ANNUAL REPORT 2014

Trusted advisor on roads and transport

Members

ARRB Group is a company limited by guarantee. The members of that company are the organisations indicated below.

Contents

Chairman's Report

Gary Liddle, Chairman of ARRB

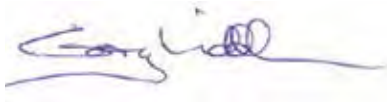
ARRB scientists and engineers have a long and proud history based on their achievements in a research-based organisation through the latter part of the 20th Century. The ongoing challenge confronting us and our customers – along with most organisations - is how to adapt to a faster-paced, leaner, more value-for-money conscious world.

ARRB explicitly included demonstrating value for money in its strategic objectives in 2014. It is pleasing to be able to reflect that in 2014 all four of the strategic objectives we set ourselves, including value for money, were delivered. Members should be pleased with the outcomes described over the following pages.

I am also pleased to note that ARRB is adapting to the new world, recognising that in order to deliver value, its research must be able to be used. The research must be followed by development of implementable outcomes, and by supporting members and their agents in implementing those outcomes. This was evidenced in 2014 by the work done with operationalising the Traffic Speed Deflectometer and adopting high modulus asphalt (EME2), amongst others.

I wish to thank Les Wielinga for his service as the ARRB Chair throughout 2014. In a short time, he has left a legacy which recognises the need to stay focused on offering value for money, whilst actively managing the longer term sustainability and value of ARRB. In this vein I also wish to thank my fellow Directors and ARRB staff for their continued commitment and support throughout 2014.

Continuing the theme of 2014 all at ARRB recognise we live in a world of rapid change, a world where there is no business as usual, people's expectations and their timelines are shorter than ever before. Customers need a fast response and enduring solutions. This is the mindset we have taken into 2015.



Managing Director's Report

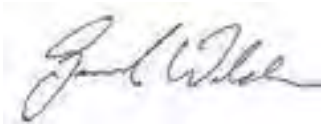
In 2014, ARRB continued to support its partners to achieve operational cost savings, contributing to outstanding returns on their research, development and implementation (R,D&I) investments. In one instance these returns are explicitly evaluated at A$1.60 in the first year for each A$1 invested, with returns in subsequent years multiplying the savings, as the new best practice is implemented more widely.

Road and transport agencies the world over are dealing with the complexity of community needs and aspirations, while funds are increasingly constrained. In response, ARRB and its international national research institute counterparts are focussing increasingly on supporting agencies in the implementation of best practice research outcomes, so that agencies are able to deliver increasing value for money in their services to the public.

We now strive to work at the highest Technology Readiness Levels (TRLs) -8 & 9- by supporting industry and agencies' demonstration programs and implementation. As partners in the implementation of best practice, we support modernisation in agencies so they deliver increasingly cost-effective community outcomes.

The full spectrum of TRLs is needed for innovation. Thus, at the lowest TRLs, ARRB supports and encourages university research. In the mid-range TRLs, we work collaboratively with universities and agencies in the applied research field. So the full spectrum is available to support innovation.

In a world where 'doing more with less' is an ongoing process, ARRB will continue to support the adoption of evidence-based best practice and thus be a valued partner to road and transport agencies. I am proud of the work ARRB has done to this end, and our staff who make it possible.



Gerard Waldron, Managing Director of ARRB

Australian and New Zealand Perspective

On a global scale, Australia and New Zealand have extensive investments in their road and transport infrastructure.

Australia | World ranking

Road km/100,000 people	Road network, km ('000)	Population million	GDP A$ trillion
3,657	**823**	**22.5**	**1.5**
5	9	56	20

New Zealand | World ranking

Road km/100,000 people	Road network, km ('000)	Population million	GDP A$ billion
2,136	**94**	**4.4**	**208**
13	50	127	71

Australia has the fifth largest network length per head of population, but only the 20th largest economy to support it. New Zealand has the 13th highest network length per head of population, but only the 71st largest economy to support it. The imperative is therefore to do more with less, compared to other parts of the world. The opportunity for ARRB in this is supporting innovation in road agencies through a combination of research, development and implementation (R,D&I) activities. Wherever possible, this will involve adapting overseas R&D to Australasian conditions.

All statistics: cia.gov/library/publications/the-world-factbook - Date: 13/05/2015

ARRB's Contribution

As a trusted advisor on roads and transport, we aim to help agencies accommodate reduced budgets, whilst ensuring the current and future needs are met.

Maximising the return of research, development and innovation for the industry is of critical importance. One of our strategies to address this is to recommend that wherever possible road agencies adopt existing overseas research outcomes and tools for Australasian conditions. Some of these may require adaptation, depending on the influence of local conditions and the relevance of overseas technologies.

The 2014 Annual Report outlines the important work we have undertaken in order to support our strategic goals and in turn support the industry.

188% capital renewal

10% revenue increase

45% revenue from road agencies

1.05 Quick ratio

0.95 Current ratio

Staff **60%** of our cost

Depreciation **4%** of our cost

Images by Joshua Seskis, ARRB Group

Our strategic goals

Knowledge

Provide a knowledge base for use by stakeholders

- Manage global knowledge dissemination for and with stakeholders
- Maintain and leverage international and domestic networks with researchers and universities
- Lead, maintain, manage and advance knowledge of roads and transport
- Understand members' information needs

People

Ensure the sustainability of expertise in critical technical areas

- Identify existing gaps and emerging critical areas
- Use networks to manage the industry's human capital
- Lead by example in placing quality of staff ahead of quantity in order to ensure sustainability
- Encourage tomorrow's experts to participate
- Advance transport system expertise

Participation

Contribute to the modernisation, cost-effectiveness and sustainability of the transport system

- Provide strategic advice and knowledgeable input into development of the research programs
- Participate in and encourage effective governance of research
- Undertake relevant research
- Transition research and technology innovations into practical applications, e.g. infrastructure standards for driverless vehicles

Value

Demonstrate value for money in delivery of all our services

- Implement continuous improvement in research team structure and capability, people skills and research methodology
- Selectively target competitively tendered research commissions
- Improve the availability of relevant information to members and clients
- Understand and articulate the contribution ARRB research makes to the administration, planning, development, maintenance and operation of the transport system
- Understand and articulate the contribution ARRB research makes to transport system users, the environment and the economy
- Pro-actively monitor, measure and promote benefits and value delivered, to all stakeholders

Goal | Knowledge

Provide a knowledge base for use by stakeholders

Two main National Interest Services benefits:

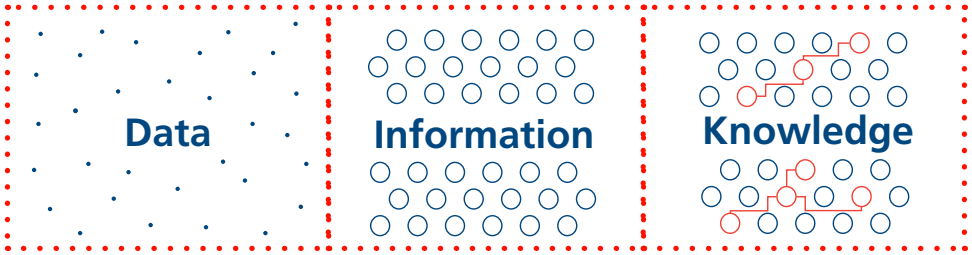
- online knowledge resources and alerting services to aid decision support.
- coordination and collaboration to aid resource sharing and information access.

A managed world of knowledge counteracting risk

The strategic investment by our members in National Interest Services (NIS) is run by the MG Lay Library. The library provides significant benefits, including;

- Access to online knowledge research and alerting services to support decision making
- Access to and sharing of worldwide information and resources.

Our members benefit from investing in the NIS through knowing their policies and actions are based on the best available knowledge which in turn lowers risks associated with trying to provide cost-effective infrastructure and access to safe, sustainable and reliable journeys for freight and people.



During the course of 2014 we confirmed with NIS investors that the offerings of ongoing relevance were:

- Online knowledge resources and alerting services, specifically:
  - Australian Transport Index (ATRI)
  - Making News in Transport
  - Rail Knowledge Bank
  - ARRB Knowledge Base
- Collaboration nationally and internationally to aid resources sharing and information access via:
  - Leadership of the Tranzinfo network of Australasian transport libraries
  - Leadership of the OECD's International Transport Research Documentation (ITRD) program to foster connections and ensure efficient national access to relevant transport information and developments, including the Transport Research International Documentation (TRID) database
- Evolution from library to knowledge managers:
  - In literature searches, to improve the efficiency of those seeking to use the results
  - Assessment of quality of reference material, to ensure only robust and reliable information is provided.

Collectively, these activities all serve to place a world of managed knowledge into the hands of decision makers as part of their structured risk management practices.

Transport Research International Documentation database receives

1.8 million visits a year	approx. **5,000** per day	**1** visitor / **17** seconds

Goal | Knowledge

26th ARRB Conference
RESEARCH DRIVING EFFICIENCY

bridges of the future

19 different countries represented

200 presentations

793 delegates

Placing the latest knowledge in the hands of practitioners

The internet has provided boundless opportunities for knowledge transfer. We use these opportunities to help agencies and other bodies implement best practice, and therefore save lives and money and improve effectiveness. We were an early adopter of webinar technology, and continues to grow this as a means of reaching customers in the convenience of their own offices, saving travel expenses and maximising time available to these busy individuals to carry out their daily tasks.

A key webinar activity in 2014 was our engagement with the National Road Safety Partnership Program (NRSPP) to deliver webinars promoting the work that NRSPP partner organisations are conducting internally to improve road safety. The objective is to pass on the wisdom gained by individual partners to the widest possible audience, to improve road safety outcomes in other organisations and improve the return on the investment made by these partners.

80 learning opportunities

40 workshops

674 attendees

40 webinars

1,103 attendees

Accessing a wider web of knowledge and expertise

Because they are so key to the innovation process upon which road agencies will increasingly depend to 'do more with less', we have active engagement with universities around the world. Our involvement with universities ensures coursework is aligned to the industry needs and students are equipped with the most up-to-date knowledge.

Key activities include:

- Staff sitting on University advisory boards, such as the Institute of Transport Studies at Monash University
- Key staff holding Adjunct Professorships at various universities
- Providing guest lectures at undergraduate and postgraduate level
- Providing university research support including:
  - Supervising Ph.D. students as part of the NACOE partnership with Queensland Department of Transport and Main Roads and as part of Austroads' targeted development of expertise
  - Providing assistance to prospective Ph.D. students and their supervisors to find topics of research that are relevant to road agencies.

Our interaction with universities can often provide a direct financial benefit to members. We are collaborating with the Department of Chemistry at Queens's University, Ontario Canada on cutting edge work on performance characterisation of bitumen and polymer modified binders. Using specialised equipment at the Queen's University laboratory has saved our members approximately A$100,000 to date.

Image by Will Hore-Lacy, ARRB Group

Goal | Knowledge

ARRB-Austroads partnership continues to deliver best practice for Australian and New Zealand road agencies

During 2014, our collaborative partnerships continued to deliver relevant, high quality research-based outcomes.

Implementing best practice has been shown to save up to 40%* in overseas road and transport programs. Development and documentation of best practice and placing it in the hands of practitioners therefore has a direct financial return to agencies. In 2014, we continued to work in partnership with Austroads to serve the needs of Australian and New Zealand member road agencies in this way. This long-standing collaboration continues to deliver relevant, high quality, research-based outcomes and to build our expertise and that of our research collaboration network.

The Austroads-ARRB work program focusses on five core discipline areas amongst the wide range of technical areas covered. The following list highlights ten of the key outputs from this program of applied research across the core discipline areas in 2013-14.

Asset management

- Assessing network-level structural condition data using the Traffic Speed Deflectometer (TSD)
- Development of interim road deterioration models for roughness, rutting and cracking – specifically for prediction of rapid road wear associated with increased heavy vehicle trafficking.

Bituminous surfacings

- Development of a new bitumen ageing predictor test for conventional and polymer modified bitumens. This enables improved knowledge as local refineries close and bitumen is increasingly imported from a variety of different sources

* McKinsey Global Institute, New York, *Infrastructure productivity: How to save $1 trillion a year* | 2013.

- Achievement of greater confidence in maximising Reclaimed Asphalt Pavement (RAP) through the development of a robust, less time-consuming, approach to characterising asphalt binders containing RAP.

Pavement technology

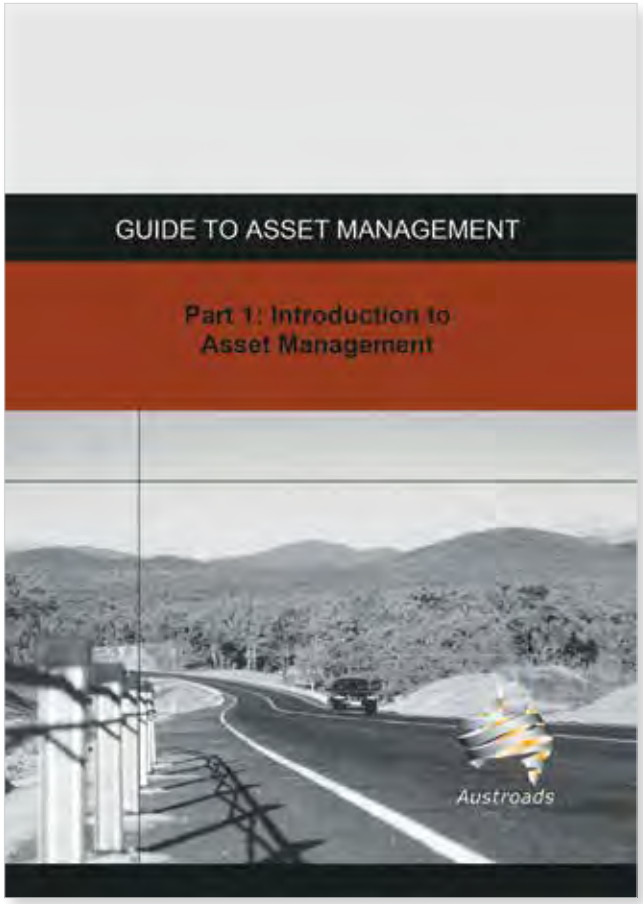
- Significant reductions in asphalt and cemented pavement layer thickness through adoption of a more rigorous pavement design approach, incorporating a detailed traffic load assessment for multi-axle heavy vehicles
- Reduced risk in the use of alternative aggregates for road construction through the development and validation of a new large format laboratory wheel-tracker performance test.

Network operations

- Increased confidence in the procurement of Intelligent Transport Systems (ITS) assets through development of a transparent and robust national ITS product acceptance process for adoption by road agencies
- Development of a general method to quantify the impact of ITS traffic signal failures on the efficiency and safety of network operations.

Road safety infrastructure

- Development of relationships between social disadvantage and crash involvement
- Critical advice on lessons learned on the performance of black spot treatments and guidance on treatment selection, installation and maintenance.



Austroads

Goal | Knowledge

470	370	80
registered partners signed onto NRSPP website	added resources to knowledge centre	news items added to the knowledge centre

Prince Michael of Kent (right, centre) with the NRSPP Steering Committee and program funders at the launch in May.

4

conferences which featured NRSPP research papers

Transafe WA	Occupational Safety in Transport Conference	9th Annual Chain of Responsibility and Vehicle Safety Conference	The Australasian Road Safety Research, Policing and Education Conference

NRSPP – creating a positive road safety culture

The National Road Safety Partnership Program (NRSPP) brings together industry, government and researchers to help develop and share evidence-based solutions and promote road safety in the community where they operate.

The NRSPP was launched by Prince Michael of Kent at the UN Decade for Action Road Safety Forum, Melbourne 2014. We were selected by the industry-led steering committee as the manager and deliverer of the program.

The program aims to help businesses and organisations create a positive road safety culture both internally and externally.

2014 Overview

- Delivered webinars based on NRSPP case studies sponsored by Safe Work Australia
- Average of 180 attendees per webinar
- Introduced Program Partners which saw a variety of new organisations make road safety action commitments for sharing through the program
- Formed two new working groups
  - Managing the driver's headspace following high stress events.
  - Business-to-business (B2B) – a coalition of organisations advocating for their peers to purchase safer vehicles and using online media to explain why.


arrb
australia
australian
development
driver behaviour
road
safety
policy
speed
transport
research
travel behaviour
management
international
brisbane
design
public
cyclist
perth
economic analysis
goal
assessment
travel demand
pavement
approach areas
industry innovation
microsimulation
report
institute
intelligent transport systems
engineering
guide
adelaide
tools
infrastructure
improve
systems
information
human fatigue
new zealand
vehicles
technical
program
highway
support
government
bond
risk
land use
access
intersection
partnership
traffic
structural
fibre reinforced polymer
including
key needs
accident analysis
austroads
conference
operations
test method
injury prevention
model
services
performance
traffic flow
melbourne
users value
freight
travel time
sprayed seal
flooding
systems
practice
usa
department
professor
rail transport
university
work
asphalt
deliver
collaboration
transport network
bus
committee
knowledge
savings
bridge maintenance
provide
investment
speed
national network
project
best bridge
organisations
association
binder
asset
sydney
evaluation
productivity
members
intersection
agencies
implementation
risk
technology
relevant return
asset managment

Goal | People

Ensure the sustainability of expertise in critical technical areas

Dr. Torill Pape


Chris Jurewicz

Outstanding researchers

ARRB's researchers recognised for their excellence

We continue to encourage our experts to participate in latest research and share best practice with the industry, providing immediate benefits to our members.

In 2014, two of our staff were recognised for their research in the industry through prestigious awards; Dr Torill Pape and Chris Jurewicz.

Dr Torill Pape is a Senior Bridge Engineer in ARRB's Bridges and Structures team. Dr Pape received the prestigious international Palmer Prize at the 2014 UK Institution of Civil Engineers (ICE) Annual Awards ceremony in London. The award celebrates the best paper published in the ICE publication Structures and Buildings for 2013. Her paper described research into the performance of ageing infrastructure in aggressive marine environments. We are proud that Dr Pape was able to represent and promote Australian investment in research on the international stage at this event.

Dr Pape's work helps bridge owners manage risks, and therefore total infrastructure costs, associated with bridge structures . This research is timely with the pending release of the revised Australian Bridge Design Code section for Bridge Assessment, AS 5100.7.

Chris Jurewicz is a Senior Research Engineer in the Safe Systems team. He received the Peter Vulcan Award for best research paper on road safety at the Road Safety Research, Policing and Education Conference in November 2014.

His paper, titled 'From Research to Practice – Development of Rural Mass Curve Treatment Program', outlines the theory and statistics behind a new curve risk mitigation program currently being carried out in Victoria. The project assesses the safety and risk factors of each curve in the road network. In so doing it allows network managers and operators to better manage risks on their networks, leading to better safety outcomes for road users.

Encouraging tomorrow's experts

In 2014, the regional prize winners in the ARRB / Roads Australia student research prize scheme were presented with their prizes. This scheme is aimed at identifying research students working in the road transportation field, acknowledging their work and encouraging them to remain in the field.

Misbah Khan from the University of Queensland is reading for his Ph.D. part-time and works as a local government engineer. Misbah's work aims to overcome shortcomings in our knowledge of how flooding events affect road pavements and how best to restore utility in affected pavements after such events. His work will create impact by improving the journey experience for those who travel on roads severely affected by flooding.

Aimee Ward is reading for a Ph.D. at the University of Otago in the Department of Preventive and Social Medicine. Her research is trying to establish links between travel behaviour and mental wellbeing in the 16-19 year old age bracket. Her work will have a powerful effect by achieving better return on investment in transport by addressing both transportation and well-being outcomes in New Zealand.

Kasun Wijayaratna is reading for a Ph.D. at University of New South Wales. The principal objective of his research is to understand road user route choices when the network is disrupted through a particular event such as a collision or flooding (as opposed to more routine congestion). Kasun's work will achieve impact by reducing the productivity losses on the network as a result of disruption, by guiding traffic authorities in helping road users make more effective choices.

Inaugural Waldron-Webb Award winner

Chris de Gruyter from Monash University is researching the effectiveness of strategies for encouraging the use of more sustainable modes of transport by residents of new housing developments. His work will create a positive effect by improving the journey experience for those in the residential development and for other road users by reducing the demand on the local road network.

Not only did Chris win the regional prize for Victoria and Tasmania, but he also won the inaugural Waldron-Webb award for the best Australasian student researcher at Roads Australia's Christmas lunch in Sydney.

L to R: Gerard Waldron (MD ARRB Group), The Hon. Duncan Gay (NSW Minister for Roads, Maritime and Freight, Chris de Gruyter (Monash University).

Goal | People

Sharing our expertise

Our staff hold a number of positions in industry and on academic committees, both nationally and internationally. Some of these include:

- 4th International Conference on Driver Distraction and Inattention 2015 – Michael Regan, Co-Chair of the Organising and Scientific Committee
- Australian Research Council (ARC) – Charles Karl, Assessor
- Australian Society for Concrete Pavements – Jeffrey Lee, President of the Queensland Branch
- Australian Standards – Charles Karl, member of IT-023 Transport Information and Control Systems; Erik Denneman, Committee CE-006 Asphalt and Sprayed Surfacing
- Austroads
  - Charles Karl, Cooperative ITS Steering Committee
  - Didier Bodin, Technical Secretary of the Pavement Structures Working Group (PSWG)
  - Young Choi, Technical Secretary of the Bituminous Surfacings Working Group (BSWG)
  - Erik Denneman, Asphalt Research Working Group (ARWG) and PSWG
  - Geoff Jameson, PSWG
  - Michael Moffatt, PSWG, Pavements Task Force (PTF)
  - Steve Patrick, Technical Secretary of BSWG
  - Laszlo Petho, Technical Secretary of the Asphalt Research Working Group
  - Robert Urquhart, PTF, BSWG and BSWG Binders Group

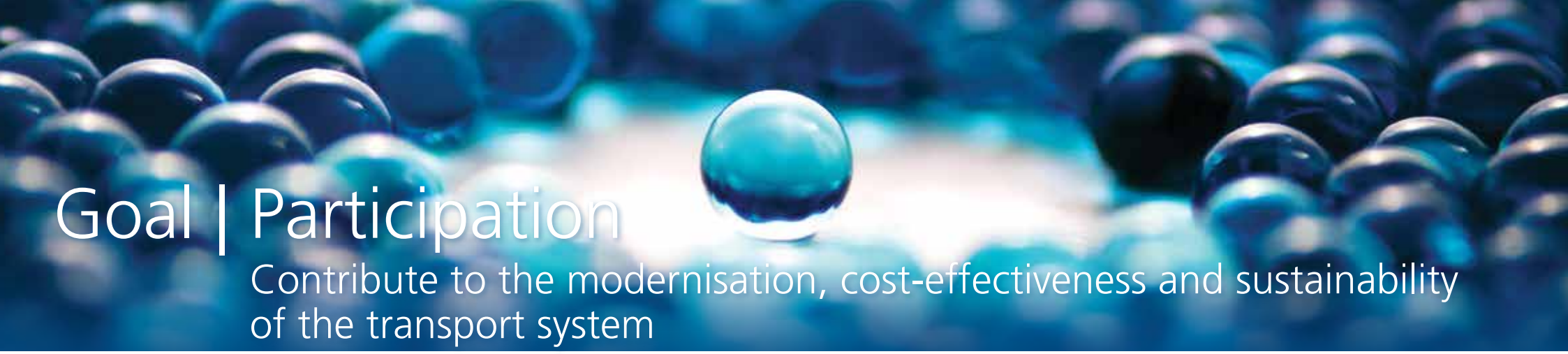
- Centre for Pavement Engineering Education (CPEE) – Richard Yeo, member on the Council
- European HUMANIST Association – Michael Regan, member of the Advisory Group
- Forum of European National Highway Research Laboratories (FEHRL)
  - Gerard Waldron, Vice President FEHRL Supervisory Board
  - Michael Moffatt, Bearing Capacity and Traffic Speed (BeCATS) and Deflection at Road Traffic Speed (DaRTS)
  - Michael Regan, Australian Representative of Technical Committee 22 and Sub-Committee 13
- Global Road Safety Partnership (GRSP) – Peter Damen, Executive Board member
- Human Factors and Ergonomics Society of Australia – Michael Regan, President
- International Advisory Committee – Michael Regan, member of the European Commission UDRIVE Project
- International Ergonomics Association – Michael Regan, member of the Organising Committee for 2015 Triennial Congress
- International Road Federation (IRF) – Paul Hillier, Vice Chair of the 'Road Safety Education and Training for Sector Professionals' sub-group
- ISO – Charles Karl, Australian delegate to the Technical Committee 2014
- Monash University – Richard Yeo, member of the Department of Mechanical & Aerospace Engineering, Advisory Board
- RILEM – Didier Bodin, Technical Committee 241-MCD

Goal | People

- Road Engineering Association of Asia and Australasia (REAAA)
  - Gerard Waldron, Vice President of REAAA International Council
  - Michael Moffatt, Technical Committee 2, Pavements
- Swinburne University of Technology
  - Ahmad Shayan, Adjunct Professor
  - Charles Karl and Ian Espada, guest lecturers
- Transportation Research Board (TRB)
  - Michael Moffatt, AFD40, Accelerated Pavement Testing
  - Jonathon Griffin, AFS50, Modelling for the Design, Construction and Management of Geosystems, and AFS80, Cementitious Stabilisation and Design and Construction Group Young Members Council
- UN Road Safety Collaboration – Michael Tziotis, Deputy Chair of the Safer Roads and Mobility sub-group
- US Association for the Advancement of Automotive Medicine – Michael Regan, member of Expert Panel on Distracted Driving
- USA-UE– Michael Regan, member of Bilateral Expert Group on Driver Distraction & Bilateral Expert Group on Cognitive Load
- World Road Association (PIARC) – Michael Moffatt, Technical Committee 4.2, Road Pavements.

There are also a number of notable activities that staff have undertaken. These include:

- Ahmad Shayan – invited to be a member of the Technical Committee for the joint International RILEM & CIA (Concrete Institute of Australia) Conference and invited to be a Guest Editor of the Special Issue (2015) of the CIA Journal on Mitigation of AAR Damage in Concrete
- Charles Karl – 32nd CAITR Conference of Australian Institute of Transport Research; BITRE Workshop: Exploring New Sources of Transport Data; Global Truck and Trailer Leaders Summit; ISO TC 204 Plenary Meeting; ITS Australia – ITS Business Summit;
- MRWA ITS Masterplan Workshop for External Stakeholders; MRWA ITS Masterplan Workshop for Internal Stakeholders
- Didier Bodin – supervised Ph.D. candidates at Queensland University and at Federation University
- Erik Denneman – presented at the Sunshine Coast University Continuing Professional Develpment seminar on Pavement Technology
- Garry Warren – presented papers at the 93rd TRB Conference in Washington, DC and at European Road Profile Users Group (ERPUG) 2014, Brussels
- James Luk – presented a seminar at the University of Hong Kong on 'Network modelling for road closure assessment'
- Kim Sedgwick held the positions of Chair, Young IPWEA and Director for IPWEAvic
- Michael Moffatt – keynote speaker at the International Seminar on Pavements, Quito
- Richard Wix – international keynote speaker at the Pavement Evaluation 2014 conference in Blacksburg, Virginia, USA; sat on the steering committee for both the Road Profile Users' Group (RPUG) in the USA and the European Road Profile Users Group (ERPUG); presented a paper at the South African Roads Federation and International Road Federation SARF/IRF 2014, 5th Regional Conference for Africa
- Rudolph Kotze – invited to speak at Engineers Australia Convention, November 2014; Convenor of the 9th Austroads Bridge Conference 2014.



Goal | Participation

Contribute to the modernisation, cost-effectiveness and sustainability of the transport system

Strategic Highway Research Program 2

Four research focus areas and topics

Road safety

involves the largest ever naturalistic driving study

Renewal

systematic rehabilitation of highway infrastructure

Reliability

of travel time and countermeasures to unexpected congestion

Capacity

collaborative decision-making on provision of network capacity

Jump-starting innovation – using successful programs from the USA

We are aiming to reduce the cost of research and development activities by bypassing the earlier, riskier stages of the research, development and implementation chain, where appropriate, by adapting overseas innovations to Australasia.

The USA's Strategic Highway Research Program 2 (SHRP2) has an overt 'develop and implement' approach. In 2014 we used an adaptation of NASA's Technology Readiness Level (TRL) system to evaluate the SHRP2's products for relevance and value to our member road agencies. The assessment identified those products which:

- Can quickly be adapted for Australasian use
- Will need significant adaptation for Australasian use
- Are not needed in the Australasian context and should not be adapted for Australasian use.

Some early examples of promising SHRP2 products address 100+ year bridge service life, continuous pavement deflection device assessments and means of improving the sophistication of field testing of construction materials.

This initiative is about knowledge-sharing, with our taking the leading role in proactive review of overseas research with a view to informing its members on new developments and innovations of relevance.

Jump-starting innovation – using successful programs from France

Our international networks and ability to evaluate overseas innovations identified a viable technology developed in France over two decades – high modulus asphalt (EME2).

Enrobés à Module Elevé Class 2 (EME2) technology was developed in the early 1990s, where it is now used on main routes and airports. Compared to conventional asphalt bases with unmodified binders, EME2 is characterised by a high stiffness, high durability, superior resistance to permanent deformation and good fatigue resistance.

Over the past two years we have been involved in an effort to transfer EME2 asphalt technology to Australasia. Two research projects were commissioned to facilitate the technology transfer.

Austroads invested in developing mix design guidelines setting appropriate performance criteria, using Australian test methods. Queensland Department of Transport and Main Roads has invested in the development of guidelines for the structural design of pavements containing EME2. A key characteristic of this effort is the involvement of, and in-kind contributions from, various industry partners including the Brisbane City Council – the use of one of its roads allowed for the evaluation of pavement design concepts and in situ performance of EME2. We carried out the pavement design and the site setup and is also performing the ongoing performance monitoring.

Australasia is now preparing for implementation of this technology on its road network. It is expected that the reduction in pavement thickness that can be achieved with this technology will lead to more cost-effective pavement designs and more sustainable use of scarce pavement materials.

A$2bn per annum

Australia's approximate expenditure on bituminous surfacings

30%

Layer material thickness reduction possible using this asphalt

Goal | Participation

Access to greater productivity for freight users

Performance Based Standards Route Assessment Tool

79

VIC local goverments have access to it

152

NSW local governments make use of it

Won the Australian Freight Industry Technology Award for 2013

Performance Based Standards (PBS) Route Assessment Tool : Cutting costs, managing risks, winning awards

The PBS Route Assessment Tool aims to make the ever-growing freight task economically and environmentally sustainable by enabling the use of higher productivity vehicles rather than simply increasing the number of trucks on the road network. Roll-out of the tools across the eastern seaboard is well underway and should be complete in 2015.

Increasing the productivity of freight vehicles is therefore a proven tool for increasing freight capacity without a similar increase in the A$22b* freight industry fuel bill, the A$16b* road maintenance and construction bill and the A$20b** congestion problem.

Since the freight task is set to double before 2035, it is clear that a means must be found to allow higher productivity vehicles onto Australasia's road networks. At various industry engagement workshops, we quickly realised that first and last-mile access was a significant barrier to the uptake of higher productivity vehicles. Together with stakeholders from road agencies, local government and port authorities, the need for a simple tool to assist time-poor local government engineers make safe access decisions consistently was identified.

* bitre.gov.au/publications/2014/files/BITRE_YEARBOOK_2014_Full_Report.pdf (9 July 2015)
** infrastructureaustralia.gov.au/policy-publications/publications/files/Australian-Infrastructure-Audit-Executive-Summary.pdf (9 July 2015)

It was first made available in Victoria in 2012 and was rolled out in collaboration with the Municipal Association of Victoria and VicRoads and won the 2013 Freight Industry Innovation award as a result. The National Heavy Vehicle Regulator invested in improvements to the tool once the benefits of the Victorian roll-out became apparent.

In 2013 and 2014, we partnered with Transport for New South Wales (TfNSW), Roads and Maritime Services (RMS), Local Government Association of New South Wales and the National Heavy Vehicle Regulator to make the improved tool available to all 152 Local governments in NSW Offering further opportunities to minimise the cost and environmental impact of doubling Australia's freight task.

This successful implementation has led to our working with Transport and Main Roads (TMR) and Local Government Association for Queensland (LGAQ) to make the tool available to local governments across Queensland.

Goal | Value

Demonstrate value for money in delivery of all our services

NACOE
NATIONAL ASSET CENTRE OF EXCELLENCE

Queensland Government

arrb GROUP

Driving innovation and cost saving: National Asset Management Centre of Excellence

Queensland's Department Of Transport and Main Roads (TMR) has long recognised that innovation, and the supporting research, development and implementation activities are a means of saving money and improving transport outcomes for all Queenslanders. To capitalise on this, they established the National Asset Management Centre of Excellence (NACOE) in partnership with us.

The benefits realised in just the first year validate this approach; it has been found that the first year return on investments made is of the order of A$1.60 for every A$1.00 invested. It is therefore possible that over a widely accepted 10 year benefits accrual timeframe, this investment could conceivably have a return on investment exceeding 15:1.

NACOE focuses on driving innovation to achieve savings through best practice. While undertaking research in all disciplines of the roads engineering, a primary focus of the centre is pavements, structures and asset management.

Images by Dr Torill Pape. ARRB Group

The most notable early achievements of the Agreement include:

- Savings through reduced asphalt pavement thickness in Queensland, resulting from evidence based revisions of design assumptions. Revised design practice is likely to save Queensland tens of millions of dollars per annum once implemented.
- Unlocking savings opportunities that appropriately performing innovative products can provide, by making Queensland's Transport Infrastructure Product Evaluation Scheme (TIPES) available to other jurisdictions. The introduction of Enrobés à Module Elevé (EME2) asphalt to Australia is a prime example of how the TIPES method can deliver savings without lowering serviceability.
- Savings which will accrue from improved pavement asset management decision making and project prioritisation, facilitated by the introduction of the Traffic Speed Deflectometer (TSD) to Queensland.
- Increases in productivity as a result of improved bridge capacity models which better reflect actual field performance. These models will allow engineers to make better-informed decisions about restricting access to bridges for high productivity freight vehicles.
- Improving TMR's return on investment by leveraging private sector co-investment through the NACOE initiative. This has a co-benefit of broader industry engagement and therefore research and development outcomes which meet the needs of both TMR and its customers.

160%

First-year return on investment

Queensland Government

Reduced asphalt pavement thickness in Queensland

TIPES CERTIFIED arrb GROUP

Delivering savings without lowering serviceability

Goal | Value

120,000+ km
driven

5.1+ million
deflection tests conducted

Image by Alana Cox, ARRB Group

Adapting international research and development for Australasian operations

Annually, Australian road agencies make decisions on a maintenance budget that collectively exceeds A$10b. To maximise the cost-benefit ratio of this investment the collection of accurate, relevant and timely data is of extreme importance.

A key parameter in the maintenance decision-making process is the structural strength of road pavement layers as this is a predictor of potential failures. Pavement strength, combined with the analysis of road surface condition, provides engineers with an indication of the remaining pavement life.

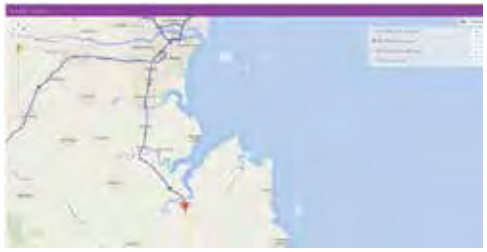
Earlier technology and devices to measure structural strength have their limitations, including the inability to measure continuously and the need to be stationary or close to stationary to do so. Falling Weight Deflectometers (FWD) have found widespread acceptance, but tests can only be performed on individual points, generally at 50 or 100 metre increments.

A recent development, the Traffic Speed Deflectometer (TSD), has the potential to provide continuous pavement deflection data at highway speed. Because of these benefits, ARRB acquired a TSD in 2014 and integrated our Hawkeye technology to provide both pavement strength and surface condition in a single device. Our TSD is recognised as the world leader in terms of length of network surveyed and in terms of sophistication through integration of Hawkeye.

Due to the years of research and development involved to prove the TSD concept, it is likely that Australia could not have afforded to develop this device. However, our policy of constantly scanning international innovations, and adapting those for Australasian conditions has allowed road agencies to have access to the technology without the costly and risky investment in the early research and development stages.

We will continue to develop and refine the combined technology to ensure it lives up to its full potential as a 'game-changing' device to more effectively manage roadway assets.

Sample maps showing the current and proposed mapping routes of the TSD within the New South Wales region.



A snapshot of the TSD's work is also available online (taken hourly).

Goal | Value

WAPARC

Image by John Best, retired ARRB Group employee

Partnership delivering fairer user charges (WAPARC)

In 2011 MRWA came to the conclusion that an R,D&I partnership was needed to extract better productivity from their road network. This partnership – Western Australian Pavement and Assets Research Centre (WAPARC) – is between MRWA, ARRB, the WA Local Government Association, Curtin University and the University of WA.

Maintenance of road pavements is key to their long-term durability, and funding for maintenance is notoriously scarce. To address this problem, MRWA's Road Maintenance Contribution Policy 2011 allows vehicles operating at a load limit of 23.5 tonnes on triaxles to be charged for freight that exceeds the original freight task.

In 2014, WAPARC was tasked with investigating whether the cost recovery for a specific iron-ore freight task in the Pilbara was sufficient to cover the marginal maintenance cost of the additional freight. As a result of the investigation, a refined approach has been suggested as a more transparent approach to setting heavy vehicle charges operating under the Concessional Loading Scheme (CLS).

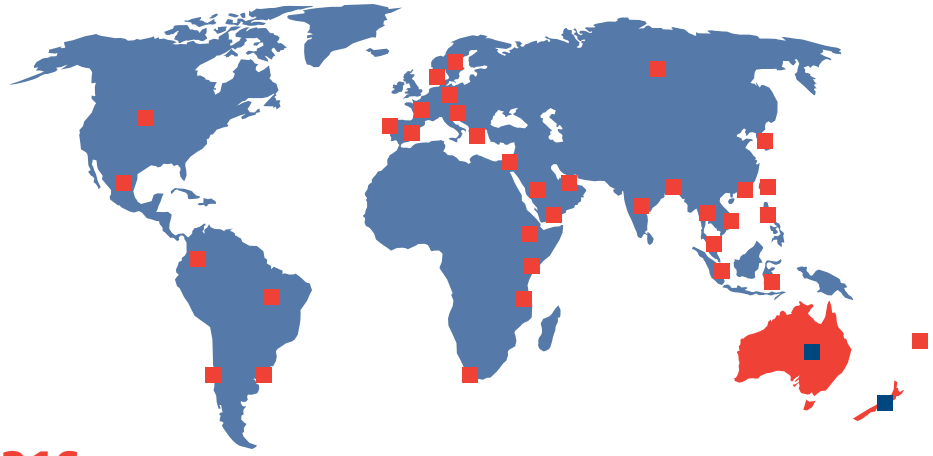
Domestic and global impact from Australian research and development - Hawkeye

Investment in roads-related data collection and research and development by Australasian funders has provided a sound return on investment domestically. Increasingly though, this benefit is making a contribution to Australasia's prestige as a smart region and to its balance of payments.

We have long used research outputs and our own operational experience to create state-of-the-art condition monitoring equipment. With investment of our own in Research and Development, we have created the Hawkeye suite of scalable survey solutions.

The latest technology implemented within the Hawkeye platform has been Automatic Crack Detection (ACD). ACD has been recognised for decades as the ultimate aspiration in terms of data collection, along with highway speed deflection testing (see page 30 for TSD article). Hawkeye's ACD has been the result of a long process of Research and Development by RMS NSW (and its predecessors) staff and collaboration between ourselves and RMS to operationalise the technology concept economically.

In 2014, the Hawkeye ACD passed the ultimate test – recognition as value-for-money by the international market. Significant increases in sales were recognised in the South-east Asia region particularly.



216 Hawkeye 1000 & 2000 models installed across the globe*

North America
- USA
- Mexico

South America
- Brazil
- Chile
- Colombia
- Uruguay

European Union
- Croatia
- Czech Republic
- Denmark
- France
- Greece
- Portugal
- Spain
- Sweden

Africa | ME
- Ethiopia
- Israel
- Kenya
- Saudi Arabia
- South Africa
- Tanzania
- UAE
- Yemen

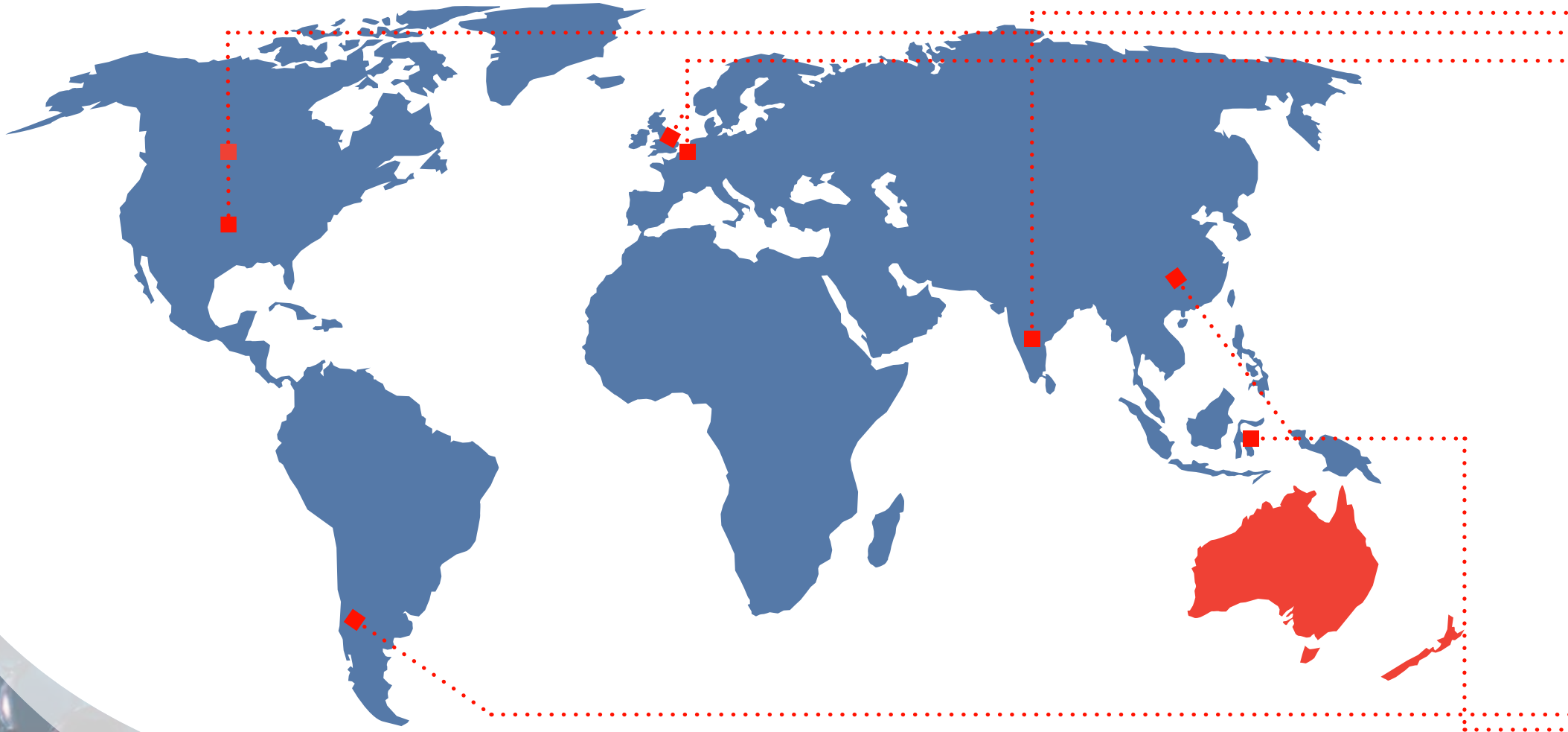
Asia
- Bangladesh
- Hong Kong
- India
- Indonesia
- Japan
- Korea
- Malaysia
- Russia
- Singapore
- Sri Lanka
- Taiwan
- Thailand
- Vietnam

Austra -lasia
- Australia
- Fiji
- New Zealand

*From 2010 to 2014

Quality connections

We had a number of international visitors in 2014, including:



North America

- Richard Habel, President of Pavemetrics, Canada
- Dr Chris Raymond from the Ontario Ministry of Transportation, Canada
- Dr Dave Jones from the University of California, Davis, USA
- Brett Bivins from the International Center for Alcohol Policy, USA
- Professor Dan M. Frangopol, Fazlur R. Khan Endowed Chair of Structural Engineering and Architecture at Lehigh University, USA
- Dr Peter Sweatman, University of Michigan Transportation Research Institute (UMTRI), USA

South America

- Dr Álvaro González from the Universidad del Desarrollo, Chile

European Union

- Danny Woollard from INRIX, UK
- Delegation from the Department of Trade and Industry, UK
- Delegation from the Belgian Road Research Centre
- Rolf Rabe from the Federal Highway Research Centre (BaST) in Cologne, Germany
- Dr Fred Wegman, Technical University of Delft, Netherlands
- Ms Birgitta Sandstedt, Director, Library and Information Centre VTI, Sweden
- Dr Fabio Biondini, Associate Professor of Structural Engineering, Politecnico di Milano, Italy
- Mr Thierry Goger, Secretary General FERHL, Belgium

Asia

- Delegation from the Ministry of Transport of the People's Republic of China
- Delegation from the Institute of Road Engineering in Bandung, Indonesia
- Managing Director of IRSM Pvt Ltd (ARRB's joint venture partners in India), along with two staff members
- Kamran Khan, the manager of Austrade Business Development
- A delegation from the Public Works Department of Uttar Pradesh Government
- Delegation from the Ministry of Transport, Indonesia
- Dr Mitsuyoshi Akiyama, Professor of Civil Engineering, Waseda University, Japan
- REAAA Governing Council

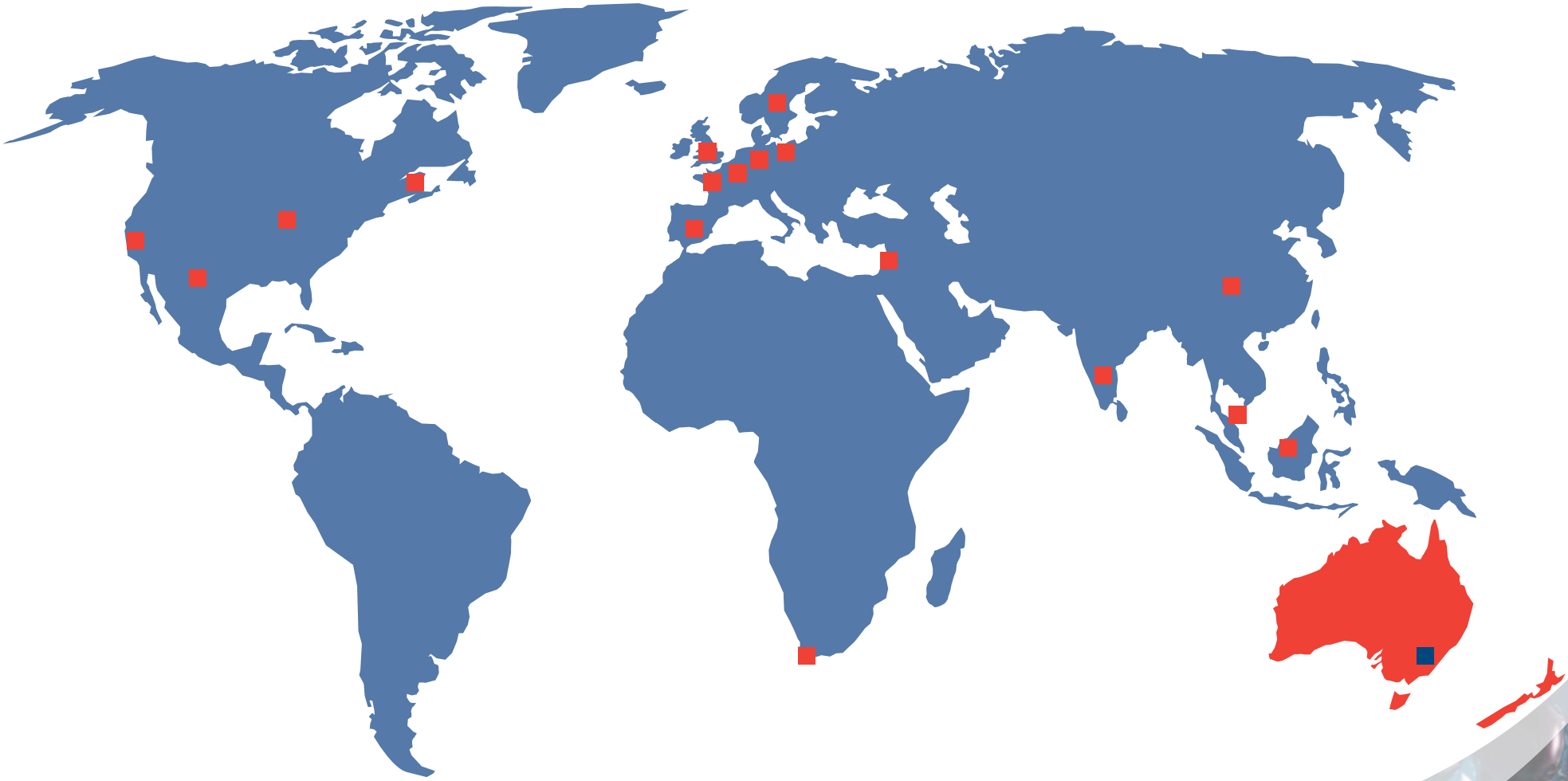
International Network

We also had the opportunity to collaborate with a number of international bodies.

One collaboration of note is with the Global Road Safety Partnership (GRSP), where we are one of the key contributors (including keynote speakers, workshops and presentations) to various GRSP events. This includes the annual Asia Pacific Road Safety Forum, hosted in conjunction with iRAP and the Asia Development Bank (ADB) in Manila. We also performed road safety inspections in collaboration with the GRSP at selected school sites in Han Nam province, near Hanoi, as well as a five day Road Safety Audit training workshop in Morocco. ARRB has also collaborated with other international bodies, including:

- American Association of Port Authorities (AAPA), USA
- Asia Development Bank (ADB)
- Asia Injury Prevention Foundation (AIPF)
- Asia-Pacific Economic Cooperation (APEC)
- Beirut Arab University, Lebanon
- Belgian Road Research Centre, Belgium
- Delft University of Technology, The Netherlands
- Department for International Development (DID), UK
- Department of Civil Engineering, University of New Brunswick, Canada
- Federal Highway Research Centre (BASt), Germany
- Fédération Internationale de l'Automobile (FIA Foundation), UK
- Forum of European National Highway Research Laboratories (FEHRL), Belgium
- International Road Federation (IRF)
- Malaysian Institute of Road Safety Research (MIROS), Malaysia
- Road and Bridge Research Institute (IBDiM), Poland
- Road Engineering Association of Asia and Australasia (REAAA)
- Road Traffic Injuries Research Network (RTIRN)
- International Union of Laboratories and Experts in Construction Materials, Systems and Structures (RILEM), France
- Research Institute of Highways, Ministry of Transportation (RIOH), China
- The Centro de Estudios y Experimentación de Obras Públicas (CEDEX), Spain
- The Council for Scientific and Industrial Research (CSIR), South Africa
- The French Institute of Science and Technology for Transport, Development and Networks (IFSTTAR), France
- The International Organization for Standardization (ISO), Geneva, Switzerland
- The International Road Assessment Programme (iRAP)
- The Organisation for Economic Co-operation and Development (OECD), France
- The Swedish National Road and Transport Research Institute (VTI), Sweden
- Transport for London (TRL), UK
- United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)
- University of Bordeaux, France
- University of California, Davis, USA
- University of Michigan Transportation Research Institute Library (UMTRI), USA
- World Bank, India
- World Health Organisation (WHO)
- World Road Association (PIARC), France.

We made several appearances in the media, including a number of road safety related radio interviews, news articles on the iStart website, in Business Day and in the Roads magazine, as well as a TV interview on ARRB's Traffic Speed Deflectometer (TSD) for Prime7 in Lismore.



Publications

Our key publications and authors in 2014

Journal articles

- Road and Transport Research, *Cooperative intelligent transport systems (C-ITS) - an overview of the ARRB/Austroads C-ITS work program 2010-2013* | D.Green, P.Bennett, C.Han, F.Faber
- REAAA Journal, *Estimating the Californian bearing ratio from the particle size distribution and Atterberg limits* | B.Lloyd
- Routes/Roads - PIARC Magazine, *Implementation of Australia's new road crash risk assessment approach* | L.Steinmetz, C.Jurewicz, R.Excell

ARRB RACV Report

- Royal Automobile Club of Victoria (RACV), Noble Park, Victoria, Australia, *Crash risk of international visitors to Victoria, Research Report* | J.Catchpole, K.Pratt

ARRB Austroads Guides

- AGPD01/14, Austroads, Sydney, New South Wales, Australia, *Guide to project delivery part 1: overview* | E.Casey
- AGPD04/14, Austroads, Sydney, New South Wales, Australia, *Guide to project delivery part 4: direct management of project works* | E.Casey
- AGTM05/14, Austroads, Sydney, New South Wales, Australia, *Guide to traffic management part 5: road management* | P.Eady, C.Han, J.Luk
- AGTM04/14, Austroads, Sydney, New South Wales, Australia, *Guide to traffic management part 4: network management* | I.Espada
- AGPD02/14, Austroads, Sydney, New South Wales, *Australia, Guide to project delivery part 2: planning and control* | E.Casey
- AGTM09/14, Austroads, Sydney, New South Wales, Australia, *Guide to traffic management part 9: traffic operations* | M.Levasseur
- AGPD03/14, Austroads, Sydney, New South Wales, Australia, *Guide to project delivery part 3: contract management* | E.Casey

ARRB Austroads Reports

- AP-R462/14, Austroads, Sydney, New South Wales, Australia, *Cemented materials characterisation: final report* | A.Alderson, G.Jameson
- AP-T264/14, Austroads, Sydney, New South Wales, Australia, *Austroads asphalt deformation trial: Dandenong Road* | A.Alderson
- AP-R450/14, Austroads, Sydney, New South Wales, Australia, *Investigation of key crash types: run-off-road and head-on crashes in urban areas: final report* | D.Beck
- AP-R454/14, Austroads, Sydney, New South Wales, Australia, *Operational management of arterial/managed motorway interfaces for network optimisation* | P.Bennett, F.Faber, I.Espada
- AP-R464/14, Austroads, Sydney, New South Wales, Australia, *Development of guide content on managed motorways* | P.Bennett, F.Faber
- AP-T252/14, Austroads, Sydney, New South Wales, Australia, *Development of the building and construction procurement guide* | E.Casey
- AP-G92/14, Austroads, Sydney, New South Wales, Australia, *Building and construction procurement guide: principles and options* | E.Casey
- Austroads, Sydney, New South Wales, Australia, *National prequalification system: inclusion of specialist steel fabrication categories* | E.Casey
- AP-C94-14, Austroads, Sydney, New South Wales, Australia, *National prequalification system: inclusion of specialist precast concrete categories* | E.Casey
- AP-T270/14, Austroads, Sydney, New South Wales, Australia, *Post-ageing characterisation of sprayed sealing binders: a laboratory study* | Y.Choi, R.Urquhart
- AP-T259/14, Austroads, Sydney, New South Wales, Australia, *Interim road deterioration cracking model during accelerated deterioration* | L.Choummanivong, T.Martin
- AP-T278/14, Austroads, Sydney, New South Wales, Australia, *Economics of material availability and recycling* | C.Evans, B.Andrews, K.Sharp
- AP-T285/14, Austroads, Sydney, New South Wales, Australia, *Updating environmental externalities unit values* | C.Evans, C.Naude, J.Teh, T.Makwasha, U.Ai
- AP-T269/14, Austroads, Sydney, New South Wales, Australia, *Best practice for mobile LiDAR survey requirements: discussion paper* | F.Faber

- AP-T268/14, Austroads, Sydney, New South Wales, Australia, *Application of new technologies to improve risk management* | F.Faber, P.Bennett, W.Muller, H.Ngo
- AP-R458/14, Austroads, Sydney, New South Wales, Australia, *C-ITS interoperability with existing ITS infrastructure* | D.Green, F.Faber, M.Levasseur
- AP-R448/14, Austroads, Sydney, New South Wales, Australia, *Procurement of ITS (international practice)* | C.Han, J.Li, I.Espada
- AP-T262/14, Austroads, Sydney, New South Wales, Australia, *Performance requirements for bitumen sprayers* | S.Patrick
- AP-T265/14, Austroads, Sydney, New South Wales, Australia, *Freight Axle Mass Limits Investigation Tool (FAMLIT) user guide* | W.Hore-Lacy, T.Martin
- AP-R463/14, Austroads, Sydney, New South Wales, Australia, *Framework for the revision of Austroads design procedures for pavements containing cemented materials* | G.Jameson
- AP-T275/14, Austroads, Sydney, New South Wales, Australia, *Design and performance of foamed bitumen stabilised pavements: progress report 2* | G.Jameson
- AP-R437/14, Austroads, Sydney, New South Wales, Australia, *Improving roadside safety: summary report* | C.Jurewicz, L.Steinmetz, P.Cairney
- AP-R436/14, Austroads, Sydney, New South Wales, Australia, *Improving roadside safety: stage 4: interim report* | C.Jurewicz, L.Steinmetz
- AP-R455/14, Austroads, Sydney, New South Wales, Australia, *Model national guidelines for setting speed limits at high-risk locations* | C.Jurewicz, C.Phillips, M.Tziotis, B.Turner
- AP-R451/14, Austroads, Sydney, New South Wales, Australia, *Australian National Risk Assessment Model* | C.Jurewicz, L.Steinmetz, B.Turner
- AP-T260/14, Austroads, Sydney, New South Wales, Australia, *Towards incorporating heavy vehicles into the Austroads sprayed seal design method* | KY.Khoo
- AP-T261/14, Austroads, Sydney, New South Wales, Australia, *Literature review of the adhesion mechanisms in emulsion seals* | KY.Khoo
- AP-R452/14, Austroads, Sydney, New South Wales, Australia, *Review of AS 5100.7: rating of existing bridges and the Bridge Assessment Group guidelines* | N.Lake, H.Ngo, R.Kotze
- AP-R466/14, Austroads, Sydney, New South Wales, Australia, *Review of axle spacing mass schedules and future framework for assessment of heavy vehicle access applications*| N.Lake, J.Seskis, H.Ngo, R.Kotze
- AP-G88/14, Austroads, Sydney, New South Wales, Australia, *Cycling aspects of Austroads guides* | M.Levasseur
- AP-G88A/14, Austroads, Sydney, New South Wales, Australia, *Cycling aspects of Austroads guides: quick reference* | M.Levasseur
- AP-T267/14, Austroads, Sydney, New South Wales, Australia, *Characterisation and performance evaluation of granular bases project: pavement construction report* | A.Lim, W.Hore-Lacy, D.Bodin
- AP-T266/14, Austroads, Sydney, New South Wales, Australia, *Austroads LTPP and LTPPM study: summary report 2012-13* | T.Martin, L.Choummanivong
- AP-T284/14, Austroads, Sydney, New South Wales, Australia, *Practical application of an alternative roughness profile validation technique (Prem method)* | T.Martin, L.Choummanivong, R.Wix
- AP-T280/14, Austroads, Sydney, New South Wales, Australia, *Traffic speed deflectometer: data analysis approaches in Europe and USA compared with ARRB analysis approach* | M.Moffatt, T.Martin, W.Muller, U.Ai
- AP-R459/14, Austroads, Sydney, New South Wales, Australia, *Using financial data in asset management decision-making* | C.Naude, T.Makwasha
- AP-T274/14, Austroads, Sydney, New South Wales, Australia, *Initial field trials with surface wear rig* | S.Patrick, B.Wright
- AP-T276/14, Austroads, Sydney, New South Wales, Australia, *Double/double primerseal inspections* | S.Patrick
- AP-T277/14, Austroads, Sydney, New South Wales, Australia, *Inspections of sprayed seal trials* | S.Patrick
- AP-T283/14, Austroads, Sydney, New South Wales, Australia, *High modulus high fatigue resistance asphalt (EME2) technology transfer* | L.Petho, A.Beecroft, J.Griffin, E.Denneman

- AP-T279/14, Austroads, Sydney, New South Wales, Australia, *Traffic speed deflectometer: data review and lessons learnt* | J.Roberts, U.Ai, T.Toole, T.Martin
- AP-R460/14, Austroads, Sydney, New South Wales, Australia, *Providing for road user error in the Safe System* | P.Roberts
- AP-T273/14, Austroads, Sydney, New South Wales, Australia, *Good practice in reseal programming* | T.Toole, P.Hillier
- AP-R449/14, Austroads, Sydney, New South Wales, Australia, *Methods for reducing speeds on rural roads: compendium of good practice* | B.Turner, T.Makwasha
- AP-T271/14, Austroads, Sydney, New South Wales, Australia, *Effects of hot storage on polymer modified binder properties and field performance* | R.Urquhart

ARRB 26th Conference papers

- The Safe System approach in NSW: how are we travelling? | D.Beck
- Asphalt moisture-sensitivity assessment in Australia using the Hamburg Wheel Tracking Device (HWTD) | A.Beecroft, L.Petho, J.Griffin, E.Denneman
- Operational management of arterial/managed motorway interfaces for network optimisation | P.Bennett
- Kwinana Freeway All Lane Running sign comprehension study | K.Boddington, K.Ralston
- APADS: finite method software for enhanced pavement analysis including nonlinear behavior of granular materials | D.Bodin, G.Jameson, M.Moffatt
- Calculating the cost of road wear on sealed local roads | N.Michel, T.Toole
- Modular AB-triples: Australia's next generation of very high productivity freight vehicles | A.Bucko, A.Germanchev
- Priorities for crash countermeasures in Australia and New Zealand: an overview based on Safe Systems principles | P.Cairney, C.Bradshaw, B.Turner
- The economic value of inputs from the community itself to a community road safety partnership | P.Cairney
- National Road Safety Partnership Program: a mechanism to demonstrate that road safety good practice is not altruistic but entirely good business | JP.Carslake, S.Van Dam
- Formulating the South Australian automatic crack data processing methodology | S.Barlow, R.Wix
- The impact of maintenance on unsealed road performance | M.Dias, T.Thoresen, T.Martin, W.Hore-Lacy
- Level of service framework for network operation planning | I.Espada, D.Green
- Australian Cooperative ITS platform | F.Faber, D.Green
- Cooperative ITS interoperability with existing ITS infrastructure | D.Green, F.Faber, C.Karl
- Heavy-duty unbound granular pavements: an example of best practice in Queensland | J.Griffin, E.Denneman, L.Petho, A.Beecroft
- Emerging digital mapping requirements for Cooperative ITS | C.Han, P.Bennett, D.Green
- ITS procurement methods and a proposed decision model | C.Han, I.Espada, J.Li
- Current and future issues in skid resistance management in Australia | P.Hillier
- Time domain reflectometry (TDR) based moisture monitoring system for unbound granular pavements | W.Hore-Lacy, D.Bodin
- Improved fatigue characterisation of cemented materials | G.Jameson
- Model national guidelines for setting speed limits at high-risk locations | C.Jurewicz
- Using the Australian National Risk Assessment Model (ANRAM) to improve road safety | C.Jurewicz, L.Steinmetz
- From research to practice: development of rural mass curve treatment program | C.Jurewicz
- Incorporating uncertainty in pavement performance modeling | P.Kadar, T.Martin, L.Choummanivong
- A review of the loading impacts of heavy vehicles on the Austroads sprayed seal design method | K.Y.Khoo
- Potential framework for the nationwide assessment of heavy vehicle access to bridges | R.Kotze, J.Seskis
- Expanded operating speed model | M.Levasseur, B.Mitchell
- Evaluating vehicle activated signs on rural roads | T.Makwasha, B.Turner
- Influence of multiple-axle group loads on mechanistic design of asphalt pavements | MA.Moffatt, GW.Jameson

- Preliminary field validation of the updated traffic speed deflectometer (TSD) device | W.Muller, R.Wix
- Managing the risks of using seawater for pavement construction | K.Neaylon
- Stiffness variability of multigrade asphalt in Brisbane | L.Petho
- Evaluation of Peninsula SaferSpeeds: speed limit reduction and community perceptions | K.Pratt
- Using driver errors to inform Safe System infrastructure development | P.Roberts
- A review of the structural performance of flooded pavements | T.Martin
- How asset management can assist in the delivery of road safety outcomes | B.Turner, T.Toole
- Development and implementation of a pavement asset management system (PAMS) at Roads and Maritime Services NSW: the journey so far | P.Kadar

Other Conferences

- Addressing accessibility gaps in network operation planning, *32nd Conference of Australian Institutes of Transport Research (CAITR), 2014, Sydney, New South Wales, Australia* | I.Espada, D.Green, P.Bennett
- Policy implications of cooperative ITS core functions, *Australian Institute of Traffic Planning and Management (AITPM) National Conference, 2014, Adelaide, South Australia, Australia* | F.Faber
- Guidelines for standardised bridge barrier designs, *9th Austroads Bridge Conference, 2014, Sydney, New South Wales, Australia* | H.Ngo, R.Kotze
- Load testing and in-service monitoring of transversely stressed deck unit bridges, *9th Austroads Bridge Conference, 2014, Sydney, New South Wales, Australia* | H.Ngo, R.Kotze, T.Pape
- Instrumented pavement condition assessments: the way of the future, *5th SARF/IRF Regional Conference, 2014, Pretoria, South Africa* | R.Wix
- Dynamic bridge-vehicle interactions, *9th Austroads Bridge Conference, 2014, Sydney, New South Wales, Australia* | T.Pape, R.Kotze, H.Ngo
- Influence of fly ash in suppressing AAR expansion in a dam wall, *36th International Conference on Cement Microscopy*, 2014, Milan, Italy | A.Shayan
- Identification of AAR in South Island bridges in New Zealand, *36th International Conference on Cement Microscopy, 2014, Milan, Italy* | A.Shayan
- Investigation of a geopolymer concrete used in retaining walls of a bridge, *36th International Conference on Cement Microscopy, 2014, Milan, Italy* | A.Shayan, A.Xu
- Importance of reactive SiO_2, Al_2O_3 and Na_2O in geopolymer formation, *9th Austroads Bridge Conference, 2014, Sydney, New South Wales, Australia* | A.Shayan
- Methods for reducing speeds on urban arterial roads, *Australasian Road Safety Research Policing and Education Conference, 2014, Melbourne, Victoria, Australia* | B.Turner, T.Makwasha, K.Pratt, A.Beecroft

Acronyms

ACD	Automatic Crack Detection
ARRB	ARRB Group Ltd
ATRI	Australian Transport Index
Austroads	Association of Australian and New Zealand road transport and traffic authorities
B2B	Business to Business
CLS	Concessional Loading Scheme
EME2	Enrobés à Module Elevé Class 2
FEHRL	Forum of European National Highway Research Laboratories
FWD	Falling Weight Deflectometer
ICE	Institution of Civil Engineers UK
ITRD	International Transport Research Documentation
ITS	Intelligent Transport systems
LGAQ	Local Government Association of Queensland
MRWA*	Main Roads Western Australia
NACOE	National Road Asset Centre of Excellence
NASA	National Aeronautics and Space Administration
NIS	National Interest Services
NRSPP	National Road Safety Partnership Program
OECD	Organisation for Economic Cooperation and Development
PBS	Performance Based Standards Route Assessment Tool
RAP	Reclaimed Asphalt Program
R,D&I	Research, development and implementation
REAAA	Road Engineering Association of Asia and Australasia
RMS*	Roads and Maritime Services, New South Wales
SHRP	Strategic Highway Research Program
TfNSW	Transport for New South Wales
TIPES	Transport Infrastructure Product Evaluation Scheme
TMR*	Department of Transport and Main Roads, Queensland
TRB	Transportation Research Board, USA
TRID	Transportation Research Board Database, USA
TRL	Technology Readiness Levels
TSD	Traffic Speed Deflectometer
UK	United Kingdom
UN	United Nations
VicRoads*	Roads Corporation Victoria
WAPARC	Western Australian Pavement and Assets Research Centre

* Our members

Directory

Mr Gary Liddle | Chairman
FIEAust, BEng (Civil), GradDipMgt, GAICD

Deputy Secretary for Transport at the Department of Transport, Planning and Local Infrastructure in Victoria

Mr Gerard Waldron | Managing Director
Dip Eng (Mech), Grad Dip Entrepreneurship, MEnterprise Innovation, GradIEAust, MAICD

Mr Waldron is Managing Director of ARRB Group Ltd

Mr Peter Duncan AM | Director
Cert L&ESD, Grad. Cert Traffic Eng, A.Dip Land. Studies, G.Dip. Mgt, MAICD, FIPAA

Chief Executive of Roads and Maritime Services in New South Wales

Mr Neil Scales OBE | Director
ONC (Engineering), HNC (Electrical and Electronic Engineering), BSc (Engineering), MSc (Control Engineering and Computing Systems), MBA

Director General of Transport and Main Roads Queensland

Dr Kevin Thompson | Director
BEng (Hons) (Civil), PhD, DistFIPENZ

Professional Director: Director of KiwiRail, Deputy Chair Environmental Protection Authority, New Zealand and the Immediate Past President of Institution of Professional Engineers, New Zealand

Dr Ann Turner | Director
BEc (Hons), MA (Economic Geography), PhD

CEO and Director of Ann Turner Consultants Pty Ltd

Mr Peter Woronzow | Director
BA (Economics), GradDip Public Sector Management, CPA, FIPA, MIPAA

Executive Director of Finance and Commercial Services, Main Roads Western Australia

Ms Kate Thomson | Company Secretary
B.Com CA (NZ), GAICD

Chief Financial Officer ARRB

Victoria | Head Office
500 Burwood Highway, Vermont South
VIC 3133, Australia.
P: +61 3 9881 1555
F: +61 3 9887 8104
info@arrb.com.au

New South Wales
2-14 Mountain St, Ultimo NSW 2007,
Australia.
P: +61 2 9282 4444
F: +61 2 9280 4430
arrb.nsw@arrb.com.au

Queensland
123 Sandgate Road, Albion QLD 4010,
Australia.
P: +61 7 3260 3500
F: +61 7 3862 4699
arrb.qld@arrb.com.au

South Australia
Level 7, Suite 713,
147 Pirie St Adelaide SA 5000,
Australia.
P: +61 8 8235 3300
arrb.sa@arrb.com.au

Western Australia
191 Carr Place, Leederville WA 6007,
Australia.
P: +61 8 9227 3000
F: +61 8 9227 3030
arrb.wa@arrb.com.au

About ARRB

ARRB Group Ltd (ARRB) provides research, consulting and information services to the road and transport industry. ARRB applies research outcomes to develop equipment that collects road and traffic information and software that assists with decision making across road networks. ARRB is the leading provider of road research and best practice workshops in Australia.

ARRB Group Ltd
ABN 68 004 620 651

arrb GROUP
arrb.com.au