td>Research</td>
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<td>Downer EDI Rail Pty Ltd</td>
<td>Essential</td>
<td>92 010 012 031</td>
<td>Industry</td>
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<tr>
<td>Faiveley Transport Australia</td>
<td>Essential</td>
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<td>Monash University</td>
<td>Essential</td>
<td>52 377 614 012</td>
<td>Research</td>
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<td>OneSteel Manufacturing Pty Ltd</td>
<td>Essential</td>
<td>42 014 651 325</td>
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<td>Queensland University of Technology</td>
<td>Essential</td>
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<td>Research</td>
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<td>Sigma Air Conditioning Pty Ltd</td>
<td>Essential</td>
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<td>Simplex Factory Automation Pty Ltd</td>
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<td>Swinburne University of Technology</td>
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<td>The University of Queensland</td>
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<td>University of Technology Sydney</td>
<td>Essential</td>
<td>77 257 686 961</td>
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<td>University of Wollongong</td>
<td>Essential</td>
<td>63 060 567 686</td>
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### Other Participants

<table>
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<th>Participant type</th>
<th>ABN</th>
<th>Organisation type</th>
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<tr>
<td>Airlinx Heating and Cooling Pty Ltd</td>
<td>Other</td>
<td>28 094 691 791</td>
<td>Industry</td>
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<tr>
<td>Australasian Railway Association</td>
<td>Other</td>
<td>64 217 352 489</td>
<td>Industry Association</td>
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<tr>
<td>Australasian Centre for Rail Innovation (ACRI) Ltd</td>
<td>Other</td>
<td>52 364 764 167</td>
<td>Research</td>
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<tr>
<td>APTN</td>
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<td>49 781 030 034</td>
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<tr>
<td>Tyre Stewardship Australia Ltd</td>
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<td>44 164 971 939</td>
<td>Industry Association</td>
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</table>

### Third Party Participants

<table>
<thead>
<tr>
<th>Participant name</th>
<th>Participant type</th>
<th>ABN</th>
<th>Organisation type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queensland Rail Ltd</td>
<td>Third Party</td>
<td>47 564 947 264</td>
<td>Industry</td>
</tr>
<tr>
<td>Industry Capability Network Ltd</td>
<td>Third Party</td>
<td>85 068 571 513</td>
<td>Government</td>
</tr>
<tr>
<td>Australia</td>
<td>Third Party</td>
<td>51 764 698 227</td>
<td>Government</td>
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</tbody>
</table>
Collaboration

The Rail Manufacturing CRC continues to promote collaboration within its R&D and education programs and through broader rail manufacturing sector activities.

The inaugural research programs undertaken by the Centre involve a number of collaborations between industry and researchers. The Centre has also recently explored new mechanisms for enhancing collaboration between SMEs and universities through the Rail Manufacturing CRC Innovation Gateway Project program, which seeks research proposals from industry to research in the rail manufacturing space. The call for projects has resulted in three new projects being developed with the Centre, which are currently being contracted and expected to begin in 2016–17.

The Rail Manufacturing CRC has also been focusing on its collaboration with its R&D providers. In 2015–16, the Centre launched the Rail Manufacturing CRC PhD Scholarship Program, a partnership with a number of universities aimed at promoting the uptake PhD projects in the rail manufacturing sector. Up to 15 PhD students are expected to begin studies in the 2016–17 Financial Year.

The Centre’s current projects are providing considerable benefit to its Essential and Other Participants. Bombardier’s condition based monitoring project (R2.3.2) being undertaken at the University of Queensland (UQ) could potentially significantly reduce maintenance and overhaul requirements. Following on, Bombardier has also recently entered into a second project with UQ to further study the effects of component wear.

Meanwhile, Downer’s project with University of Technology Sydney on passenger counting (R3.1.2) will offer an array of benefits to rail operators, enabling them to operate more efficiently and effectively, along with the potential to reduce railway operation costs. This project has garnered significant interest from industry and government organisations.

Supercapacitor technology being developed jointly by CRRC and the CSIRO (Projects R1.3.1–1.3.4) holds significant opportunities for the domestic and global rail sector. The realisation of the ongoing quest to develop more efficient and effective energy storage devices for rail will ultimately lower the cost of infrastructure associated with electric rail units and also create new opportunities to incorporate these technologies in hybrid diesel-electric applications.

In terms of supporting SMEs, Airlinx is deriving a greater understanding of its ventilation products through modelling and simulation research being undertaken in collaboration with RMIT.

The Rail Manufacturing CRC is also actively working with a number of SMEs on future projects in the coming year, looking to partner them with first tier organisations to fast-track their product offerings.

Joining the Rail Manufacturing CRC as an Other Participant in 2015–16 was Tyre Stewardship Australia, who is partnering with the Centre, the Australasian Centre for Rail Innovation and the University of Wollongong to undertake an inaugural project investigating the use of recycled rubber tyres for rail ballast applications. The project expands the Centre’s work in rail manufacturing as well as looking at new sustainable uses for a problematic waste material.

The Rail Manufacturing CRC’s participation in numerous rail industry forums has enabled the Centre to develop key relationships with rail manufacturers, rail operators and government organisations in Australia and overseas. The Centre has participated in a number of joint industry briefings with the Industry Capability Network and the Australasian Railway Association during events held in Perth and Sydney.

The Centre also participated in the Victorian Government’s Trains, Trams and Jobs Forum in April 2016, launched by the Minister for Public Transport, Hon Jacinta Allan, and in a number of industry forums, including the AusRAIL Rail Conference in November 2015 and the RTSA Conference on Railway Excellence (CORE) in May 2016.
Financial management

For the year ended 30 June 2016, the Rail Manufacturing CRC expended its financial resources on:

- continuing to undertake, manage and support, research projects already contracted at the start of the year
- developing its pipeline of potential new research projects with both existing, and potentially new, participants
- establishing its operations at its new location in North Melbourne.

Taxation Status

During the year, the Rail Manufacturing CRC was successful in its application to the Australian Charities and Not-for-profits Commission for registration as a charity, which was granted in effect from 21 June 2014. Concomitant with this change in company status, the Australian Taxation Office granted income tax exemption, a Fringe Benefits Tax rebate on capped employee fringe benefits and certain GST concessions, all taking effect from the same date. As a result, no provision for income tax has been made in the Centre’s financial accounts.

Financial Performance

For the year ended 30 June 2016, the Rail Manufacturing CRC earned revenue of $3.51M and other income of $0.08M, and incurred expenses of $3.59M, resulting in a $nil operating profit. Revenue of $3.51M comprised $2.40M of CRC Programme Funding from the Department of Industry, Innovation and Science and $1.11M from Participants. Expenditure of $3.59M included $2.08M of Research costs, $1.20M of employee benefits costs and $0.31M of Administration and depreciation expenses.

Research expenditure was $8.3M lower than budgeted for the year, reflecting delays in securing and commencing projects.

Cash Flows

During the year, the Rail Manufacturing CRC received $9.95 million of operating cash inflows (inclusive of GST), consisting of $7.33 million from the Commonwealth CRC Programme, $2.55 million from participants and $0.07 in interest receipts. Operating cash outflows totalled $4.43 million (inclusive of GST), consisting of $2.46 million of Research payments and $1.97 million of Administration payments.

Investing cash outflows totalled $0.02 million (excluding GST) for the purchase of office equipment and the giving, to its landlord, of a security deposit in relation to the lease of the Centre’s North Melbourne premises.

In-kind Contributions

Total in-kind contributions of $5.9 million for the year ended 30 June 2016 comprised $4.4 million of staff in-kind and $0.5 million of non-staff in-kind contributions, being non-cash contributions to the Rail Manufacturing CRC’s research programs by research and industry participants, representing contributions of people, equipment and facilities.

Financial Position

As at 30 June 2016, Total Assets were $8.1M and Total Liabilities were $8.1M. Total Assets was comprised predominantly of Cash and Cash Equivalents of $7.9M, Trade and Other Receivables of $0.1M and Prepayments of $0.03M. Total Liabilities was comprised of Deferred Revenue of $6.6M, Trade and Other Payables of $1.9M and Provisions of $0.03M.

Financial Issues

The key financial challenges, for the next and subsequent years, in order to meet the Centre’s current obligations to the Commonwealth, are to:

1. source and secure $4.1 million of research contributions from new participants in order to match the Commonwealth’s CRC research funding
2. agree and finalise research projects to the value of approximately $10.6 million with existing participants.
Performance review

The CRC Programme Review Report – Growth through Innovation and Collaboration – made 18 recommendations which were all accepted by the Federal Government and are now being implemented. The CRC Advisory Committee advised that as per recommendation 10 of the review, all current CRCs must undergo a review by the CRC Advisory Committee to ensure that they are performing in accordance with their funding agreement, are likely to deliver against their stated outcomes and to determine any potential linkages with the Industry Growth Centres.

A performance review of the Rail Manufacturing CRC was held in Sydney on Tuesday 8 December 2015. The Advisory Committee noted the appointment of a CEO and that stakeholder engagement was increasing and improving. The CRC Advisory Committee also noted that the Rail Manufacturing CRC is closely aligned with the Advanced Manufacturing Growth Centre, with the Centre seeking to define the collaboration with a more substantive agreement to ensure activities are complementary and aligned.

Upon completion of the review, the CRC Advisory Committee requested that the Rail Manufacturing CRC provides:

> a written update on developments related to collaborations or formal agreements (MOU) with the Advanced Manufacturing Growth Centre
> details on the actions it will be taking to ensure research activities are rationalised and, in light of some of the recent economic conditions affecting rail, projects are refocused to enable the Centre to deliver its outcomes under the Commonwealth Agreement.

Responses to these requests were provided to the Committee noting that the Centre is in ongoing formal discussions and regular meetings with the Advanced Manufacturing Growth Centre. Furthermore, the Centre has continued to assess and refine its current project portfolio and it continues to engage additional organisations to join the Centre as participants in 2016–17.

A further review of the Centre will be held in May 2017 under the revised processes recently outlined by the CRC Advisory Committee, which will replace the previous third year reporting process.

Glossary of terms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>ACRI</td>
<td>Australasian Centre for Rail Innovation</td>
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<tr>
<td>AMGC</td>
<td>Advanced Manufacturing Growth Centre</td>
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<tr>
<td>ARA</td>
<td>Australasian Railway Association</td>
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<tr>
<td>ARBIC</td>
<td>Audit and Risk Board Committee</td>
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<td>CQU</td>
<td>Central Queensland University</td>
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<td>CRC</td>
<td>Cooperative Research Centre</td>
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<td>CRRC</td>
<td>China Railway Rolling Stock Corporation</td>
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<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organisation</td>
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<td>ICN</td>
<td>Industry Capability Network</td>
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<tr>
<td>IP</td>
<td>Intellectual Property</td>
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<tr>
<td>Other Participant</td>
<td>A participant who is not an Essential Participant who has signed an agreement with the CRC</td>
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<tr>
<td>QUT</td>
<td>Queensland University of Technology</td>
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<td>RDMC</td>
<td>Research and Development Management Committee</td>
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<td>RMRC (or ‘the Centre’)</td>
<td>Rail Manufacturing CRC</td>
</tr>
<tr>
<td>RNBC</td>
<td>Remuneration and Nominations Board Committee</td>
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<td>Small-to-medium enterprises</td>
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<td>UQ</td>
<td>University of Queensland</td>
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<td>UTS</td>
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