

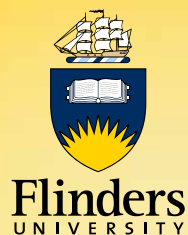
FOCUS

LINKING WITH BUSINESS

HOW AUSTRALIA'S UNIVERSITIES ARE WORKING WITH BUSINESS

Contributors discuss how we are collaborating to bring the benefits of the nation's research to business to boost productivity.

Connecting Ideas. Developing Solutions. Improving Lives.



Flinders University
The Medical Device
Research Institute

Ground-breaking technologies and new medical devices are boosting the quality of life for people living with disabilities, the elderly, and those suffering other medical conditions. With close links to industry, Flinders University's **Medical Device Research Institute (MDRI)** is at the forefront of this innovation – delivering benefits through the application of technology to the medical and allied health sectors.



Developing serious games for children with cerebral palsy

Bringing together the collaborative skills of biomedical engineers, computer scientists, occupational and physio-therapists, game developers and industrial designers, Flinders University are pushing the boundaries of technology to benefit the lives of children with CP.

The team has developed a novel, haptic Serious Gaming System that children with CP are able to play as part of an intensive but specific rehabilitation program.

Smart living apartments

Based on expert advice by Flinders University, eight 'smart living' apartments featuring cutting-edge assistive technologies have been purpose built for those living with disabilities.

The apartments are a major step forward in maximising people's choices and control over their own lives, providing cost benefits and an enhanced quality of life.

flinders.edu.au/mdri

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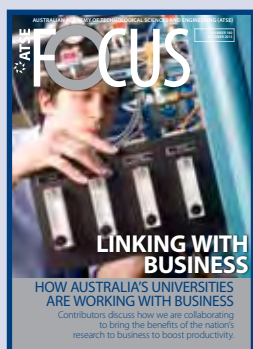
Cutting-edge technology in ceramic
armour manufacture.

PHOTO: VCAMM

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FOCUS

ATSE *Focus* is produced to stimulate discussion and public policy initiatives on key topics of interest to the Academy and the nation. Many articles are contributed by ATSE Fellows with expertise in these areas. Opinion articles will be considered for publication. Items between 800 and 1400 words are preferred. Please address comments, suggested topics and article for publication to editor@atse.org.au.

Deadline for the receipt of copy for next edition of *Focus* is

8 November 2013.

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ACN 008 520 394

ABN 58 008 520 394

Print Post Publication No 341403/0025

ISSN 1326-8708

Design and production:

Coretext 03 9670 1168 www.coretext.com.au





University of
South Australia

Addressing industry needs through research and business partnerships.

A new patented technology that can plot walls or furniture from life-size building design plans is just one of the research projects that highlights how the University of South Australia (UniSA) is using its world-class expertise and capabilities to address industry needs through the University's commercialisation arm, ITEK Ventures.

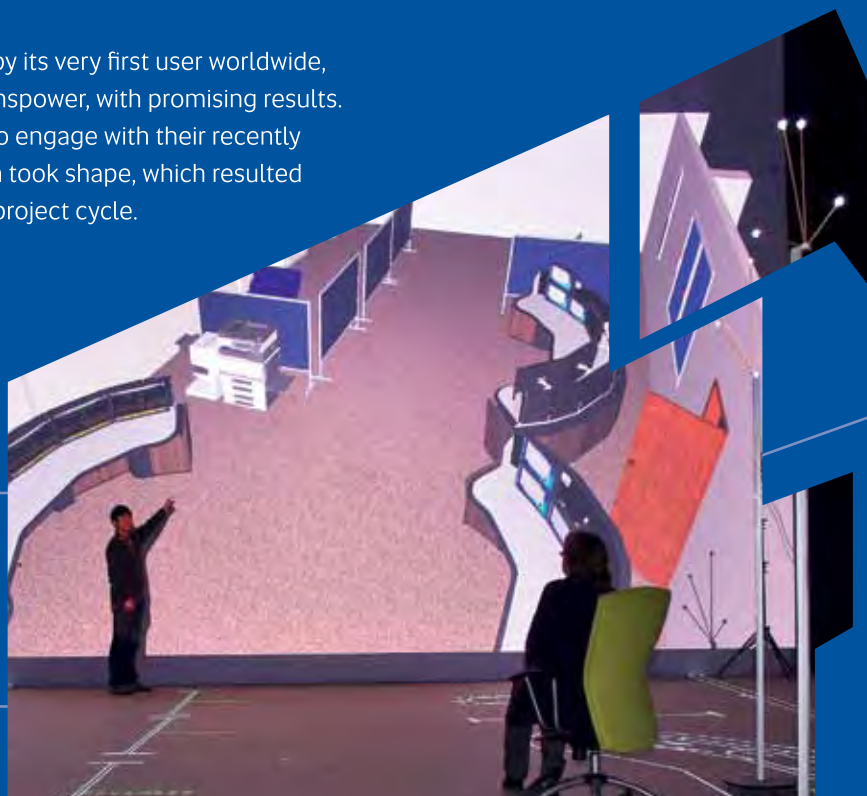
Jumbo Vision International's ingenious fusion of high-tech 2D and 3D visualisation and control room design skills, CADwalk™ allows users - such as operators, architects, builders and engineers - to walk their way through a full-sized representation of a control room. Modifications of the room layout are made possible by a special camera and movable pole receptor system created by Jumbo Vision International and UniSA which allows users to physically walk through their project at 1:1 scale.

The result is a life-sized digital playground that gives users a fully immersive visual sense of the room as it will appear when completed. Interactive software provides feedback and control over the layout in real time, with users simply having to physically move the tracking devices until they have achieved the desired output.

CADwalk™ has already been utilised in a live setting by its very first user worldwide, New Zealand's national electricity power provider Transpower, with promising results. Here, the virtual reality based system allowed users to engage with their recently completed major control room upgrade as the design took shape, which resulted in an estimated cut of three months from the design project cycle.

To find more about research at the University of South Australia visit unisa.edu.au.

"This is world first. We estimate it can save three months or longer in design time."
Lena Kimenkowski, General Manager Jumbo Vision International.



Knowledge is growth: building the firms of the future

The firms of the future will need graduates from all disciplines with an entrepreneurial outlook, interdisciplinary perspectives and an understanding of industry needs.



By Margaret Sheil
margaret.sheil@unimelb.edu.au

Andrew Wyckoff, OECD Director of Science, Technology and Industry, argues that “knowledge is growth” in modern economies. Knowledge-based capital (KBC) encompasses a range of intangible assets, such as research, data, software and design skills.

Policy makers in developed and developing countries are focused on fostering investment in these assets because the value-add in systems of production is concentrated in upstream activities (such as product design, R&D, systems integration and production of core components) or in far downstream activities (such as marketing and branding).

The example often cited is the iPhone 4. For each iPhone 4, sold at a retail price of US\$600, Apple earns US\$270 of margin, while Korean firms supplying core components earn US\$80, and enterprises in China providing assembly services earn US\$6.50, a mere one per cent of the total value (OECD, *New Sources of Growth*, May 2012).

New policy settings are required to promote business investment in KBC, such as adjustments to intellectual property regimes. However, universities also have a critical role to play. The production and use of KBC requires new skills and stronger links between businesses and the curators and generators of new knowledge, such as universities.

Recent work on KBC emphasises the importance of input from all disciplines and of interdisciplinary approaches. Businesses need access to the latest ideas and information about marketing, sales, HR and logistics, as well as assistance with new technology. The firms of the future will need graduates from all disciplines with an entrepreneurial outlook, interdisciplinary perspectives

and an understanding of industry needs.

These global concerns resonate in Australia as we seek to seize the opportunities offered by emerging Asian markets. The urgency of the task is evident in Victoria, where traditional manufacturing accompanies strengths in biotech, aviation, agriculture, hospitality, ICT, logistics, design, education, health and financial services.

As Ken Henry has highlighted, other high-wage countries have secured an indispensable place in regional and global manufacturing supply chains, and has commented: “We need to ask how, and in what areas, Victoria might secure a future in this sort of manufacturing, and in all the other areas in which it has demonstrated excellence”. (‘Right time, right place to be part of the Asian century’, *Sydney Morning Herald*, 6 August 2013).

The University of Melbourne is well placed to help its home state and the

nation answer this vital question. We have demonstrated excellence and a commitment to innovation in learning, research and engagement – all essential ingredients when it comes to fostering an environment conducive to business investment in KBC.

Melbourne has re-engineered its entire approach to undergraduate and postgraduate education. Its new-generation bachelor degrees combine disciplinary depth with intellectual breadth and expand the student learning experience beyond campus. The well-rounded education and work experience opportunities provided are appreciated by students and employers and reflected in high demand for the university’s courses and graduates. This more flexible approach emphasises expanding career horizons and is paying dividends in demand for science courses in particular, despite concern about declining student interest in science elsewhere.

The University of Melbourne’s

Food innovators at work in the new Asia-Pacific Chocolate and Confectionery Centre of Excellence at Ringwood, Melbourne.



research expenditure is second only to that of CSIRO and it has one of the largest cohorts of research students in Australia. This research strength is reflected in high international rankings across all major disciplines. The university provides opportunities for researchers to tackle the problems facing our world in interdisciplinary teams, through its own research institutes and affiliations with other research centres. In particular, the sheer quantity of life-sciences research facilities, clinical institutes, research fellows and postgraduate students in the Parkville Biomedical Precinct is without parallel in the southern hemisphere.

Community engagement is integral to all aspects of university activity. Students pursue local and global opportunities beyond campus in leadership, volunteering, exchange, internship and project management. Faculties seek out the expertise of business leaders to inform student programs. Commercialisation services make licensed technology, customised courses and the consultancy capacity of academics accessible to business. And collaborative projects link researchers with industry.

In 2013, for example, the University of Melbourne received more than \$14 million from the Australian Research Council (ARC) for Linkage Projects. In areas ranging from environmental water use to the benefits of cloud computing, these projects rely on industry contributions and reflect industry needs.

The university has recently launched 'The Carlton Connect Initiative' to develop an innovation precinct with a sustainability and social resilience focus in the Carlton area. A National Water Productivity and Innovation Hub is a core element of the new precinct. Improving water productivity requires strong integration of water research with the activities of communities and industries.

The Hub represents a campus-wide and industry-led effort to achieve transformational change in this area by drawing on the university's previously dispersed capability. The Hub is also providing a focus for partnership arrangements with other Australian universities, building further capacity based on shared commitments to innovation.

The University of Melbourne has secured more than \$6 million in ARC and industry funding for seven new water

projects in the latest round of Linkage Project grants. In addition, Melbourne researchers are also involved in many other water projects led by partner universities. Through the Hub, an interdisciplinary team supported by senior executives from Commonwealth and State water management agencies has been consulting across the water industry to develop a "water productivity" innovation statement that will identify areas where change is most urgently needed and the mechanisms required for successful innovation.

Hub researchers are also working with two university partners, Griffith University and Charles Darwin University, to prepare a bid for a Cooperative Research Centre for Regional Water Productivity, as one mechanism to implement the innovation statement's agenda.

Universities have a unique contribution to make to Australia's transition to a knowledge-intensive economy because of the tri-fold nature of their mission – teaching, research and engagement. This tri-fold approach can help to turn an advance in technology into a competitive advantage or to connect new markets with improved products.

The potential benefits are well illustrated by Melbourne's recent partnership with Mondelez International (previously Kraft Australia), which has secured funding through the ARC to establish an Industrial Transformation Research Hub for confectionery.

Food processing is Australia's largest manufacturing sector, employing nearly 222,800 people, with exports valued at \$17 billion a year. Despite its strong position and significant export opportunities, the food-processing sector has failed to capitalise on the boom in Asian demand for processed foods. The Research Hub aims to demonstrate by example how an integrated approach to R&D and innovation can



University of Melbourne researchers in Electrical and Electronic Engineering are partnering with Rubicon Water to deliver automatic control techniques that will improve the efficiency of irrigation systems.

deliver sustained competitive advantage to Australian food manufacturers in premium value-added products for Asian markets.

In Australia, Mondelez International is headquartered in Melbourne, has more than 3000 employees and operates five manufacturing plants. It has one of the largest food research and development teams in Australia with more than 100 employees, and is a world leader in chocolate, biscuits, gum, confectionary, coffee and powdered beverages.

University of Melbourne researchers are working with Mondelez colleagues to undertake an integrated multidisciplinary program of research over four years to better understand Asian markets. Researchers from six faculties of the university are involved in the Hub, including experts in functional food and nutrition, the use of ultrasound in food processing, macromolecular chemistry, cross-cultural psychology, operations management, intellectual property, market analytics and the economics of innovation. In Australia, only a large, established, research-intensive university has the disciplinary depth

and breadth to source such a range of expertise and the operational capacity to sustain a partnership on this scale.

The project will unlock and understand consumer preferences and behaviours and align those to points of Australian advantage, leading to product and supply chain innovation. Current and emerging technologies will be evaluated against market insights and then translated through product and process development to market. Mondelēz has committed to an “open innovation” model to build the strengths of its supply chain partners and ensure a thriving food processing industry in Australia. The project’s business-process-led approach will reach every part of the Mondelēz supply chain, including more than 35 small to medium enterprises (SMEs).

The University of Melbourne is now seeking to further stimulate innovation in the Australian food processing industry by launching a postgraduate program in food innovation, based on insights gained from the Research Hub. Graduates will be qualified across Asian insights; international marketing; food packaging and product design, including designing for health and wellbeing;

quality assurance; intellectual property; worldwide innovation best practices; and a pathway to market that extracts a premium. SMEs in particular are expected to benefit from access to graduates who can work across their entire business.

Mondelēz will commit to more than a dozen supported scholarship and placements opportunities for the program each year and is working with Melbourne to attract further industry support from both SMEs and other multinational enterprises (MNEs) to ensure the program’s success.

It is through projects like these that universities realise their enormous potential to help businesses reap the rewards of investment in KBC. In the process, the sector can help Australia attract higher value-added industries, activities and segments of the global market place, and the high-wage jobs that go with them. In playing our part in this most recent transformation of the Australian economy, the University of Melbourne looks forwards and outwards to a world where knowledge is growth, while upholding its traditional motto: ‘to grow in the esteem of future generations’.

FURTHER READING

OECD Directorate for Science, Technology and Industry, *New sources of growth: knowledge-based capital*, <http://oe.cd/kbc>

Andrew Wyckoff, ‘Knowledge in Growth’, OECD Forum 2013, www.oecd.org/forum/knowledge-is-growth.htm

The Carlton Connect Initiative, www.carltonconnect.com.au

Innovation at Mondelēz, www.mondelezinternational.com.au/about-us/innovation

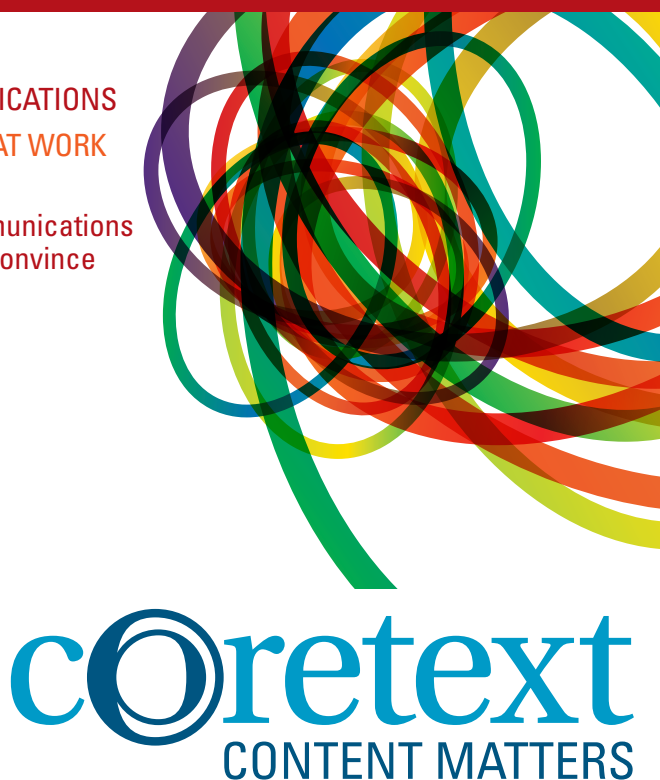
As the Provost at the University of Melbourne, PROFESSOR MARGARET SHEIL FTSE is the standing deputy to the Vice-Chancellor. From 2007–12 she was Chief Executive Officer of the Australian Research Council. She is a member of the Advisory Council of the Science Industry Endowment Fund (SIEF) and the Education Specialist on the Board of the Australian National Commission for UNESCO. She has been a member of the Prime Minister’s Science, Engineering and Innovation Council, the National Research Infrastructure Council and the Cooperative Research Centres Committee. Prior to joining the ARC, she was Deputy Vice-Chancellor (Research) at the University of Wollongong.

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CONTENT MATTERS

Enhancing Australia's prosperity through technological innovation

The Australian Academy of Technological Sciences and Engineering (ATSE)

ATSE is made up of some of Australia's leading thinkers in technology and engineering. One of Australia's four Learned Academies, it's an eclectic group, drawn from academia, government, industry and research, with a single objective in mind – to apply technology in smart, strategic ways for our social, environmental and economic benefit.

To achieve that goal, ATSE has formed a variety of expert, independent forums for discussion and action – platforms to move debate and public policy on issues concerning Australia's future. These focus on energy, water, health, education, built environment and innovation – and the international collaboration necessary to ensure that Australia is abreast of world trends.

It's an open, transparent approach – one that government, industry and community leaders can trust for technology-led solutions to national and global challenges.

Each year, the Australian Government recognises the importance of the work we do by awarding the Academy an establishment grant to help with:

- Fostering research and scholarship in Australia's technological sciences and engineering;
- Providing and conducting administrative support, workshops, forums and similar events to enable the Academy and its Fellows to contribute on important national issues;
- Managing the development and execution of our programs; and
- Supporting relationships with international communities.

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Excellence Plus is the new collaboration paradigm

Collaborations and partnerships have a multitude of beneficiaries because they help ensure that great research results are utilised locally, nationally and internationally.



By Max Lu
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Higher education in Australia faces many challenges and uncertainties in the tight fiscal environment where the new Federal Government is seeking savings everywhere to deliver on its election promises.

Universities need to think strategically on how to diversify funding and develop productive partnerships with industry, businesses and the broader communities, including donors.

To engage effectively and work with external partners, institutions need to play to their research strengths, backed by excellent people – talent underpins research excellence. This requires a great deal of commitment, determination, communication and collaboration.

There is a growing awareness outside research and academic circles of the impact of peer-reviewed quality research, and the advantages that accrue to industry by partnering with strong, research-intensive institutions. The 2012 Deloitte Report on Global Manufacturing Competitiveness Index (GCMi), based on interviews with more than 550 CEOs and other corporate leaders, concluded that: “Countries that lead in developing public-private collaborations not only bring together the skills required to spur innovation, but also create an ecosystem that thrives on innovation through collaboration”.

Collaborations with industry take many forms but, whatever their shape, these partnerships have a multitude of beneficiaries because they help ensure that great research results are utilised locally, nationally and internationally. This is often referred to as ‘research translation’ or – as the UQ Vice-Chancellor Professor Peter Høj FTSE likes to call it – Excellence Plus: taking a breakthrough discovery and turning it into products or services that

have meaning and value, in any language.

To optimise UQ’s performance, we are embarking on a strategy to expand the quality and scale of mutually beneficial engagement with industry, focusing on UQ’s key research strengths (www.uq.edu.au/research/research-at-uq/research-strengths). Proclaiming these

research strengths makes it easier for industry to identify areas of potential interest and future opportunities to work with our top researchers, who have outstanding track records of research excellence and innovation capacity.

The breadth and depth of relationships between researchers and industry leaders

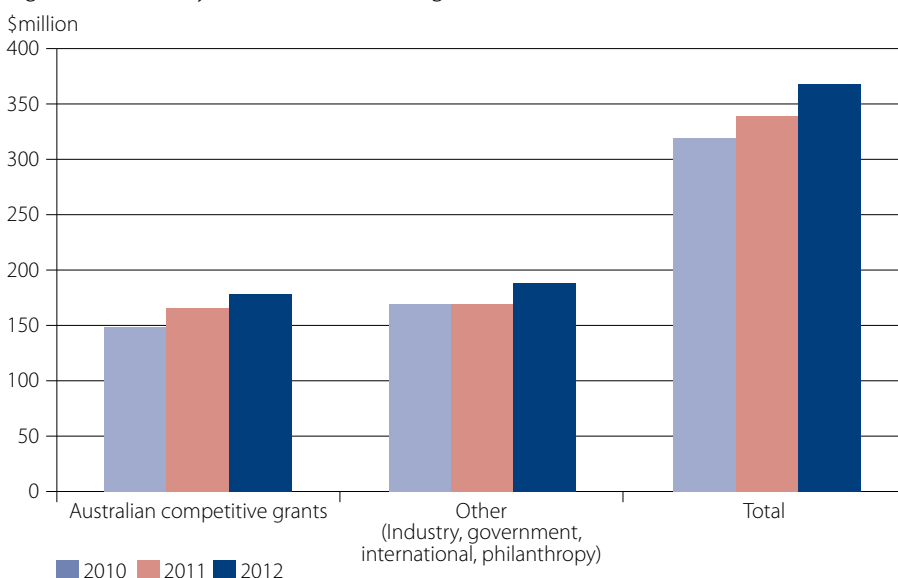
UQ’S TRACK RECORD

The University of Queensland (UQ) collaborates well with industry and the broader community, and has a good track record in competitive grants and contract research involving industry partners.

In the past three rounds of ARC Linkage Projects, UQ has been ranked 1st or 2nd in outcomes in relation to ARC funding, partner organisation contributions (cash and in-kind) and total number of projects. In the Higher Education Research Data Collection (HERDC), UQ ranked 2nd in total grants (\$368 million) in 2012. UQ has been consistently ranked highly for industry-sourced research income for a number of years. UQ is an Essential Participant in 11 CRCs and an Other Participant in a further six programs. In 2012 UQ researchers brought in more than \$100 million in research income from non-government sources. UQ’s research outputs and outcomes are also going up, as reflected by all major international rankings. Compared to 2012, UQ’s position has improved in the four most highly referenced systems for benchmarking global universities (85th in the Academic Rankings of World Universities and 43rd in the QS ranking).

UQ’s success is underpinned by the quality of its people and research excellence that is manifested in the Australian Government’s Excellence in Research for Australia (ERA) 2012 assessment, which rated all of UQ’s research fields as world standard or above.

Figure 1 University of Queensland total grants reached \$368 million in 2012



is the key to successful engagement with industry. The challenge is to make a lasting connection between the industry's priorities and the researchers' expertise and capacity. To facilitate and support the development and sustaining of academic-industry relationships, UQ has a highly professional and efficient supporting system comprising the Research Management and Partnership Offices, and two main commercialisation companies – Uniquest and JKTech. At the core of such engagement are academics who are highly motivated and committed to working fruitfully with industry partners.

A significant trend has been for global corporations to consolidate their partnerships with research institutions into centres of excellence, having accessed what they have identified as concentrations of the best expertise in the world for specific types of research.

Industry funding for research does not necessarily focus on company-specific or short-term issues, as major organisations are increasingly prepared to take a sectoral benefit view. Two of the more than 30 externally funded professorial positions at UQ are funded by Brazilian mining giant Vale. At the announcement of the second partnership

last year, Vale Institute of Technology Director Dr Luiz Mello said: "This alliance will not only build competencies and research infrastructure for both our organisations, it offers real potential to deliver research solutions for complex mining and mineral sector problems."

Another significant trend has been for global corporations to consolidate their

From page 14

Dreamliner is real collaboration

Collaboration is something that The Boeing Company knows a bit about, having established strategic research and technology partnerships all over the world in the commercial, defence and space domains.

It has established six international research centres around the globe: Boeing Research & Technology Australia (BR&T-A) has research teams in both Melbourne and Brisbane, supporting the growth and prosperity of the Australian business units and broader enterprise.

With 3400 employees across 27 sites, Boeing Australia is the largest presence for the company outside the US. The BR&T-A team works closely with a diverse range of world-class researchers from across the national innovation system in areas of aerospace composites, light robotics, unmanned aerial systems, human factors, advanced manufacturing and maintenance technologies, and sustainable aviation biofuels.

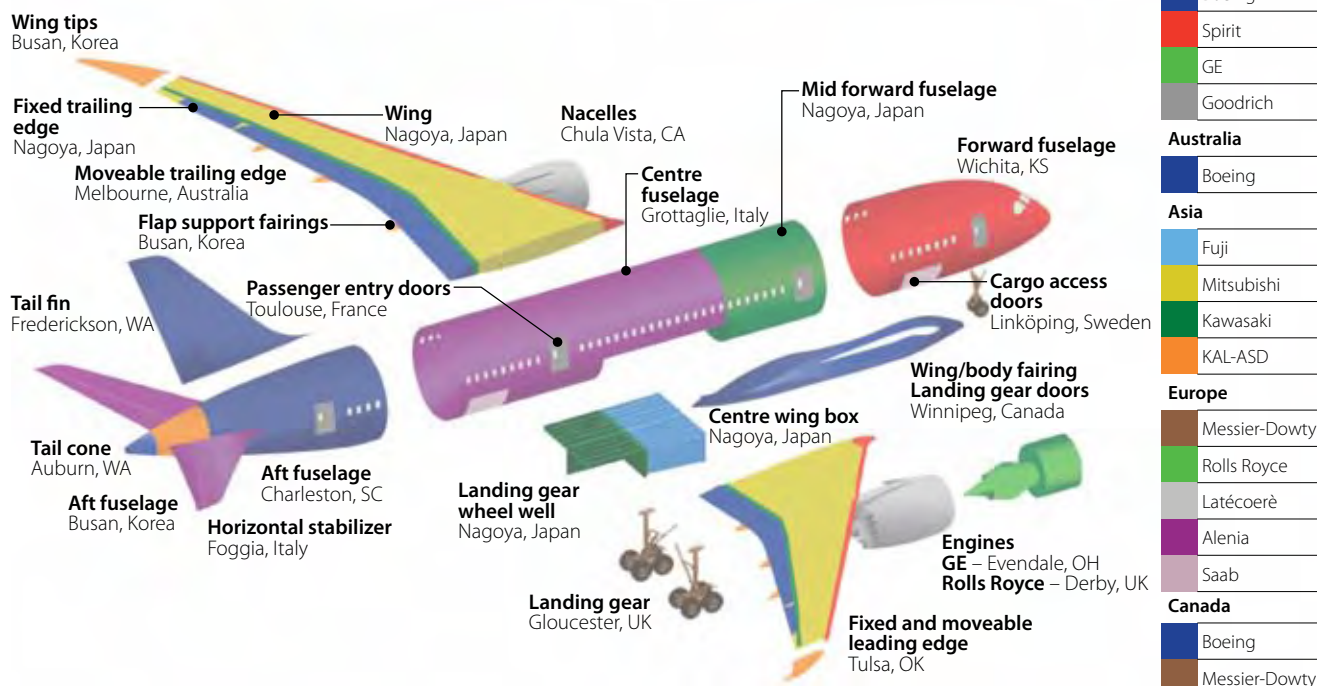
Boeing has a 23-year research partnership with CSIRO and conducts

collaborative research programs with nine universities across Australia.

The 787 Dreamliner program has been one of the largest collaborative development programs ever undertaken by The Boeing Company and is underpinned by an incredible array of ground-breaking innovations.

In collaboration with Australian researchers over a number of years, Boeing Aerostructures Australia has developed and refined an out-of-autoclave resin infusion composite process for the manufacture the moveable trailing edges for the 787 (the flaps and ailerons) and this now comprises the largest ever aerospace export program for Australia. These technologies continue to be advanced by BR&T-A, in collaboration with the Australian research sector, to drive further cost and productivity improvements for the company's manufacturing and assembly operations over the long term.

The complexity and scale of the Boeing 787 Dreamliner program – supply partners across the globe.



partnerships with research institutions into centres of excellence, having accessed what they have identified as concentrations of the best expertise in the world for specific types of research. Such centres aim to generate step-change innovations in processes, products and services for the companies involved or beyond.


The Rio Tinto Centres of Excellence exemplifies this strategy, with specialist research centres at the University of Sydney, Imperial College London, the Julius Kruttschnitt Mineral Research Centre at UQ, and the Centre of Excellence for Mining Innovation at Laurentian University in Canada.

Small to medium enterprises (SMEs) prepared to allocate scarce resources to research are strongly motivated to have a clear path to implementation and utilisation as part of their planning to engage with a research institution. One of the challenges of partnering with larger organisations, by contrast, is overcoming internal hurdles for implementation of great research outcomes – due to risk averseness, lack of resources for development, dispersed decision making or simply a lack of understanding of the potential benefits of new technologies.

Successful translation of research outcomes into mainstream company activities can be considerably enhanced when the organisation has its own in-house research groups. Such groups can act as highly effective bridges to successful implementation, with excellent understanding of both the research agenda and the company's operational imperatives.

A very good example of successful collaboration UQ has led is the Boasteel Australia Joint Research and Development Centre (BAJC) funded by Baosteel, one of the world's largest steel companies. Researchers from each of the four Australian universities involved in the BAJC (UNSW, Wollongong, Monash and UQ) have direct counterparts identified in the Boasteel Research Institute in Shanghai. Each research project is required to have at least one Boasteel Research Institute partner investigator to collaborate with the Australian chief investigators. That person generally has responsibility for championing successful research outcomes within the Baosteel business units or technology outlets.

Universities are often criticised for



The Triple P Positive Parenting Program is delivered in 18 languages in 25 countries.

GOING TO MARKET

One common feature of the best examples of demonstrated research impact is the length of time from initial development of a concept or discovery of a technology, to its successful translation to societal benefits. Some excellent UQ examples illustrate this reality.

GARDASIL AND CERVARIX

Research conducted by Professor Ian Frazer AC FRS FAA FTSE and Dr Jian Zhou at UQ on virus-like particles and first patented in 1991 led to the development of the HPV vaccines Gardasil and Cervarix, for the prevention of cervical cancer and other HPV-related cancers. The vaccines are now available in 120 countries and more than 100 million doses of Gardasil and Cervarix have been distributed worldwide.

TRIPLE P

The Triple P Positive Parenting Program is a multi-level, preventively oriented parenting and family support strategy developed by a research team headed by Professor Matthew

Sanders at UQ, built from research initially published in his PhD thesis in 1981. Triple P is currently available in 18 languages, across 25 countries and there are more than 62,000 professionals trained to deliver the program, benefiting over seven million children globally.

GROUNDPROBE

Monitoring slope stability is a critical safety issue in open cut mines. Major wall failures can occur without obvious warning, causing loss of lives, damage to equipment and major disruption to the mining process. GroundProbe technology, based 100 per cent on IP developed at UQ in the mid-1990s, was the first to introduce the slope stability radar to the mining industry.

MARXAN

Marxan is the most widely used software in the world for supporting the design and implementation of marine and terrestrial reserve systems. It provides decision-makers with free, systematic, transparent and scientifically based conservation planning options.

taking too strident a position on IP ownership, which can get in the way of establishing productive collaborations with industry, but there is a growing movement towards a more pragmatic approach, as exemplified by the University of New

South Wales's Open Innovation model.

On the other hand, a robust, properly protected IP position for a specific technology can be a selling point for engaging with industry prepared to invest in further research and development

Successful translation of research outcomes into mainstream company activities can be considerably enhanced when the organisation has its own in-house research groups. Such groups can act as highly effective bridges to successful implementation, with excellent understanding of both the research agenda and the company's operational imperatives.

to realise full its commercial potential. This is the case with UQ's partnership with Janssen – a multi-billion-dollar pharmaceutical company within the Johnson & Johnson group. Janssen commenced its partnership with a small project to test the application of a proprietary UQ technology to treatment for rheumatoid arthritis. The researchers delivered on milestones, thus establishing trust and recognition of the novelty of the technology. Consequently, Janssen recently announced a major, multi-million-dollar project with an option for Janssen to commercialise the outcome. This would not have been possible without the strong IP position for the technology that was established by UniQuest.

The ultimate expression of Excellence Plus is quality research that can be clearly

demonstrated to have lasting beneficial impact. The benefits may be economic, social or environmental or policy improvements. There is considerable debate worldwide on the need to evaluate research impact, both from the point of view of accountability for public funding for research and to motivate industry to take more interest in funding R&D. The main point of agreement seems to be that evaluation of research impact is necessary, but that finding a methodology that is credible, robust and acceptable to all stakeholders is very challenging.

Partnerships between universities and industry take many forms, and while most initially rely on relationships between individual researchers and key industry players, they can grow to multifaceted, complex and highly

beneficial organisational arrangements/partnerships. Fundamental to such partnerships, however simple or complex, is the common desire to maximise the opportunities for quality research to be successfully translated for economic and societal benefits.

Universities known for research excellence are well positioned to develop sustained relationships, both nationally and internationally, that deliver value to their partners and enhance their institutional reputation.

PROFESSOR MAX LU FAA FTSE is Deputy Vice-Chancellor (Research) at the University of Queensland. He has won the ARC Federation Fellowship twice and, with more than 500 publications and 20 patents, is a highly cited researcher in materials science, with more than 20,000 citations (h-index of 72). He is past Chair of the IChemE Australia Board and a former Director of ATSE. He has also held other Board roles including Uniseed Pty Ltd, Queensland China Council and the Australian Synchrotron. He is currently a director of NeCTar, Research Data Storage Infrastructure and Stem Cell Australia.

Starting with the customer

From page 14

The broadband radio mounted on a mast.



EM Solutions is an Australian SME engaged in innovative product design and manufacture. Over many years, it has developed broadband radio equipment used in satellite and microwave telecommunications networks.

In 2012, CSIRO approached EM Solutions with an international end-user customer that was seeking to buy a commercially supported product that could be developed around CSIRO's IP. By combining its own novel IP with CSIRO's, EM Solutions was able to embark on a large-scale product development and commercialisation program to develop a first-to-market broadband radio that was co-funded by the customer.

By coming to EM Solutions with a paying customer, the incentive was there to establish the value chain and gain alignment to achieve a productive outcome. Features of the collaboration – apart from the direct involvement of the customer in defining

requirements – included strong peer-to-peer respect and relationships (high absorptive capacity); experienced project management; and joint commitment and incentives to successful field trials and sales through royalties on licensed IP.

Successful collaborations ultimately bear fruit on the demand side. Unless customers exist to purchase innovation, its pursuit can be pointless. With a customer at the head of a value chain during commercialisation, its funding is more assured, requirements are better informed, risk is reduced, and stakeholders will line up.

Introducing incentives for public sector researchers to identify and bring potential customers to Australian SMEs would establish more collaborations such as this one, since research commercialisation can then be justified and co-funded by both the SME and the end buyer.

**LETTERS
TO THE
EDITOR**

ATSE Focus welcomes letters from readers in response to published article or on technological science and related topics.

PLEASE KEEP LETTERS BRIEF. LONGER LETTERS MAY BE RUN AS CONTRIBUTED ARTICLES.

Please address to editor@atse.org.au

Bionic partnerships in new-era manufacturing

Melding the 'brains at Monash' with the 'brains from industry' created immediate momentum and helped the team to slot into design mode.



By Edwina Cornish
edwina.cornish@monash.edu.au



Universities have never been short on ideas. Knowledge creation is, after all, our stock in trade – ideas abound. Less common, though, are ideas that are developed into working systems, products or technologies with defined commercial or economic function.

There is a traditional barrier between research for general knowledge or 'public good' and research for economic advantage, which is often unpublished as it contains industrial secrets.

However, we are seeing barriers falling as countries look to strengthen their global competitiveness by building 'knowledge economies'. This demands stronger university–industry collaborations to marry creative thinking with advanced manufacturing. Many universities now actively invite industry to inform their research and the skills sets of their graduates.

It is a shift in thinking and practice that harbours enormous social and economic potential, and is being pursued as a central tenet to enhancing Monash's position as university of economic influence.

This is exemplified by our role in the formation and progress of the Monash Vision Group (MVG).

The MVG stands as an instructive case study – a university–industry response to a challenge to develop a bionic eye as a follow-up to Australia's earlier delivery of the world's first commercial 'bionic ear', the Cochlear implant.

The challenge was set at the Australia 2020 Summit in April 2008 and from the outset it required combining the most creative and skilled practitioners across diverse disciplines – electronics engineering, computer vision, circuit design, industrial design, materials science, mathematics, neurosurgery, physiology



A prototype device from the Monash Vision Group.

THE KEYS

- Research needs to start with a product focus – an 'audacious goal' motivates people.
- Teams should be assembled to design that product in a convivial environment.
- Academics and industry experts need to work closely from the outset.
- A challenge is the interfaces between parts of a system, thus including a mix of people in the design team for each part is essential.
- Strong management of resources and people is critical for success.
- Once a team and design capability is created, it can tackle many challenges.
- Smart human implant technology has applications far beyond vision.

and immunology – and these skills needed also to merge academic rigour with industrial and manufacturing acumen.

In short, the science had to begin with a clear product in mind, and every member of the consortium had to regard their contribution as a component product of that ultimate goal – a practical, robust device that would provide a functional form of human sight.

The kick-start for the project was \$50.7 million put up by the Australian Government (through the Australian

Research Council) for a consortium or consortiums to take up the challenge. We felt we had the expertise at Monash to put together a team able to develop an alternative approach to that already begun by Bionic Vision Australia, a group led by the University of Melbourne. That group is working on a retinal implant, whereas we opted to pursue a complementary technology – a cortical implant on the back of the brain. A cortical implant does not require a viable retina or optical nerve to work so, if successful, would

suit the majority of blind people.

Professor Arthur Lowery FTSE, an ARC Laureate Fellow, and Dr Elaine Saunders, then business development manager at the engineering faculty, put together a team and a grant proposal.

Both knew from the start that we would need external partners with experience in manufacturing advanced electronic systems and biomaterials.

Grey Innovation and MiniFAB were, for us, the two obvious industry collaborators, along with The Alfred, in particular Professor Jeffrey Rosenfeld, Director of Neurosurgery at the hospital and at Monash.

Grey Innovation is a leader in manufacturing small electronic devices and we needed a pocket-size processor that could take the detailed image from a camera and reduce this to a few hundred electrical stimulation sites on the visual cortex – perceived as dots of light. MiniFAB is skilled in manufacturing using biocompatible materials – crucial for encapsulating the electronics for use within the skull.

The team gathered for two weeks in a room at Monash, next to a café to ensure a steady supply of coffee, cake and conversation, and thrashed out the technical approach to be taken. That initial two weeks was critical. It shaped a highly creative team with a passionate, collective view of the end-goal – an actual device that would allow blind people to see.

The team left behind the usual bottom-up research methodology: 'let's do some research and see what comes of it'. Instead, they drew upon an extraordinary diversity of skills and experience to create, from the outset, a product – and no ordinary product.

The systems built into this technology are extremely complex. Several million transistors within tiny tiles embedded in the brain and billions of transistors in the pocket processor, all needing to perform as intended. As with most systems, the problems are at the interfaces – for example, ensuring an element designed by one group will 'talk' to an element designed by another.

The skills required to tackle these problems are learned through experience rather than taught in a lecture theatre, which makes the partnership with an SME such as Grey Innovation so valuable.

Melding the 'brains at Monash' with

Clinical trials of the bionic eye are now within sight. This is an extraordinary achievement – for its human and technical values – in just a few years, but even this is only part of the story. On the way to creating a device that will enable the blind to see, we have been establishing valuable new linkages between faculties and their disciplines, and industry.

the 'brains from industry' over that initial two weeks created immediate momentum and helped the team to slot into design mode the moment they learned they had been short-listed for the ARC grant.

From 2011 the group has worked in multidisciplinary teams to develop the component parts of the final product. For example, the team charged with creating the implant comprised materials scientists, chip designers, electronics engineers and specialists in building micro wireless receivers, electrodes and biocompatible electrode coatings.

Another critical success factor for the program has been the 'project management' committee. This group has been crucial for coordinating the numerous elements and stages. For example, just to make the implant tile is a 50-step manufacturing process.

The core program has now involved more than 60 researchers, clinicians and engineers from all of the project partners, and scores of support professionals from the university and industry.

Clinical trials are now within sight. This is an extraordinary achievement – for its human and technical values – in just a few years, but even this is only part of the story.

The manner in which academia and industry has worked on this project is delivering outcomes that extend beyond even the ambitious bionic eye – in California speak, the 'big hairy audacious goal'. On the way to creating a device that will enable the blind to see, we have been establishing valuable new linkages between faculties and their disciplines, and industry. In particular we have created an advanced new medical implant capability within the brain, arguably the hardest place to work, and this will have implications globally for biomedical research.

The project has also taken electronic processing to new levels. Just think about it: the team is sealing an advanced analogue and digital processor, and a wireless receiver, inside a box the size of your little fingernail and designing

it to work reliably and safely inside a person's head for at least 25 years.

When you consider that most electronics are obsolete in a few years, this is a 'hard ask', although the software algorithms that convert complex visual scenes into a few hundred dots can be updated to provide new functionality.

These algorithms translate what the camera captures into three-dimensional outlines like a radar, with light points representing objects or paths around objects. Alternatively, faces in a crowded room can be represented by emoticons. It won't be vision like an HD television, but enough to allow a person to navigate independently in a real world environment, socialise and work.

Bionic vision stands to profoundly change many people's lives and become the genesis of a new manufacturing sector. But we would not be in this position without the collaboration that brought together the skills and experience of both academia and industry. Universities are a tremendous knowledge resource, but this project has demonstrated very clearly the exponential benefits of marrying this with the skills and experience of industry partners.

This is why we at Monash regard this project as an exemplar. It's a solid demonstration of how new relationships between universities and industry will drive future economic growth.

PROFESSOR EDWINA CORNISH FTSE is the inaugural Provost and Senior Vice-President, Monash University. Professor Cornish was appointed to the position of Deputy Vice-Chancellor (Research) at Monash in February 2004. In August 2009 she was also appointed Senior Deputy Vice-Chancellor. In 2012 she was appointed to the role of Provost and Senior Vice-President, with responsibilities as chief academic officer. Professor Cornish has a BSc (Hons) in biochemistry and a PhD in microbiology from the University of Melbourne. She played a key role in building one of Australia's first biotechnology companies, Florigene Ltd, which established global research and development and marketing operations, and successfully commercialised the world's first genetically modified flowers.

Rethinking linkages and turning research into economic benefits

Collaboration between The University of Melbourne and food manufacturer Mondelez sweetens the corporate results.

Improving productivity and facilitating economic growth are key priorities for Australia, and technological innovation based on research plays a key role in both, according to a new Academy publication.

It says collaboration between publicly funded research organisations (PFROs) and industry is crucial to improving the translation of research into productive outcomes that increase the nation's output, but there are fundamental systemic barriers to increasing this collaboration in Australia.

Translating research into economic benefits for Australia: Rethinking linkages is a Position Paper prepared by ATSE from the discussions at a recent Brisbane workshop.

It notes that technology-based small and medium enterprises (SMEs) play a vital role in the Australian economy, but there are major gaps in the funding mechanisms available to support high-growth-potential SMEs to engage in collaboration and new approaches are needed.

It points out that companies can benefit in many ways from a relationship with a PFRO – by creating talent pipelines and developing technology or capability roadmaps. Collaboration can also provide business with affordable and rapid access to PFRO skills, people, equipment, facilities and ideas and so contribute to improved productivity. It says that PFROs often have strong brands and international networks that can be leveraged and they can provide a 'problem solving' service to business, which can be a useful way of initiating collaborations.

Collaboration with industry can benefit PFRO researchers by developing innovative 'receptors' and improving researcher understanding of how to pitch their capabilities. In many leading OECD countries, excellence in research goes hand-in-hand with impact and collaboration with business.

The Brisbane workshop was co-sponsored by the Australian Council of the Learned Academies (ACOLA) to discuss collaboration issues,

which are part of the remit of an expert working group convened under ACOLA's Securing Australia's Future Program.

Opening the workshop, ATSE Vice President **Professor Peter Gray** FTSE noted OECD data that shows Australia performs poorly in research collaboration by comparison with other leading developed countries. He urged the workshop participants to identify examples of good practice.

In his keynote address, **Professor Alan Hughes**, Director of the Centre for Business Research at the University of Cambridge, who travelled to Australia to address the workshop, pointed to the impact of the global financial crisis (GFC) on the way in which large companies source their research needs. At the same time, he said, there had been pressure on universities for greater accountability.

In this context, the concept of 'user-inspired basic research' had grown in significance in the UK, particularly in its 10 top-ranked universities, which also rated highly on indicators of external interactions. The UK experience showed that, with the right incentives, research excellence could go hand-in-hand with industry collaboration.

Professor Hughes pointed to the gap between PFROs and potential users of their research. In some countries this had been addressed through technology intermediary organisations. The US national network of advanced manufacturing centres and the UK Catapult Centres provided relevant examples. Technology intermediary organisations also played a key role in Germany, Korea, Taiwan and Belgium.

Dr Rowan Gilmore FTSE focused on the SME challenge and related his experience in commercialising broadband technology. The lessons learnt from this included the benefits of finding a potential customer at the start of a research project, and not trying to value intellectual property on the basis of the cost of the research.

***Translating research into economic benefits for Australia: Rethinking linkages* accompanies this edition of ATSE Focus and is available on the ATSE website at Activity/Innovation.**

One of the conclusions of ATSE's Brisbane workshop was that compared with some OECD countries, Australia does not provide a sufficient range of incentives to researchers, students or firms to encourage collaboration;

He emphasised that 'money talks' and that if a research organisation could identify and attract a customer or end user to help fund product development of its IP, industry would come onboard to assemble and align the necessary value chain to reach commercialisation.

A potential product, rather than an idea, attracted industry attention, but multi-year stable commitment in relation to government support was critical. The University of Queensland's Collaboration and Industry Engagement Fund was a simple model that worked, he said, also urging researchers to use conference travel to make contact with potential customers (see page 10).

Professor Chris Moran (Director, Sustainable Minerals Institute) and **Mr Brian Bock** (Director, Rail Innovation Australia) provided examples of how collaboration worked in their sector. Professor Moran emphasised the need to find innovative 'receptors' in potential partner companies. Researchers that could relate to customers and build confidence and trust were the key to successful collaboration.

Mr Michael Edwards (General Manager, Boeing Research and Technology Australia) used the example of his company's long-standing relationship with Australian researchers to argue that successful partnerships needed to be built on truly collaborative relationships and that these could be based on simple, template agreements. Celebrating achievements was also important. He noted that CSIRO was one of 11 partners in Boeing's global research consortium and contributed technology experience from outside the aerospace sector (see page 8).

Mr Buzz Palmer, General Manager of Melbourne's Small Technologies Cluster (STC), highlighted the important role of incubators and accelerators. STC operates the Victorian Government's successful technology voucher program and sponsors collaboration between SMEs, and between SMEs and universities. Placing students in companies during vacation periods has been one of the novel approaches adopted by the STC.

The Victorian Centre for Advanced Material Manufacturing (VCAMM) is also a successful technology intermediary. **Mr Brad Dunstan**, its CEO, explained how VCAMM works with universities, government and the private sector. He spoke of their challenges and successes in helping SMEs. (see page 16)

Professor Tony Peacock (CEO, CRC Association) provided novel examples of collaboration involving Cooperative Research Centres including speed-dating experiments with industry, where achieving researcher take-up was a challenge even though some of those that participated found the experience life changing.

Dr Rob Porteous (Head of Science & Research Division, Department of Industry, Innovation, Climate, Science, Research and Tertiary Education) drew attention to some of the challenges for government in seeking to increase innovation. He noted that Australia's industry structure, public sector research culture and a lack of capital available for early stage investment in companies needed to be taken into account when considering measures to increase collaboration.

Discussion at the workshop identified a number of issues relevant to improving collaboration between publicly funded researchers and the private sector:

- compared with some other OECD countries, Australia does not provide a sufficient range of incentives to researchers, students and firms to encourage collaboration;

- while we have a few good examples, Australia generally lacks technology intermediary organisations that could play a valuable role in improving collaboration – there are useful models in Australia and from other OECD countries;
- the ARC Linkage Program is researcher-driven (rather than driven by business), its annual grant cycle is not sufficiently frequent to meet business needs and opportunities as they arise, too much of the funding goes to collaborations that do not involve the private sector and there is no measurement of industry outcomes;
- Researchers in Business is a good initiative but some SMEs find the \$50,000 commitment a problem and the program should also be accessible by larger firms;
- the entry costs and the long-term commitments of the CRC Program are out of reach of most SMEs – the gap between ARC Linkage and the CRC Program needs to be addressed;
- while Excellence in Research Australia (ERA) is encouraging more attention to quality in university research, it is discouraging external collaboration because of perceptions that this may result in fewer articles in leading scientific journals (even though the UK experience shows that, with appropriate incentives, industry collaboration and research excellence can coexist);
- Australia's university system is not encouraging science, technology and engineering students to look to industry as a source of future employment;
- the lack of capital for investment in start-ups and high growth SMEs in Australia has been particularly critical since the start of the GFC;
- relationships provide a key building block for collaborations and need to involve researchers and students in engagement with the private sector through networks and clusters; and
- productivity in Australia can be enhanced through increased connectivity.

ATSE's third workshop on research translation

The Brisbane workshop was ATSE's latest initiative in this area and followed two workshops held in 2011.

Strengthening links between public sector research organisations and industry (held in May 2011) explored the role of collaboration between PFROs and industry and called for simpler schemes to enable collaboration that: are based on international best practice; reduce costs of collaboration; increase incentives for researchers to collaborate with industry; and balance market pull with capability or technology push.

Increasing the innovation dividend from emerging technologies (held in August 2011) explored challenges and opportunities for emerging technologies in Australia, with a focus on the biotech, IT and energy sectors, and discussed approaches to pulling technologies through to successful commercialisation. The recommendations called for a substantial upgrade of support for the Australian innovation system and for increased levels of innovation in Australia to: make innovation more attractive, especially for SMEs; change the incentives for Australia's world-class researchers; and improve innovation skills.

The ARC Linkage Program is researcher-driven (rather than driven by business), its annual grant cycle is not sufficiently frequent to meet business needs and opportunities as they arise, too much of the funding goes to collaborations that do not involve the private sector and there is no measurement of industry outcomes.

Applied research needs to be shaped by the market

Success relies not only on excellent research and education, but on our ability to listen and to work collaboratively with industry and society, to respond to their needs and challenges.



By Richard Head
richard.head@unisa.edu.au

Australia's universities and research organisations contribute some of the most critical assets for productivity in Australia: highly skilled workers and new bases for competitiveness through innovation.

To deliver economic impact and boost productivity, universities need to connect these assets with the needs of industry and society. This sounds straightforward, but is often difficult to achieve – particularly in a repeatable way.

Success relies not only on excellent research and education, but on our ability to listen and to work collaboratively with industry and society, to respond to their needs and challenges.

These characteristics resonate with the ATSE vision of “a future in which the technological sciences, engineering and innovation contribute significantly to Australia's social, economic and environmental wellbeing”.

The Australian Technology Network (ATN) has recently released a collection of examples showcasing university–industry collaboration entitled *50 Solutions That Count*, which provides case studies of successful collaborations. Two key examples from the University of South Australia's (UniSA) collaboration portfolio highlight the opportunities and productivity benefits that a collaborative approach to research can deliver. These examples are characterised by collaboration capacity, product optimisation and a focus on end-user-led solutions.

To be relevant to end users, the

outcomes of applied research need to be shaped by the market.

The development of collaborative relationships with industry to guide and shape development is vital to the delivery of practical, useful and timely outcomes for society from research. The plastic automotive mirrors project is an example.

The interaction between product innovation and its optimal application is a key area in which partnerships between university-based research and industry

can work together to unlock unrealised value and productivity. An example of this in action is Ceridia Pty Ltd's innovative drug-delivery technology.

UniSA has a strong reputation for being connected to the needs of end users and can cite various examples of success, but there is still room for improvement. So, where to next? We have identified that we can be better at embedding an end-user-led approach throughout our core business activities.

Success relies not only on excellent research and education, but on our ability to listen and to work collaboratively with industry and society, to respond to their needs and challenges.

PLASTIC AUTOMOTIVE MIRRORS

The development of the world's first lightweight, robust plastic automotive mirror occurred through research conducted by teams at UniSA's Mawson Institute and Ian Wark Research Institute, supported by industry partner SMR Automotive and the Cooperative Research Centre for Advanced Automotive Technology (AutoCRC).

Once proof of concept was achieved, a whole new realm of research problem-solving started between UniSA and SMR Automotive. The challenges that were solved through this collaborative relationship have not only enabled the product to be produced at a commercial scale, but have developed new, value-added manufacturing techniques that have provided additional business opportunities (locally and export) for this business, as well as a new generation of scientific capability for UniSA that will extend into applications for this technology and expertise base beyond the automotive sector.

This project has delivered a 50 per cent reduction in mirror weight, which has created benefits for both consumers and the environment through 16,864 litres of fuel savings a year per 100,000 vehicles, and a potential reduction in greenhouse gas emissions of more than 400,000 tonnes from now until 2017.

Commercially, this success has converted into supply contracts into North America. The mirrors are produced exclusively at SMR Automotive's facility in Lonsdale, South Australia – resulting in new income streams for SMR and the creation of 20 new jobs.

CONTRIBUTIONS
ARE WELCOME

Opinion pieces on technological science and related topics, preferably between 600 and 1400 words, will be considered for publication.

They must list the full name of the author, if a Fellow of the Academy. Other contributors should provide their full name, title/role and organisation (if relevant) and email address.

Please address to editor@atse.org.au

UniSA has identified three major areas of current and future focus:

1 Focus on solving grand challenges

UniSA is committed to engaging in and supporting research, and developing future workforce capabilities, that address the issues and needs of direct relevance to industry, government and the community.

In an environment where competition for research funding continues to increase, as does the pressure to ensure that universities remain relevant, research and policy agendas need to address grand challenges and significant unmet societal needs.

Success in this approach is most notable when those at the coalface – who best understand the unmet need – work together with unique combinations of research skills (engineers, scientists, social scientists) to develop unique, multifaceted and tailored solutions to these challenges. At UniSA this approach is a core determinant in the development and implementation of research strategies that link with industry.



Dr Roey Elnathan from UniSA's Mawson Institute operating the Atomic Force Microscope.

2 Providing students with an industry-relevant education and businesses with industry-ready graduates

UniSA recently released a new Strategic Action Plan, 'Crossing the Horizon', which presents a snapshot of current thinking and immediate actions, as well as plans for the longer-term delivery of the university's strategic vision up to and

beyond 2020. Crossing the Horizon makes the commitment that every academic discipline at UniSA will be informed by, and responsive to, industry needs. UniSA plans to offer all students the opportunity for practicums, work-based learning experiences or competitive internships as part of this key strategy, while also restructuring its PhD offerings to allow much greater industry involvement.

From page 14

Protecting our troops

Australian Defence Apparel (ADA) is a uniform and clothing manufacturer with more than 100 years' experience providing garment solutions for a wide range of clients and situations, including Australia's defence forces.

The Victorian Centre for Advanced Material Manufacturing (VCAMM) is a successful technology intermediary and has assisted ADA interact with the research community to develop new technologies that have led to the development of new armour technologies and business opportunities.

VCAMM identified an opportunity for ADA to develop value-adding manufacturing processes around the production of personal ballistic protection. VCAMM assisted ADA to apply for a Commonwealth Technology Demonstration (CTD) Grant and helped in the project management and delivery of the project, which showed ADA being able to manufacture ballistic protection plates at globally competitive prices.

VCAMM then assisted ADA to secure a project within the Advanced Manufacturing CRC – which further refined the CTD IP and led to provisional patents being filed – and provided valuable engineering assistance and direction when ADA set up a Pilot Plant at CSIRO, through a Defence Materials Technology

Centre (DMTC) program. VCAMM was involved in the technology transfer, handover and integration of the plant to ADA's Bendigo manufacturing facility.

VCAMM engineers and researchers are now collaborating with Deakin University researchers to develop a new manufacturing method for the production of shapeable, lightweight, ballistic components, like combat helmets.

ADA estimates that the armour technologies business will become a \$10 million adjunct to its broader business through the commercialisation of VCAMM-inspired and supported technologies.



Stuart Thomas from VCAMM oversees high temperature vacuum furnace operation in ADA ceramic armour manufacture.

3 Facilitating industry input through social media and other innovative technologies

In May 2013 UniSA undertook a world-first exercise that engaged staff, students and external stakeholders in a three-day conversation on a range of issues impacting the university and the broader higher education sector. 'Unijam' provided a forum for discussion on a broad range of subjects from campus life to the university's curriculum, industry-engaged research, enhancing the student experience and many more. The Unijam format provided an opportunity for the entire UniSA community to engage directly with leaders in business, government and community sectors, while also offering stakeholders a rare insight into of the inner workings of the university. This was a highly successful and productive exercise, the results of which contributed significantly to the development of Crossing the Horizon.

Future research directions

The historic contributions of universities to Australian industry, on the pillars of a skilled workforce and innovation underpinning competitiveness are equally relevant to future decades, modified appropriately for contemporary and future settings.

UniSA has charted an institutional approach for the future research directions based on an industry-relevant curriculum closely aligned with an end-user-informed research agenda (Crossing the Horizon). The application of this approach requires ongoing and greater connectivity and participation with industry, along with enhanced internships and placements in industry and end-user settings.

Embracing research themes across both training and industry engagement will, in all likelihood, increase significantly as a consequence of the value proposition that occurs at the intersection of disciplines. It will be essential to put in place processes that embed thematic approaches with industry collaboration and dialogue, which includes the support of a culture of multi- and interdisciplinary research. In all these areas, it is critical to view the pathways to delivery of research impacts as a discrete series of interwoven processes.

Finally, there is a considerable amount of current discussion on the impact of research. Two aspects of this are essential

if we wish to drive the interaction between universities and industry further:

- supporting a culture in Australian researchers that has strategy and the potential for impact as a centrepiece; and
- acknowledging the powerful role of industry and end-users as adoption and uptake partners in innovation.

This discussion is central to the future of the Australian research sector and should be encouraged as it provides a basis for the ATSE vision of "a future in which the technological sciences, engineering and innovation contribute significantly to Australia's social, economic and environmental wellbeing". -

PROFESSOR RICHARD HEAD is the Deputy Vice Chancellor and Vice President Research and Innovation at the University of South Australia

(UniSA). A pharmacologist with more than 40 years' experience in research before his UniSA appointment, Professor Head was the Director of CSIRO's Preventative Health Flagship, where he was responsible for driving a national research program focused on early detection an intervention in chronic diseases. His achievements include establishing Australia's most comprehensive collaborative to tackle Alzheimer's disease and founding the nation's largest research group in early detection of colorectal cancer. He has published extensively in the cardiovascular and nutrition areas.

RECOMMENDED READING

O'Keefe, C. and Head, R. Application of logic models in a large scientific research program, *Evaluation and Program Planning*, 34 (2011) 174–184.

<http://w3.unisa.edu.au/news/2011/230511.asp>



Dr Steve McInnes and Dr Stephanie Pace from the Mawson Institute researching novel drug delivery technologies.

INNOVATIVE LIPOCERAMIC DRUG DELIVERY

Approximately 40 per cent of all drugs on the market are poorly soluble and have inherent limitations in their use. An example of this are the side effects and food effects caused as a result of needing to use large quantities of the active compound to achieve the necessary dosing and resultant therapeutic effect.

Researchers from UniSA have shed their discipline bounds to create a novel and highly effective solution to this issue using technology to create reformulations of poorly soluble, lipophilic drugs. Looking at the problem through a truly transdisciplinary lens has created connections in science across divisions to develop a novel solution to this problem. UniSA has supported the team to develop capability in this area, to attract funding and to deliver market-ready solutions through the establishment of a spin-out company, Ceridia Pty Ltd.

Ceridia has been successful at generating clinical data and relationships with large multinational drug companies, which has ultimately fed back into supporting continued success in the research program at UniSA and competitive grant income.

Creating new industries and revitalising the old

Collaborations are helping improve the productivity of local, national and international industry, developing new technologies and incrementally improving both technologies and processes.



By Judy Raper
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Professor Stephen Blanksby and Dr Phil Barker from UoW are working with Bluescope to improve the longevity of Colorbond® products.

Australia's universities in the 21st century do so much more than teaching and research. Increasingly, they are performing an important national economic development role by working with industry to focus on solving real-world problems.

This business-oriented approach is doing much to break down the traditional 'ivory tower' image that universities laboured under in the past, where they were accused (often undeservedly) of an elitist disconnect with the everyday world.

At the University of Wollongong (UOW), for example, we are developing a number of new technologies to aid the creation of economically viable clean energy industries for Australia's future.

After winning the 'Energy Olympics', the 2013 Solar Decathlon in China in

August, Team UOW has been flooded with offers to help commercialise its solar-powered, net-zero-energy house of the future, the Illawarra Flame.

Modelled on the iconic 1960s Aussie 'fibro' house, the Illawarra Flame, designed and built by students from UOW and TAFE Illawarra in collaboration with UOW's Sustainable Buildings Research Centre, demonstrates how to make existing houses both energy efficient and comfortable to live in.

It is hoped the Illawarra Flame will be considered as a stylish, sustainable and affordable option for Australia's ageing population who are looking to downsize and hence open up a whole new industry for retrofitting Australian houses.

To create the clean tech cars of the future, researchers at UOW's Institute

for Superconducting and Electronic Materials (ISEM) are working closely with car manufacturers and car component manufacturers from around the world to improve electric vehicles and to support Australia's future automotive industry.

As leaders of the Auto Cooperative Research Centre's vehicle electrification program, ISEM recently had a breakthrough that will vastly improve the efficiency of lithium-ion batteries used to power electric cars.

A team of ISEM researchers developed a novel germanium (Ge)-based material with five times more energy storage and the potential to go at least twice as far on a charge than current electric vehicles.

The development of this inexpensive manufacturing technique also allows for much faster charging time. To put it into perspective, after 10 hours of charging, the 2013 Holden Volt can only travel 87 kilometres, whereas a Ge-based battery would take just minutes to charge and could travel hundreds of kilometres.

At the neighboring ARC Centre of Excellence for Electromaterials Science, researchers recently joined True North Venture Partners to form spin out company AquaHydrex to help accelerate the passage of clean energy breakthroughs from the laboratory to the market.

The culmination of years of research by scientists at UOW and Monash University, AquaHydrex technologies incorporate new electrochemical systems for splitting water (with and without the use of sunlight) for a clean and renewable way of producing hydrogen energy.

In September, the Federal Government awarded AquaHydrex \$2.2 million under the Clean Technology Innovation program to help produce a market-ready, cost-competitive alternative

to fossil-fuel-based hydrogen.

The additional funding will help UOW's Intelligent Polymer Research Institute, the lead node of the multi-institutional ARC Centre of Excellence for Electromaterials Science (ACES), work with AquaHydrex to drive research and development of this revolutionary technology, potentially turning the Illawarra region's traditional low-cost, high-volume manufacturing into specialised high-tech production.

While clean energy promises to be a booming industry in the future, Australian farming needs to thrive to mitigate the effects of climate change and to ensure that agriculture is both sustainable and productive.

UOW's Professor Brian Cullis is about to embark on a \$554,000 study into genomic selection aimed at significantly improving wheat yields.

With an increasing demand for food and a real reduction in the availability of arable land, there needs to be a step-change in the rate of genetic progress in wheat to address future world food shortages. Genomic selection is the most likely candidate tool capable of delivering the improvements needed.

Working in partnership with Australian Grain Technologies, this project will enable successful implementation of improved genetic selection in wheat breeding through improvements in the data and statistical methods used.

In another example of how Australian universities are helping to breathe fresh air into established industries, UOW is trailblazing the way for future medical practice in Australia's rural and remote areas after a successful high-definition, online trial of a virtual clinic across three campuses up to 1500 kilometres apart.

In an Australian first, UOW's Graduate School of Medicine recently set up an interactive virtual teaching clinic to link campuses across NSW in Wollongong, Armidale and Shoalhaven in a session taught by a practicing psychiatrist and involving a general practitioner and a patient.

By using an existing broadband connection and software costing less than \$1000, this NBN-driven project aims to boost regional areas by encouraging the current crop of young doctors to stay in rural communities.

Another Australian-university-developed invention that will change the way we collaborate in the future is iSee.

Developed by UOW's Professor Farzad Safaei and colleagues at the Smart Services Cooperative Research Centre, this video collaboration tool will change the way people work and learn individually or remotely, and is now being rolled out commercially with a range of organisations including a multinational food company, local government and organisations with dispersed work teams.

Using live video feeds, iSee allows tens to hundreds of users to meet simultaneously in a customised immersive environment and dynamically break off into conversations as they would in real life.

UOW has also been working in partnership with BlueScope, to assist in the transition from a steelworks heavyweight to a high-tech company that sells Australian innovations to the booming Asian and global growth markets in the 21st century.

Our chemists at the ARC Centre of Excellence in Free Radical Chemistry and Biotechnology have been working closely with BlueScope scientists and engineers to make Colorbond® steel products even more durable in the future.

The team has been designing new, highly specialised, anti-oxidant molecules to soak up harmful free radicals, which can form in paint and cause it to prematurely age, especially in harsh Australian climates.

These examples are just a few of the collaborations with federal, state and local governments, not-for-profit organisations and large and small enterprises being carried out at UOW.

Typical of many Australian universities, we are helping improve the productivity of local, national and international industry, not only by the development of new technologies, but also through the introduction of incremental improvements to both technologies and processes.

In our own region, the Illawarra, our new Global Challenges Program with its 'Manufacturing Innovation' challenge, aims to help the region transfer its manufacturing base to encompass future technology-based companies.

PROFESSOR JUDY RAPER FTSE was appointed Deputy Vice-Chancellor (Research) at the University of Wollongong in July 2008. Previously she was the Division Director of Chemical Bioengineering, Environmental and Transport System at the US National Science Foundation. Prior to this secondment, she had been Department Chair, Chemical & Biological Engineering at the Missouri University of Science and Technology and Dean of Engineering at the University of Sydney (1997 to 2003). Professor Raper has an impressive research background in chemical engineering and is the recipient of a number of prestigious awards (including the Sheddon Pacific Award for the most outstanding young chemical engineer in Australia in 1992 and the Professional Engineer of the Year in 1998).

12 GET THROUGH TO NEXT CRC STAGE

Twelve CRC applications have passed the second major hurdle of the 16th CRC funding round, gaining an interview in November. Five applications have been excluded from further participation in the round.

Successful applicants have to submit exemplar and prepare their teams for interviews, on which rest more than \$500 million in government, research provider and industry money.

Of the 12 applications going to the next stage of the round, five come from existing CRCs (Advanced Manufacturing, Cancer Therapeutics, Capital Markets, Sheep Industry Innovation and Hearing).

The Round 16 shortlisted applicants are:

- Advanced Manufacturing CRC;
- Cancer Therapeutics CRC;
- Capital Markets CRC;
- The CRC for Cyber Security (CyberCRC);
- CRC for Increasing Agricultural Soil Productivity;
- CRC for Sheep Industry Innovation;
- Data to Decisions CRC;
- The Hearing CRC;
- Manufacturing Industry Innovation CRC;
- Rail Manufacturing CRC;

- Space Environment Management CRC; and
- Wildlife Biodiversity CRC.

The five applicants excluded are:

- Centre of Perinatal Excellence Cooperative Research;
- CRC for Exercise, Fitness and Injury Technologies;
- CRC for Active and Engaged Ageing;
- CRC for Diabetes and Obesity; and
- CRC for Innovative Science Communication and Outreach (CISCO).

Innovation partnerships underpin offshore energy developments

Australia is well placed to develop a strong offshore engineering service industry, from which the intellectual capital will grow our economy well beyond any local resource boom.



By Mark Cassidy
mark.cassidy@uwa.edu.au

Australia is currently undergoing a resource boom and our biggest private investments are in building the civil engineering infrastructure required to transform our offshore reserves into liquefied natural gas (LNG).

For example, the \$43 billion Gorgon project is, in capital terms, the single largest resource project in Australia's history and Chevron's largest worldwide project. It is one of \$120 billion worth of LNG projects currently under construction off the north-west coast of Australia.

However, installing oil and gas infrastructure off Australia's coasts has proved challenging because of our carbonate seabed soils, which are highly compressible and variably cemented. For example, remedial treatment of piles for the first platform built on the North West Shelf, the North Rankin A, cost \$340 million and the loss of a full year of revenue.

This surprised engineers, and further difficulties in translating generic Gulf of Mexico and North Sea technology to our problematic soils have been the genesis for a productive and symbiotic relationship between industry, government-funding bodies and Australian academia.

Major developments have been building leading international physical testing facilities at the Centre for Offshore Foundation Systems (COFS) at the University of Western Australia. An early seed grant from the WA Government was used to refurbish our soil characterisation laboratory. Industry service contracts have provided new specialised triaxial, simple shear and resonant column equipment, and soil testing has underpinned close to all major oil and gas developments off Australia's shores in the intervening period.

In 2012, more than \$2 million worth

of testing was conducted, characterising the engineering design properties of seabed sediments at our major development fields, including Browse, Prelude and Ichthys. The COFS laboratory is only one of handful worldwide trusted to test soil properties to the accuracy required for the large capital investments and difficult cyclic conditions found offshore.

Without a partnership of industry, government and academia such world-class laboratory facilities would not be

financially viable in Australia and all engineering testing would be performed in the traditional oil and gas hubs in Norway or the US. This would be more timely and costly to industry. It would also hinder specialist knowledge of Australia's unique offshore conditions being developed locally, hindering the growth of specialised engineering consultancy at home.

COFS's geotechnical centrifuge facility is another example where initial government support has been enhanced



Working on the drum centrifuge.

through collaborative partnership between industry and academic researchers. We operate a 3.6-metre-diameter, fixed-beam geotechnical centrifuge capable of accelerating modelling experiments of 200 kilograms up to 200 gravities and a 1.2-metre drum centrifuge that can operate at up to 400 gravities.

These facilities have been an essential component of the development of new design and analysis methods for offshore foundations for over two decades. This is because both the strength and stiffness of geomaterials depend on the effective stress level. Only by spinning the soil and foundation models at high gravities can similitude between small-scale models and full-scale conditions be maintained.

The sheer size of offshore engineering structures removes any potential for performing full-scale physical tests, so geotechnical centrifuge testing has been essential. Testing provided Australia's engineers with theoretically sound and experimentally validated geotechnical models – all now incorporated within industry as design methodologies and software for analysing the stability and risk of collapse of offshore anchors, pipelines, platforms, risers, foundations and manifolds.

With Federal Government support through the Australian Research Council we are enhancing Australia's testing capabilities by commissioning a new 10-metre-diameter centrifuge that will spin 2400 kg of soil at 134 revolutions per minute to accelerations of 100 gravities. It will be the largest in the southern hemisphere.

In his book *The Next Convergence*, Nobel Prize in Economics winner Michael Spence warns that "sustainable wealth creation is ultimately built on people, human capital and knowledge" rather than just natural resources. This provides Australia with both an opportunity and challenge. With the epicentre of the offshore industry moving away from the Gulf of Mexico and the North Sea, Australia has the potential to become a regional leader for offshore engineering design and development.

Strong links between industry, government and academia have the potential to provide testing facilities, design methods and software that will build Australia's knowledge-based

consultancy industry and contribute to Perth's growth as an oil and gas hub of international stature.

There is, however, intense competition for regional industry supremacy throughout Asia, with our competitors having the advantage of access to cheaper engineering labour and a local rig-building industry. Australia must meet the challenge by developing its intellectual capital through targeted research, new facilities and by promoting quality research training and mentoring.

With the commissioning of the world's first floating liquefied natural gas (FLNG) development at the Prelude field, Australia has first mover advantage in developing a leading engineering service hub in designing the future floating production facilities. The Prelude FLNG floating facility will be 488 metres long, 74 metres wide and, as advertised by operators Shell, will weigh about 600,000 tonnes or "roughly six times as much as the largest aircraft carrier".

FLNG is now being considered at a number of sites in the Browse Basin, Timor Sea and Exmouth Plateau, including the Greater Sunrise, Scarborough and Bonaparte fields.

Advancing the design and development of floating systems will require the same governmental, industry and academic partnerships found successful in Australia's initial fixed platform offshore industry. Now is the time to commission the infrastructure and testing equipment required to sustain this new floating industry here in Australia.

Only with a coherent, focused collaboration will Australia reap the full benefit of hosting a burgeoning international engineering service industry on our shores.

PROFESSOR MARK CASSIDY FTSE is Professor of Civil Engineering, Director of the Centre for Offshore Foundation Systems and Deputy Director of the Australian Research Council (ARC) Centre of Excellence for Geotechnical Science and Engineering at The University of Western Australia. He graduated in Civil Engineering from the University of Queensland in 1994 and, as a Rhodes Scholar, attained a doctorate in Engineering Science from the University of Oxford in 1999. He was recently awarded an ARC Laureate Fellowship to investigate 'New Frontiers in Offshore Geotechnics: Securing Australia's Energy Future'.

IMAGE: JOAN COSTA



The UWA beam centrifuge in action.

DEVELOPING AN AUSTRALIAN ENGINEERING SERVICE INDUSTRY

Despite the incredible capital investment recently seen in Australia's offshore oil and gas infrastructure, we are only partially meeting society's insatiable appetite for energy. This ongoing demand will ensure that, if more Australian natural gas can be accessed, it will remain a major global source of energy for the rest of this century.

However, the potential discoveries are located remotely, hundreds of kilometres offshore, in deeper waters, and on weak seabeds characterised by problematic carbonate soils, the mechanical behaviour of which differs significantly from conventional behaviour.

Australia is well placed to leverage off the innovations required to access these stranded gas fields to develop a strong engineering service industry. If done right, the intellectual capital developed will grow our economy well beyond any local resource boom.

Making green steel in the Arrium EAF.

Collaborating to re-use waste and reduce pollution

Arrium has cut production costs, reduced power usage, cut coke usage by 12 to 16 per cent and transformed some 1.6 million waste tyres.



By Veena Sahajwalla

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Almost a century ago, Albert Einstein insightfully warned: “The significant problems we have cannot be solved at the same level of thinking with which we created them”.

In the first decades of the 21st century that reality – and the urgent need for new thinking – has only become ever more apparent. In the past 50 years alone, the world has consumed more resources than in all previous history.

The conversion of ‘waste to value’ is seated in these realities and led to the University of NSW (UNSW) working with industry to produce a new industrial process to produce ‘green steel’.

Our first steps towards transforming ‘waste to value’ in steelmaking dates back to laboratory research at UNSW from 2003, where we began testing a new idea in our high-temperature research furnaces.

In conventional electric arc furnace (EAF) steelmaking – which produces

about 40 per cent of the world’s steel – scrap metal is reprocessed in furnaces using large amounts of non-renewable coke and coal as sources of carbon, a process that has remained largely unchanged since its inception.

But many other materials contain carbon, including problematic waste streams that currently clog landfills, such as plastics and waste tyres.

We discovered that transformations to the molecular structure of carbonaceous materials occur rapidly in extremely reactive, high-temperature environments over 1500°C, in which liquids/solids behave aggressively. Consequently, we realised that exposing a carbon-rich rubber/plastic waste mix to high temperatures resulted in the production of carbonaceous materials and clean gases. Then we tested the hypothesis that the submerged lances in electric arc steelmaking furnaces – usually used to inject coke (the standard source of

carbon in steelmaking, essential for iron oxide reduction and stable slag foaming) – could provide this rapid heating.

Our laboratory experiments showed that mixtures of coke, rubber and plastics mixtures introduced into the furnace at steelmaking temperatures produced carbon/slag reactions and extremely efficient slag foaming. As slag is the key to furnace efficiency, and therefore determines electricity usage, the resulting ‘foamier’ slag reduced power demand.

Industrial trials were conducted with Australia’s largest long-products steel maker, Arrium (formerly OneSteel), in the company’s industrial furnaces. The resulting patented Polymer Injection Technology (PIT) – known colloquially as ‘green steel’ – enabled steelmakers to introduce a blend of granulated tyres and coke into electric arc furnaces with no loss of quality in the steel produced.

Last year, PIT was named on the 2012

'GREEN STEEL' A TEMPLATE FOR SOMETHING BIGGER

Ultimately, our research goal is to entirely replace coke in steelmaking with a renewable carbon source, such as agricultural waste, and to leverage this approach across multiple waste streams. Our published laboratory research has already demonstrated that palm shells, for example – which are available in huge volumes as a byproduct of palm oil processing – can be successfully transformed into a carbon source for industry.

The success of 'green steel' as a long-term, collaborative venture between UNSW and Arrium also points to the way we need to work into the future to achieve our 'waste to value' goals.

No research discovery, no matter how brilliant, can make a difference without a clear path to implementation. Collaboration between universities and industries, locally, nationally and across the globe, is critical. Research can only lead to change if it can be practically applied.

List of Innovations that Could Change the Way we Manufacture (US Society for Manufacturing Engineers) and won the Australian Innovation Challenge. This year, PIT was recognised by the steel industry's premier global association when, as its inventor, I was invited to deliver the 2013 Howe Memorial Lecture in the US.

Meanwhile, Arrium has cut production costs, reduced power usage, cut coke usage by 12 to 16 per cent and transformed some 1.6 million waste tyres.

In steelmaking alone, the potential to reap economic and environmental benefits is considerable – there are 750 EAF steel plants worldwide and steel production is responsible for between four and five per cent of global greenhouse emissions.

But 'green steel' is only the beginning in finding ways to productively use our waste.

We are confident we can update the familiar environmental mantra of 'reduce, reuse and recycle' with the addition of a couple more 'R's – 're-form' and 'refresh'. Instead of stopping at 'recycling' – which turns materials back into more of the same materials, like waste glass back into glass and waste paper back into paper – we can think about waste more

creatively to build a global commitment to sustainable manufacturing and living.

If we look at the elements of waste – such as the carbon and hydrogen in waste tyres – we can harness those elements and 're-form' them into entirely new materials. This would overcome the current limitations of conventional recycling, opening up many new opportunities for industries to collaborate creatively across sectors to take advantage of waste streams from entirely different industries. 'Refresh' refers to refreshing our thinking to truly think outside the square.

The key drivers for new 'waste to value' processes and industries are already in place. The urgent need to solve waste problems coincides with the economic and environmental benefits of sourcing resources from materials the world has thrown away.

The world's used tyre stockpiles contain some four billion tyres and we are generating one waste tyre per person each year. Then, there is the world's fastest-growing waste burden – e-waste. Some 40 million tonnes of e-waste are created every year and some 80 per cent of it ends up in informal recycling sites in developing countries, posing a serious threat to human health and the environment.

The United Nations Environment Program (UNEP) estimates the volume of e-waste could rise by 500 per cent over the next decade, led by growth in China and India. UNSW is currently working in partnership with India's leading research institutions to address the e-waste challenge.

By re-forming waste we can also create

new 'green collar' jobs. UNEP notes that for every 13 jobs lost in the extraction of virgin materials and dumping of waste in landfill, 100 jobs are created in recycling. Australia's Access Economics estimated in 2009 that for every 10,000 tonnes of waste collected in Australia, 2.8 full-time equivalent (FTE) jobs are created at landfills – but that 9.2 FTE jobs are created if that same waste is recycled.

Over the past 10 years, the average amount of waste generated by the residents of the world's cities – now more than three billion people – has doubled to 1.2 kilograms per person every single day. There are no reliable global recycling statistics available but the UNEP estimates that only about 25 per cent of global urban waste is recycled, squandering vast quantities of potentially valuable resources.

This waste represents an extraordinary global opportunity for industries, businesses, the community and the environment.

Collaboration between researchers and industry will be a key to realising this opportunity.

SCIENTIA PROFESSOR VEENA SAHAJWALLA FTE is the inventor of 'green steel' and holds a number of senior positions at UNSW, including Director of the Centre for Sustainable Materials Research and Technology and Associate Dean for Strategic Industry Relations. Professor Sahajwalla's research has completely changed how the properties of carbon-bearing materials are understood, including coals, cokes, graphites, plastics and rubber tyres. She is a Eureka Prize winner (2005), was the 2008 NSW Scientist of the Year (Engineering Science) and won the 2012 Innovation Challenge.

EUREKA PRIZE FOR LEADERSHIP GOES TO NANOSCIENTIST

The University of Melbourne's Professor Frank Caruso, an international nanotechnology expert, won the 2013 CSIRO Eureka Prize for Leadership in Science for his leadership in developing nanotechnology-enabled materials for biomedical applications.

Associate Professor David Wilson, from the University of NSW, won the 3M Eureka Prize for Emerging Leader in Science for his work combating HIV and hepatitis C using mathematical modelling to drive adoption of appropriate drugs in Armenia and promotion of needle-syringe programs in Australia.

CSIRO scientist Dr Elliot Duff and his colleagues, who call themselves 'The Zebedee Team', in honour of the spring-loaded host of the popular children's TV program, *The Magic Roundabout*, won the ANSTO Eureka Prize for Innovative Use of Technology. Their Zebedee device is able to survey enclosed spaces where GPS cannot reach, such as inside caves, mines, factories and public buildings, or beneath forest canopies.

The 2013 Australian Museum Eureka Prizes rewarded excellence in 17 fields: research and innovation; leadership and commercialisation; science communication and journalism; and school science.

ATSE hosts Indonesian Science Academy

The President and Secretary General of the Indonesian Academy of Sciences (API), Professor Sangkot Marzuki and Dr Budhi Suyitno, met with ATSE Fellows and staff at the Academy office in Melbourne during their September visit to Australia.

The meeting was attended by ATSE President, Dr Alan Finkel AM FTSE, CEO Dr Margaret Hartley FTSE, Victorian Division Chair Dr Glen Kile AM FTSE and Professor Ana Deletic FTSE, Professor of Civil Engineering and a Director of Monash Water for Liveability.

Discussed during the meeting was potential areas of collaboration between Australia and Indonesia and Professor Marzuki and Dr Suyitno were briefed on the STELR program.

The visit followed two previous missions from API, which included the re-signing of an MoU in 2011. The two Academies have been exploring opportunities for Australia and Indonesia to collaborate primarily on urban water management, including health implications and governance issues.

Dr Budhi Suyitno (left) and Professor Sangkot Marzuki at the Academy discussions.



STEM education vital for our future

Australia needs to improve its approach to science, technology, engineering and mathematics (STEM) education to underpin its prosperity, its capacity to meet national challenges and its global competitiveness.

Improved quality and reach of STEM education are vital for sustainable wealth creation in Australia, which will be driven by science and technology, according to an Academy Action Statement – *Advancing STEM Education*.

The Academy makes three strong recommendations for a national re-focus on STEM education:

- governments should increase the amount of teaching time devoted to quality STEM subjects;
- governments should eliminate STEM teaching by teachers without STEM qualifications; and
- universities must improve science and technology teacher education.

It says the demand for STEM skills in Australia is clear – 75 per cent of the fastest-growing occupations require significant STEM skills and knowledge. STEM-based employment

is projected to grow at almost twice the pace of other occupations, but currently 41 per cent of employers are having difficulty recruiting STEM-skilled technicians and 26 per cent struggle to recruit STEM skilled professionals and managers.

These skills shortages will increase if no action is taken, ATSE says.

Typically, there is minimal time spent on teaching science in primary school and this has severe effects on the scientific literacy and numeracy levels of the community; only half of the community is able to cope with the mathematics requirements of daily life.

It notes that students are presented with a wide range of offerings in secondary school and in many schools there is little encouragement provided to undertake STEM subjects. Many students perceive STEM as boring and difficult and therefore often opt for subjects they are confident in and that will help them gain a higher university entrance score.

Many tertiary programs have dropped STEM prerequisites recently – even for STEM-related courses and professional pathways. This has acted as a further disincentive for students to study STEM subjects in senior school years, and has contributed to the decline in the numbers of teachers with STEM qualifications.

ATSE's vision for STEM education in Australia is:

1 Enhanced fundamental STEM teaching in primary schools to capture the imagination of students and to inspire their interest to continue STEM subjects through to secondary school and beyond.

2 A national secondary school science, mathematics and technology curriculum delivered to a greater proportion of school students by STEM-qualified teachers with access to ongoing professional development linked to career progression.

3 Enhanced learning experiences in the school and tertiary STEM curriculum that include experimental and practical learning that develop STEM-based problem-solving and critical thinking in all students.

4 STEM-based tertiary graduates with workplace skills (including entrepreneurship, project management, research translation and critical thinking) better able to meet the needs of technology-intensive industries in Australia and who engage in continuous development of these skills through further informal and formal study.

Advancing STEM Education accompanies this edition of *ATSE Focus* and is available on the ATSE website at Activity/Education

ATSE says the demand for STEM skills in Australia is clear:

- 75 per cent of the fastest-growing occupations require significant STEM skills and knowledge
- STEM-based employment is projected to grow at almost twice the pace of other occupations, but currently 41 per cent of employers are having difficulty recruiting STEM-skilled technicians and 26 per cent struggle to recruit STEM skilled professionals and managers

ATSE takes nuclear speakers on the road

Following the ATSE National Conference 'Nuclear Energy for Australia?' in Sydney in late July, a group of four conference speakers travelled to additional events in Sydney, Brisbane, Canberra, Melbourne and Adelaide.

This conference 'road show' addressed more than 220 people – doubling the audience reach of the event – and took the conference's key speakers and messages to diverse audiences around Australia. A similar event is planned for Perth in October.

The speakers were Professor Peter Guthrie OBE FREng (Cambridge), Dr Ron Cameron PSM FTSE (Head of the Nuclear Development Division, OECD Nuclear Energy Agency), Mr Timo Äikäs (Corporate Advisor Posiva Oy, which manages spent nuclear fuel for Finland) and Dr Ian Duncan FTSE.

The Sydney event, held at ANSTO, was also attended by Dr Massimo Salvatores, (Senior Advisor, CEA, France) who addressed an ANSTO audience on future technical concepts for nuclear development.

In Brisbane, the Queensland Division held an evening briefing at Customs House. The following day the road show delivered two



(From left) Professor Peter Guthrie, Dr Ron Cameron, Mr Timo Äikäs and Dr Ian Duncan at the South Australian Division event.

events in Canberra: a morning briefing with the Department of Resources, Energy and Tourism and an evening public function organised by the ACT Division.

The team addressed an evening function organised in Melbourne by the Victorian Division and the following day in Adelaide attended a University of South Australia lunch hosted by Chancellor Dr Ian Gould AM FTSE and then an afternoon workshop organised by the SA Division.

The 'road show' concept was a strenuous exercise following the conference, but allowed Fellows and guests in four States to see and hear speakers who are top of their field and who they would not have seen otherwise.

'Nuclear Energy for Australia?' was covered extensively in the August issue of *ATSE Focus* (#179). The Communiqué, Conference Report, Presentations and related material are on the ATSE website.

Academy backs research impact

ATSE believes the publication of the results of a survey of research impact will assist the public perception of university research and guide the public sector and industry on which universities are fostering a research culture where uptake of research findings is important.

ATSE notes it is essential to demonstrate to key stakeholders the dividends arising from Australia's investment in research and the importance of the application of research.

The comments were part of an Academy submission that responded to a discussion paper circulated by the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education titled *Assessing the wider benefits arising from university-based research*.

ATSE suggests consideration be given to differentiation between 'researcher-push' and 'user-pull' types of research, noting the traditional linear model of university research leading directly to innovation has now been replaced by diffuse models such as open research by industry, which seeks more direct

interaction with universities at the time research directions are formulated.

"Impact assessment as a result requires different approaches to be adopted as uptake is far more secure if a defined problem can be solved. The evaluation process needs to ensure researchers are not discouraged from more blue-sky type research, where at the outset, the path to uptake might not be immediately apparent," the ATSE submission says.

"By highlighting collaboration as an important component of research engagement, high-impact research that has fostered such collaboration will be adequately recognised."

ATSE suggests a campaign for enhanced research impact would benefit from:

- providing a basis on which public-sector funding bodies could assist universities to ensure appropriate research leads to public benefits;

- increasing investment in university research from sources outside traditional funding mechanisms;
- encouraging State and Commonwealth governments to develop policy to better capture the benefits of university research; and
- providing the private sector with a basis to engage with universities or research groups to maximise beneficial outcomes from supported or collaborative research.

The establishment of a scheme to evaluate the benefits or impacts of university research is needed urgently, ATSE says.

It says that, in the same way as peer review requires an element of subjective judgement, an experienced expert panel appears able to reach consensus on potential research benefits/impacts reasonably easily.

How any system will handle shared impacts will need careful consideration, as the nature of applied research is that it is often undertaken collaboratively.

Broadband 'app-ortunities'

Alarms that send you mobile alerts warning of smoke detected in your house and tele-health systems that help to measure home-based

breathing exercises for patients suffering from chronic disease are just some of the potential applications available over next-generation broadband networks, according to a new report by the Australian Centre for Broadband Innovation (ACBI).

Informed by range of expert industry perspectives on how future services will be offered in health, education, energy, business and media, the *App-trepreneur's Guide to Broadband Connected Services* outlines opportunities for the development of

new broadband-enabled applications.

"We are at the dawn of a new 'App Age', where next-generation broadband networks will allow us to better manage our home energy use and support the elderly living independently at home, as well as providing us with more personalised entertainment content by connecting people in their homes with services enabled by sensors and cloud computing," says Colin Griffith, Director of ACBI.

"With predictions that by 2020 the average person will own six smart devices connecting then to over 37 billion 'things' – from cows in the field, to our car, to our washing machine – it's clear that a better broadband infrastructure will revolutionise the way we access services in the home."

In April this year ACBI, with its industry partners Intel, iiNet, Foxtel, Pottinger, NSW Trade and Investment, NBN Co, CSIRO and NICTA, announced the Apps4Broadband competition for developers to create new ideas for apps that run over next-generation broadband networks. The *App-trepreneur's Guide to Broadband Connected Services* report highlights winners of the competition as examples of these future services.

"The Apps4Broadband competition was designed to help Australians better understand what is possible through the smart use of broadband and to accelerate the ability of Australian developers to realise new business opportunities by connecting with service providers, technology partners and end users to build game-changing apps," Mr Griffith says.

"We've had a great response from developers who've come up with some really interesting and new ways for people to access health, energy, education, retail, security, entertainment and many more services.

"The diversity of these ideas not only demonstrates the tangible benefits of broadband to the public but also suggests that we have only scratched the surface in identifying future business models and services that leverage our national broadband infrastructure. The 'app-ortunity' for innovation really is endless from here."

The winners of the Apps4Broadband competition include:

- TutorBee – a platform that allows tutors to give interactive lessons to students in their homes;
- Pepster – breathing exercise app and device for cystic fibrosis patients;
- Pass the Popcorn – a second screen app for synchronising watching on-demand television and chatting with friends;
- The Bop Smoke Alarm – a smoke detector and app for managing alerts, false alarms and the need to replace batteries; and

- Senograph – a sensor management platform and prototype sensor for home air quality and detection of carbon monoxide.

ACBI is a national research initiative led by CSIRO in conjunction with National ICT Australia (NICTA) and NBN Co, with funding support from the NSW and Tasmanian governments.

\$42 MILLION FOR NICTA

NICTA, Australia's ICT Research Centre of Excellence, will receive an additional \$42 million in 2015-16 to support the digital economy and help sustain Australia's economic strength beyond the mining boom. The former Minister Assisting for the Digital Economy, Senator Kate Lundy, announced the additional funding at a visit to NICTA's headquarters in Sydney.

"NICTA is a world-class information and communication technology research and commercialisation facility. It connects research excellence to practical, real-life challenges faced by industry, government and society, driving efficiency and productivity growth," Senator Lundy said.

"With more than 580 researchers, technical and professional staff, 260 PhD students working across 30 research projects, training and commercialisation activities and partnerships with 22 universities, NICTA brings both scale and depth to Australia's ICT research. Investing in skills, innovation and research is essential for Australia to remain productive and competitive and to ensure economic growth into the future."

As Australia's largest Centre of Excellence for ICT, NICTA was uniquely placed to undertake large-scale, world-class research and development projects that made a real difference to Australia's economy, said Dr Hugh Durrant-Whyte FRS FAA FTSE, CEO of NICTA. "We are proud of the progress we have made so far at NICTA and look forward to the future advances this new funding will support," Dr Durrant-Whyte said.

NEXT THE FLEXIPHONE?

RMIT University research is advancing transparent, bendable electronics, bringing unbreakable rubber-like phones closer to being a reality. Researchers have developed a new method of transferring electronics with versatile functionality onto a flexible surface, rather than rigid silicon.

The ability of micro- and nano-electronic devices to sense, insulate or generate energy is controlled by nanolayers of oxide materials, often thinner than 1/100th of a human hair. These oxide materials are brittle and their high processing temperatures – often in excess of 300°C – have until now prevented their incorporation in flexible electronic devices.

RMIT PhD researcher Philipp Gutruf says the new process could unleash the potential of fully functional flexible electronics, while providing a new way for the materials to mesh together.

"We have discovered a micro-tectonic effect, where microscale plates of oxide materials slide over each other, like geological plates, to relieve stress and retain electrical conductivity," he says. "The novel method we have developed overcomes the challenges of incorporating oxide materials in bendable electronic devices, paving the way for bendable consumer electronics and other exciting applications."

Supervisor and co-leader of the research group, Dr Madhu Bhaskaran, says the new approach used two popular materials – transparent conductive indium tin oxide and rubber-like silicone which is also biocompatible.

"The ability to combine any functional oxide with this biocompatible material creates the potential for biomedical devices to monitor or stimulate nerve cells and organs. This is in addition to the immediate potential for consumer electronics applications in flexible displays, solar cells, and energy harvesters," Dr Bhaskaran says.



App-trepreneur's guide to Broadband Connected Services

ACOLA seeks input on new technology

The Australian Council of Learned Academies (ACOLA) Securing Australia's Future project – 'New technologies and their role in our security, cultural, democratic, social and economic systems' – is seeking input to assist with the identification of important and impactful technologies for Australia.

The Expert Working Group behind the New Technologies project comprises a mixture of leaders from academia and industry and is led by Professor Rob Evans FAA FTSE, from the University of Melbourne, and Professor Robert Williamson FAA, from the Australian National University.

The project seeks to present in its final report a series of case studies that explore the complexity of the interaction between technology and society. Some case studies will be centred on particular technologies (past, present and emerging) and the impact they have on society. Other studies will take a particular societal issue as the starting point and explore technologies that might contribute to a solution.

The aim of this survey is to capture views on important and impactful technologies with a particular interest in insights that would be difficult to find in the published literature. The link to the survey and the projects consultation blog is at <http://technologyforaustralia.org/>.

Survey respondents will have the opportunity to attend invitation-only panel sessions to be held across Australia in early 2014.

Australia's four Learned Academies come together through ACOLA to contribute to national policy development and innovative solutions to complex global problems and emerging national needs. Securing Australia's Future is a multi-project, three-year research program funded by the Australian Research Council and conducted by ACOLA for the Prime Minister's Science, Engineering and Innovation Council through the Office of the Chief Scientist.

Securing Australia's Future delivers evidence-based research and findings to support policy development in areas of importance to Australia's future. Read more at www.acola.org.au or <http://technologyforaustralia.org/>

UNIVERSITIES RANK IN TOP 100 AGAIN

Australian universities have been listed again among the world's top 100 varsities in the publication of the 2013 university rankings.

The University of Melbourne ranked highest among Australian universities in the 2013 Academic Ranking of World Universities (ARWU), released by the Center for World-Class Universities at Shanghai Jiao Tong University.

Ranked 54 (up from 57 last year), Melbourne led the Australian National University (ANU) (66), the University of Queensland (UQ) (85), the University of Western Australia (UWA) (91) and the University of Sydney (97). Monash University and the University of NSW (UNSW) were ranked 100-150. In total 19 Australian universities were listed in its listing of 500 top universities worldwide.

The **Quacquarelli Symonds** QS World University Rankings 2013-14 listed ANU at 27, followed by the University of Melbourne (31), University of Sydney (38), University of Queensland (43), UNSW (52), Monash University (69) and UWA (84). The University of Adelaide was ranked 104.

The **Times Higher Education** World Reputation Rankings listed the

University of Melbourne (39), ANU (42) and the University of Sydney (49) as the leading Australian universities, followed by UQ (71-80), UNSW (81-90) and Monash University (91-100).

ZEBEDEE MAPS PISA'S LEANING TOWER

Australian researchers have created the first ever three-dimensional, interior map of Italy's iconic Leaning Tower of Pisa by using a breakthrough mobile laser mapping system. Developed by CSIRO, the Eureka-Prize-winning Zebedee technology is a handheld 3D mapping system incorporating a laser scanner that sways on a spring to capture millions of detailed measurements of a site as fast as an operator can walk through it. Specialised software then converts the system's laser data into a detailed 3D map.

While the tower's cramped stairs and complex architecture have prevented previous mapping technologies from capturing its interior, Zebedee enabled the researchers to create the first comprehensive 3D map of the entire building, completing the scan in 20 minutes.

As well as its applications in cultural heritage, ZEB1 – the Zebedee product – is already assisting mining companies to better manage their operations and helping security forces to quickly scan crime scenes.

WOMEN FIND SUCCESS IN EUREKA PRIZES

Dr Kerrie Wilson from the University of Queensland won the 2013 Macquarie University Eureka Prize for Outstanding Young Researcher, an acknowledgement of her innovative budgeting approach to protect threatened species.

Dr Wilson has shown that smart, targeted spending can have a greater impact than simply spreading the dollars as widely as possible – insights that are helping to prioritise orang-utan conservation efforts in Borneo in a way that balances competing land-use demands and the maintenance of forests to offset greenhouse gas emissions.

Professor Michelle Simmons of the ARC Centre of Excellence for Quantum Computation and Communications Technology at the University of NSW was nominated as a finalist in the CSIRO Eureka Prize for Leadership in Science section for her work leading 180 Australian researchers to the forefront of global electronics investigation.

Two finalists for the 3M Eureka Prize for Emerging Leader in Science prize were a marine ecologist passionate about protecting coastal environments and an astronomer pioneering data-driven research.

Dr Melanie Bishop of Macquarie University has built a reputation for her work on human impacts on coastal ecosystems. Her research is helping native oyster populations in Australia and the US, and providing practical solutions for minimising the impact of boat wakes.

Dr Tara Murphy of the University of Sydney leads an 80-strong international collaboration searching for supernovae and other astronomical explosions using radio telescopes. She also advocates for the rising science of astroinformatics, which combines astronomy and computing.

Sydney company OneSteel and Professor Veena Sahajwalla FTSE from the Centre for Sustainable Materials Research and Technology at UNSW were recognised as finalists in the Rio Tinto Eureka Prize for Commercialisation of Innovation for their implementation of a process in which coking coal used in electric arc furnace steelmaking can be replaced by old car tyres that would otherwise end up as landfill.

Bronwyn Harch leads CSIRO Informatics

Dr Bronwyn Harch has been appointed chief of CSIRO's newest research division, CSIRO Computational Informatics (CCI), which focuses on data-driven computational and information sciences.

CCI will work in partnership with CSIRO's National Research Flagship program to address key national

challenges across the information and decision-making value chain. It will also work closely with a range of external partners and collaborators to create a capability hub in key research areas including next-generation data analytics, autonomous robotics, complex systems modelling and decision-making under uncertainty.

Dr Harch leads researchers who use digital technologies and mathematical sciences to make a real difference to industry, society and the environment. She provides research oversight for the division, which is part of CSIRO's Information Sciences Group.

Dr Harch joined CSIRO in 1995 as a research statistician and has held positions of research leadership since mid-2005. She became Chief of CSIRO Mathematics, Informatics and Statistics in 2012 after serving as

Deputy Director of the Sustainable Agriculture Flagship.

"From pioneering the development of digital image analysis for agriculture in the 1980s to securing the landmark patent to Wireless LAN technology in the 1990s, CSIRO has always been at the forefront of technology-related research which tackles the nation's toughest challenges," Dr Harch says.

"The proliferation of smart devices and increasing access to next generation broadband has caused an explosion in the volume, velocity and variety of data and information.

"We have responded to the information and data challenges facing Australia with the formation of this new CSIRO Computational Informatics (CCI) Division.

"Our integrated and strengthened capabilities in this division will enable us to remain at the forefront of global developments in key research areas that transform the information and decision making workflows of industry, government and the innovation sectors."

L'OREAL AWARDS FOR DIVERSE RESEARCH

Medicine and geoscience were highlighted when the 2013 L'Oréal For Women in Science Fellowships were announced in August.

The winners were: Dr Kathryn Holt, Bio21 Institute, The University of Melbourne; Dr Joanne Whittaker, Institute for Marine and Antarctic Studies, University of Tasmania; and Dr Misty Jenkins, Peter MacCallum

Cancer Centre, Melbourne.

The Fellowships are part of L'Oréal's global program to celebrate and support women in science. Each winner was awarded a \$25,000 Fellowship, which may be used for any expenses incurred, including childcare.

Dr Holt is using genetics, maths and supercomputers to study the genome of deadly bacteria and work out how they spread. She will use her L'Oréal For Women in Science Fellowship to understand how antibiotic-resistant bacteria spread in Melbourne hospitals and to answer questions such as: 'Are people catching these superbugs in hospital, or are they bringing the bugs into hospital with them?'



Kathryn Holt



Jo Whittaker

and 'Can we give the intensive care clinicians early warning of a drug-resistant bacteria in their patients?'

Marine geoscientist Dr Jo Whittaker likes to solve jigsaw puzzles and is tackling the biggest puzzle on the planet – the formation of

continents. Aboard Australia's national marine research vessels, she is reconstructing how the Indian, Australian and Antarctic tectonic plates separated over the past 200 million years, forming the Indian Ocean and the continents as we see them today. This information will help better model climate change, find new gas resources and help us understand the dynamics of the land in which we live.

Dr Jenkins spends a lot of her time watching killers at work – the white blood cells of the body that eliminate infected and cancerous cells. She can tell you a great deal about how they develop into assassins and arm themselves. Now, with the support of her L'Oréal For Women in Science Fellowship, Dr Jenkins is exploring how white blood cells become efficient serial killers – killing one cancer cell in minutes and moving on to hunt down others. Her work will give us a greater understanding of our immune system and open the way to better manage T cells to defeat disease.



Misty Jenkins

Bronwyn Harch

WOMEN IN TSE

ATSE Ambassador in spider venom project

A former ATSE Young Science Ambassador is part of a University of Queensland (UQ) research team which has found that a natural component of Australian tarantula venom is more potent against certain insect pests than existing chemical insecticides.

Professor Glenn King and Dr Maggie Hardy, from UQ's Institute for Molecular Bioscience (IMB), identified a toxin known as OAIP-1 that is lethal if eaten by the cotton bollworm or termites.

Professor King said OAIP-1 could be developed into an environmentally friendly insecticide.

"There is an urgent need for new insecticides due to insects becoming resistant to existing products and others being deregistered due to perceived ecological and human health risks," Professor King says.

Dr Hardy says numerous insecticidal toxins have already been

isolated from spider venom but few of these have been tested to determine whether they are orally active, a vital property for an effective insecticide. The team screened toxins from spider venom for oral activity and isolated OAIP-1, which has the highest oral activity reported to date for an insecticidal venom toxin.

In addition to her research interests, bringing science to the public is one of Dr Hardy's goals. As an undergraduate and graduate student she was involved with programs designed to

help marginalised and minority students succeed in higher education and careers in science. While a PhD student at the IMB, she founded the IMB Science Ambassador Program to train early career researchers in speaking to the public, the media and funders.

In 2008 she was selected as one of the Academy's Young Science Ambassadors and spoke to high school students and stakeholders in outback Queensland.

EZY AMP WINS STUDENT AWARD

The top student award at the 2013 University of NSW (UNSW) Innovation Awards went to a team from the Faculty of Science that developed the Ezy Amp software, which enables portable diagnostic devices to rapidly test DNA onsite. This can be used to detect diseases

and contaminants in water.

Lead developer was biotechnology student Evelyn Linaryd, who worked with students Alison Todd, Simon Erskine, Elisa Mokany and Tina Loneragan. She was also the student winner in the Early Stage Innovation award category.

"Simple tests like Ezy Amp can be done by anyone, anywhere – like the staff at border control or patients in a remote developing country," Evelyn says.

The annual Innovation Awards are coordinated by UNSW's commercialisation company, NewSouth Innovations (NSi), and recognise major research discoveries and inventions made by staff and students.

PHOTO: ONUR KARAOZBEK



Evelyn Linaryd

KATRINA BUKAUSKAS WINS ENGINEERING AWARD

Engineers Australia has named Katrina Bukauskas from Woodside Energy as winner of the 2013 Young Environmental Engineer of the Year award.

In 2012, Katrina received the Western Australian Chamber of Minerals and Energy (CME) Outstanding Young Professional Woman Award. She was named 2009 Queensland University of Technology (QUT) Student Leader of the Year and awarded the undergraduate category in the Queensland Government's Smart State, Our Women Our State Awards for recognition in the fields of science, engineering and technology.

Since 2010 she has worked as an environmental engineer with Woodside Energy, after graduating with first class honours in her Bachelor of Engineering (Civil and Environment) degree at QUT. She has provided environmental engineering support to a range of activities including the downstream component of the Browse LNG concept, offshore production facilities and brownfield projects.

Katrina has also had the unique opportunity to have been involved in an aerial humpback whale survey and visited many of Woodside's production facilities, including onshore LNG plants, supply bases and offshore facilities in the Canarvon, Dampier and Timor basins.

For the past seven years Katrina has been an active volunteer for not-for-profit organisation Engineers Without Borders and been involved in education and awareness activities in both Cambodia and India.



Maggie Hardy



Katrina Bukauskas

Twelve new Fresh Scientists

Organisers have announced the 12 Fresh Scientists for 2013 – chosen from 58 early career researchers from across the country. They are:

- Robin Beck (University of NSW) – A rice-grain-sized fossil bone challenges marsupial evolution;
- Alexe Bojovschi (RMIT University) – Electric fish sparks power-fault system;
- Yee Lian Chew (University of Sydney) – Worm gene may regulate brain health and ageing;
- Angela Crean (University of NSW) – Sea squirt sperm challenge an IVF paradigm;
- Lee Hickey (Queensland Alliance for Agriculture and Food Innovation/UQ) – Saving barley, farmers and beer-drinkers from rust
- Julie Lovisa (James Cook University) – Formula for new land – just subtract water
- Hossein Mokhtarzadeh (University of Melbourne) – Footballers' knees modelled with maths

- Christian Reynolds (University of South Australia) – Just how much food do we throw away and what does it cost us?
- Aliaa Shallan (University of Tasmania) – Disposable nanotech for home diagnosis
- Evan Stephens (University of Queensland Institute for Molecular Bioscience) – Algae fuel green petrol hope
- Ruth Thornton (University of Western Australia) – Fighting chronic ear infections in children
- Meng Wai Woo (Monash University) – Tiny particles to micro-manage your drugs

This is the 16th year of Fresh Science, a national program sponsored by the Australian Government, through the Inspiring Australia initiative, to give Australia's up and coming early-career researchers a crash course in communication with the general public and the media to help promote Australian science and discoveries.

In this issue of *Focus* we highlight the work of seven of this year's Fresh Scientists.

AUSSIE ALGAE FUEL A GREEN OIL HOPE

Newly trialled native algae species provide real hope for development of commercially viable fuels from algae, a Queensland scientist has found.

Dr Evan Stephens and the team at the University of Queensland's Institute for Molecular Bioscience, in collaboration with Germany's Bielefeld University and Karlsruhe Institute of Technology, have identified fast-growing, hardy, microscopic algae that could prove the key to cheaper and more efficient production of alternative fuels.

With the help of these native species, Australia could potentially become an oil exporter like the Middle East by devoting just one per cent of land to algae farms.

"Previously, the main focus has been looking for oil-rich algae, but usually these are not fast-growing and they are tastier to predators – like microscopic scoops of icecream," says Dr Stephens, manager of the Solar Biofuels Research Centre at UQ.

"The integration of new technologies means we can turn a broad range of algae into bio-crude oil that can be processed in existing oil refineries, so now the success of the industry comes down to rapid growth and low production costs," he says.

"A major new frontier is in the biology and developing new strains – and we've already made significant advances through the identification of high efficiency strains that have really stable growth, as well as being resistant to predators and temperature fluctuations."

The team identified hundreds of native species of microscopic algae

from freshwater and saltwater environments around Australia. They then tested these strains under thousands of environmental conditions in the laboratory, creating a shortlist of top performers. The project has garnered international and domestic investment, including from Finland's Neste Oil, global engineering company KBR, Siemens, the Queensland Government and Cement Australia.

Traditionally, algae have been grown for health foods, aquaculture and waste-water treatment. In recent years, algae oil has become the focus of an emerging biofuel industry. However, its production is still expensive and viable commercial production has not yet been achieved in Australia or overseas.

UQ's Dr Evan Stephens has identified native Australian algae species capable of commercially viable bio-crude oil production.





Ruth Thornton with a young patient.

STICKY EAR MYSTERY BEING SOLVED

Perth researchers are planning to end the sleepless nights that families face when ear infections strike and won't go away. Their research could reduce the need for antibiotics and surgery, and help tackle hearing loss in Indigenous communities.

Dr Ruth Thornton and her research team at the University of Western Australia have discovered that bacteria in the ears of children with recurrent middle-ear infections are hidden by sticky nets of DNA, and that they evade antibiotic treatment by creating impenetrable slimy biofilms.

The researchers are targeting these nets with a drug that has been shown to break up the thick lung secretions of children with cystic fibrosis, and clinical drug trials are currently underway.

"Bacteria in the ear hide in a sticky glue made up of big nets of DNA from the children's own immune system. It is similar to what happens in the lungs of people with cystic fibrosis, where a treatment known as Dornase alfa is used to break this sticky DNA up," says Dr Thornton, a research assistant professor in the School of Paediatrics and Child Health.

"We are now trialling this treatment in the ears of children as they are having grommets put in. We believe this could get rid of these bacteria and stop children getting more infections and needing more ear surgery."

Middle-ear infection (otitis media) is one of the commonest childhood complaints. Some children have chronic infections that resist antibiotics and require the insertion of ventilation tubes (grommets) in their eardrums. Thirty per cent of these children need repeat grommet surgery due to re-infection, and the condition's chronic nature has been associated with hearing loss and learning difficulties.

The clinical trials involve 60 children under the age of five, with a larger national trial planned after their completion.

There are also plans to trial the treatment in Indigenous children, who suffer from high rates of severe, chronic middle-ear infections.

"This is the first potential change in treating middle-ear infections for a long time, and more effective treatments will hopefully lead to improved hearing, better learning outcomes and a reduced burden on children and their families," Dr Thornton says.

ANKLE AND TOOTH UPSET EVOLUTION THEORY

Two tiny fossils are prompting an overhaul of theories about marsupial evolution after they revealed unexpected links to South America – and possibly Africa.

One of the fossils, found at the Tingamarra site in south-eastern Queensland, is a 55 million-year-old ankle bone from a mouse-sized marsupial previously known only from South America. The second is a tooth that derives from a formerly unknown species and which shows similarities to fossils found in South America and, surprisingly, North Africa.

The two fragments are set to overturn the conventional theory about the evolution of marsupials, which holds that there was a single migration from the part of the Gondwana 'supercontinent' that became South America to the part that became Australia.

"The origins of Australian marsupials suddenly got a lot more complicated," says palaeontologist Dr Robin Beck, a postdoctoral Fellow at the University of NSW.

"All the species of modern-day marsupials here are quite closely related. The species represented by the ankle bone belongs to an entirely different group – a group that we know lived in South America but, up until now, we thought never made it to Australia."

"The tooth is more of a mystery: are its origins in South America, Africa or somewhere else?"

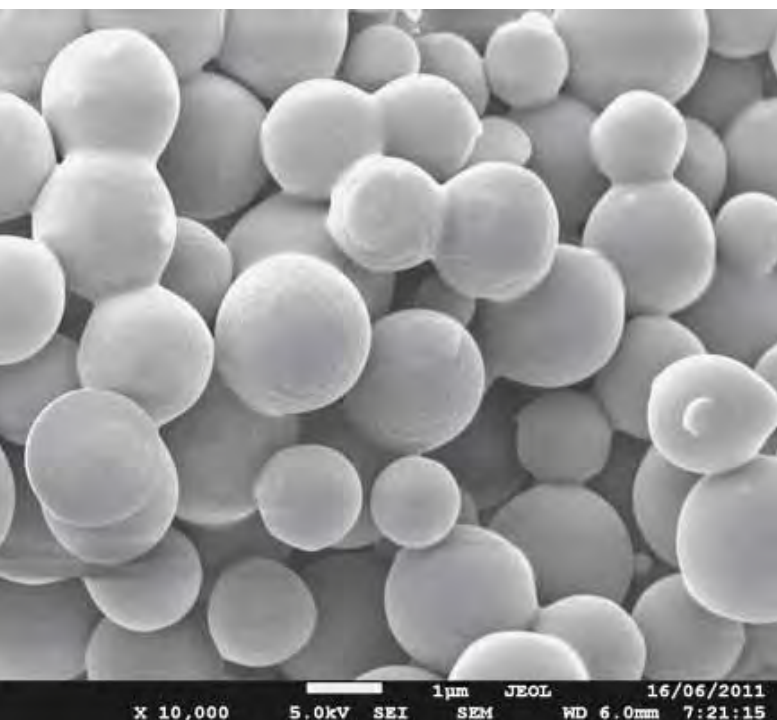
"It is impossible to explain the presence of these new fossils in Australia using the single dispersal model. Instead, there may have been multiple movements of marsupials between South America and Australia."

The similarities between the fossil tooth and those of an extinct species recorded in Tunisia remain the tantalising subject of further research. However, for the moment Dr Beck thinks the tooth and the ankle bone provide fascinating new information about the history of marsupials in Australia.

"They mean that extinction has played a much bigger role in the story than we previously thought," he says. "Some species became extinct in Australia but survived in South America. And perhaps the opposite is also the case – will there be discoveries in South America of typically 'Australian' fossils?"



Robin Beck: the origins of Australian marsupials are suddenly a lot more complicated than previously thought.



Mixing drugs & ethanol for better inhalers

Asthma inhalers could soon become much more effective, thanks to a clever new way of making the particles they deliver, invented by a Melbourne chemical engineer and his team.

Current puffer designs and typical particle size ranges mean a large portion of the medication propelled into a patient's throat remains there and only a fraction reaches the lungs.

But Monash University lecturer Dr Meng Wai Woo and his team have now developed a method of making ultra-fine particles, which will make drug delivery much more consistent and efficient. The new method, known as anti-solvent vapour precipitation, uses ethanol to dehydrate droplets, and results in super-small particles of uniform size.

"Ultrafine uniform particles will ensure that fewer drug particles get stuck in the throat while more can reach the lower regions of the lungs," Dr Woo says. "Because we can now make the small particles more uniform, it means the inhalers will work better."

The team's work results in particles smaller than a micron (thousandth of a millimetre) in diameter – much smaller than those produced by conventional dehydrating mechanisms, which are limited by the size of the atomised droplet.

The team's discovery is likely to excite a lot of interest among pharmaceutical companies. Infusion devices and metered-dose inhalers account for about US\$20 billion in worldwide sales each year, with the key development aim being to balance improved efficiency against the cost of manufacture.

Investigations into using ethanol as a means of producing ultrafine particles began in 2011, as part of Dr Woo's ongoing research into manufacturing processes in the dairy industry.

Attempting to produce lactose crystals, his team decided to reject the traditional hot air drying method and use nitrogen laced with ethanol vapour as an alternative dehydrating agent. To their surprise, the result was not the crystals they expected, but hundreds of very tiny, very uniform lactose particles. Further testing showed that the amount of

Ultrafine particles are the key to better inhalers.

alcohol absorbed into the initial droplets was a key variable in influencing the outcome.

The Monash team is now testing its method on another dairy product – whey – researching the ultrafine particle delivery of protein-based medicines. They are also building a demonstration unit to showcase the anti-solvent vapour precipitation process, which will be completed later this year.

ANKLES THE KEY TO FOOTBALLERS' KNEES

Knee injuries to AFL footballers could be dramatically reduced if physiotherapists paid more attention to ankles, says a Melbourne mechanical engineer who is now trialling mathematical models to help Carlton Football Club predict and screen for players most at risk of knee injuries.

Dr Hossein Mokhtarzadeh has demonstrated that the ankle is key to preventing knee injuries, which cost the Australian football codes tens of millions of dollars a year.

As a University of Melbourne postdoctoral Fellow at the Australian Institute for Musculoskeletal Science, Dr Mokhtarzadeh is hoping to expand his work into protecting the anterior cruciate ligament (ACL) against injury by developing exercises to strengthen critical muscles supporting the ankle joint. He also has a vision for a mechanical bracing system for those who may not be able to train their muscles to a sufficient level.

He filmed athletes landing using a motion capture system, and measured their landing force with a detector plate on the ground. He then used the data he collected to customise a pre-existing mathematical model of the interactions of leg muscles and bones. It allowed him to calculate the forces in each of the muscles during the landing motion and develop another model to determine the force on the ligament itself.

Using this data and information from previous studies, Dr Mokhtarzadeh designed a series of experiments on the limbs of pig carcasses to determine the actual injury mechanism.

"I found that if you fix the shin bone at the ankle so it doesn't rotate, you need to increase the level of force to cause injury to the ACL. So this protects the ACL. There is a limitation, however, because if you continue, you can cause other forms of damage – a there is a kind of trade-off"

He says that, until now, no one has recognised the significant role in protecting the ACL played by the soleus, a large muscle behind the calf at the back of the lower leg that runs from below the knee to the heel.

"If we could prevent just half of the knee injuries in Australian football, we would save more than \$60 million a year and a lot of pain."



Hossein Mokhtarzadeh

COUNTERING RUST AND SAVING THE BEER

An international study led by a Queensland scientist has found a way to better safeguard an important food crop – and the world's beer supply.

The study, led by University of Queensland geneticist Dr Lee Hickey, successfully identified a gene that protects barley against leaf rust – a disease that hit Queensland farmers in 2010 and could destroy almost a third of the national crop.

In Australia, barley is used primarily for beer and stockfeed. The situation is much more significant in North Africa and south-west Asia, where barley is a critical human food, and rust commonly attacks vulnerable plants.

Barley farmers around the world currently spend large amounts of money on fungicides to combat leaf rust. But Dr Hickey's discovery will enable selective breeding of barley to provide genetic protection to the disease, resulting in much lower chemical use, reduced crop losses and a more reliable grain supply.

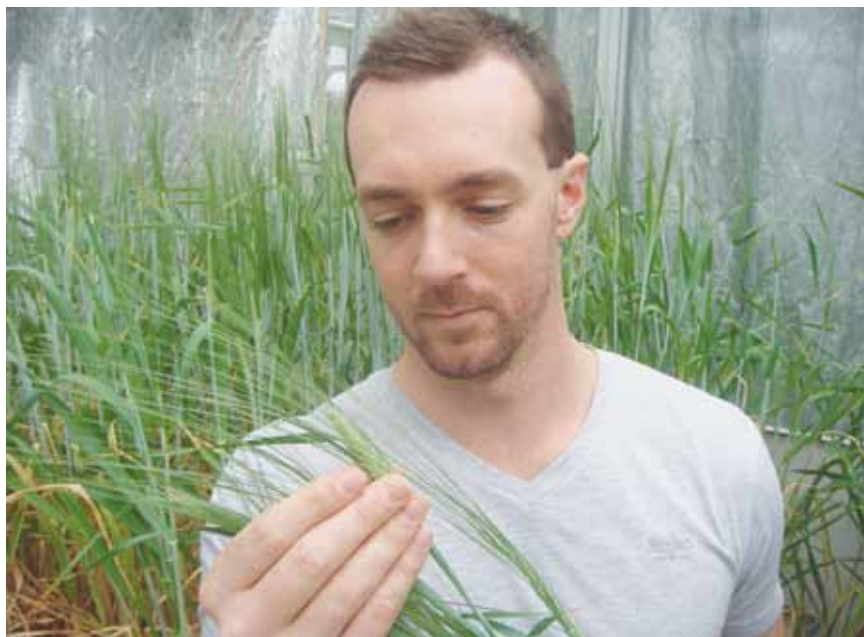
A research Fellow at UQ's Alliance for Agriculture and Food Innovation, he conducted his pioneering study with collaborators from the Queensland Department of Agriculture, Fisheries and Forestry, the University of Sydney and Uruguay's Instituto de Investigacion Agropecaria.

In field trials in Australia and Uruguay, the research team was able to identify a specific gene, Rph20, which provided resistance to the leaf rust pathogen in the adult plants of some barley varieties. It then successfully developed a diagnostic DNA marker to determine the presence of the gene. The researchers traced its origins back to a type of barley first cross-bred in the Netherlands in 1928.

The findings could provide an important boost to global barley production.

Dr Hickey has declined to patent the DNA marker, preferring the information to be freely available.

His research has also conclusively linked the Rph20 gene to resistance to another devastating barley disease, powdery mildew. "We're finding that it's linked to other disease resistances, as well," he says. "It seems to be a key gene in the barley genome."



Lee Hickey checks a barley crop for rust.



Fish sparked the electrical fault invention.

ELECTRIC FISH SPARK SAFER POWER LINES

Melbourne researchers have invented and patented a way of detecting and locating potential electrical faults along large stretches of power line before they occur – sparked by a boyhood interest in electric fishes, such as the black ghost knifefish.

The detection system, already being employed by local electricity companies, could help prevent the major discharges that lead to sparking and blackouts, says Dr. Alexe Bojovschi, a postdoctoral Fellow in electrical and computer engineering at RMIT University.

"Internationally, this is very important. Last year, blackouts left 620 million people in India without power for a couple of days and cost the US economy more than US\$120 billion. Electric sparking has been blamed for major bushfires in Australia."

Dr Bojovschi says he got the idea on how the electromagnetic signatures of potential faults could travel in the power networks from the ability of electric fishes to transmit and receive electromagnetic radiation.

Our power networks, many of which were built at least 50 years ago, are ageing and deteriorating just at the time when they are being overloaded with new appliances, he says.

"All it takes is a salt deposit or a build-up of lichen to provide a conductive path on an insulator, and you enhance the likelihood of electrical discharges."

The patented wireless sensing technology can be mounted to the power poles to detect the discharge signature in the power network. The sensors can be used to locate the fault point by translating the time of arrival of the signature into a measure of distance.

Dr Bojovschi and his project managers, Associate Professors Alan Wong and Wayne Rowe have established a company, IND Technology, to commercialise the system. At present, IND Technology is offering the technology as an early-fault-detection service to electricity companies in Victoria online, 24 hours a day.

"The system provides a dynamic picture of the health of their power networks," Dr Bojovschi says. "But this is a worldwide issue, so the company has the potential to expand globally."

WA radio astronomy centre gets a \$26M boost

The International Centre for Radio Astronomy Research (ICRAR), based in Perth, Western Australia, has been extended for another five years following a \$26 million investment announced by WA Premier Colin Barnett.

The \$26 million from the WA Government will allow ICRAR's local activities in science and with industry to continue, but will also expand WA's high tech and scientific capabilities.

A joint venture between Curtin University and The University of Western Australia, ICRAR was launched in 2009 with initial support for five years from the WA Government and joint venture partners.

ICRAR played an important role in attracting part of the world's biggest telescope, the Square Kilometre Array (SKA), to WA and is now considered one of the top 10 radio astronomy centres in the world. As well as attracting more than 50 world-leading researchers to Perth, ICRAR is now one of Australia's largest training centres for graduate students in astronomical science and technology.

"This extended funding has come at the perfect time for ICRAR to take

world use the telescope each year.

The Compact Array has given us the first 3D picture of the radiation belts around Jupiter, the first good evidence linking exploding stars with flashes of gamma rays and the first image showing how gas churns in interstellar space.

The telescope is so sensitive that it would see a mobile phone on the Moon as a very strong radio source. It can be pointed with an accuracy of better than two arcseconds – about the width of a finger seen one kilometre away. The telescope has become better and better over time, as upgrades have made it more sensitive to faint radio signals and allowed it to capture more of the radio spectrum.

GREEN LIGHT FOR NICTA HUB

A new Transport and Logistics Partnership, with 41 participants from industry, the university sector and peak industry bodies, will be headquartered in Sydney.

Under the scheme, the collaborators will receive funding of up to \$6 million to 2016-17 to help drive productivity and efficiency through technology innovation.

NICTA and the Australasian Railway Association (ARA), as joint bid coordinators, will combine into an industry-led collaboration of 41 large and small companies in the transport and logistics sector, including Linfox, Sydney Ports Corporation and Bombardier Transportation Australia.

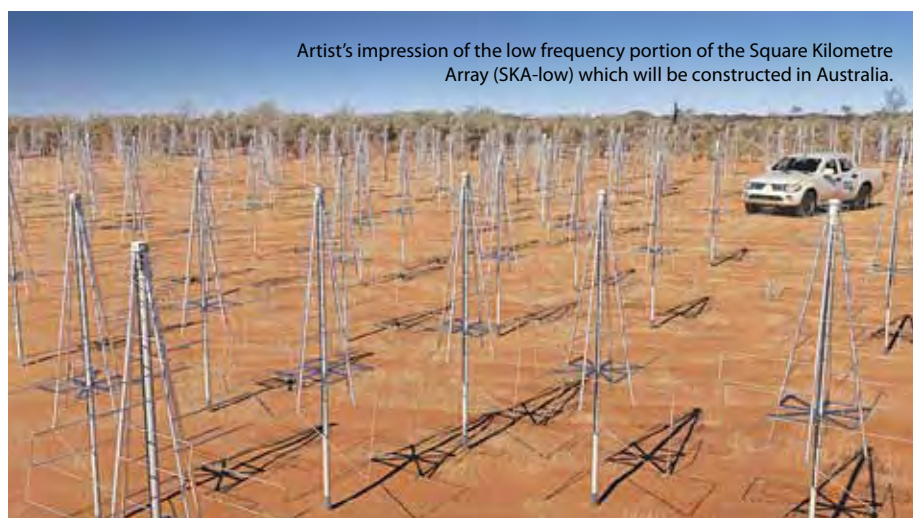
The total includes industry associations (the Australian Logistics Council, the ARA and Infrastructure Partners Australia) and seven research organisations (The Australian National University, Central Queensland University, NICTA, the University of Technology, Sydney, the University of Western Sydney, the University of Wollongong and Victoria University) to build innovation capability across the board.

The Transport and Logistics Innovation Partnership builds on NICTA's existing Transport and Logistics industry cluster — 'the Future Logistics Living Lab' and the Australian Logistics Council (ALC). NICTA has already brought together some 33 companies and research bodies across transport and logistics Australia wide and overseas. The cluster's focus is using technology to have industry-wide impact, drive productivity, cost efficiency, emissions reduction and safety.

Senator Kim Carr, former Federal Minister for Innovation, Industry, Science and Research, announced the partnership at an industry workshop at NICTA's Future Logistics Living Lab at NICTA's headquarters in the Australian Technology Park in Eveleigh, Sydney.



Kim Carr (left) and Neil Temperley, Leader of NICTA's Future Logistics Living Lab.



Artist's impression of the low frequency portion of the Square Kilometre Array (SKA-low) which will be constructed in Australia.

advantage of preparations for the Square Kilometre Array and puts us in an excellent position to ensure local WA industry benefits from worldwide investment in radio astronomy," says ICRAR Director Professor Peter Quinn.

"ICRAR will be a major part of pre-construction work for the Square Kilometre Array, building on the skill and knowledge we gained from the Murchison Widefield Array."

The Murchison Widefield Array is the first SKA precursor telescope to complete construction and commence science operations, and is one of the major radio astronomy projects building WA capacity in radio astronomy, engineering and information and communications technology.

COMPACT ARRAY TURNS 25

One of the world's most successful astronomy observatories, CSIRO's Australia Telescope Compact Array near Narrabri, NSW, has turned 25.

The Compact Array is a set of six dishes that work together as one much larger radio telescope. It lies between the towns of Narrabri and Wee Waa in north-west NSW, about 500 kilometres from Sydney, at CSIRO's Paul Wild Observatory. About 500 scientists from around the

Smallholders key to food challenge

The world's small-scale farmers and livestock keepers, both relatively neglected in global food security discussions and agenda, can be a large part of the solution to feeding the world sustainably to 2050.

This was the message from Dr Jimmy Smith, an animal scientist, food security specialist and Director-General of the International Livestock Research Institute (ILRI), in his address to the 22nd International Grassland Congress in Sydney in September, attended by 1000 delegates from more than 60 countries.



Dr Jimmy Smith

"Producing sufficient quantity and quality of food for nearly 10 billion people represents a huge challenge," he said. "We need lots more food in the next four decades and we need to produce it profitably, efficiently, safely, equitably and without destroying the environment."

It is estimated that by mid-century the world will need – each year – one billion tonnes each of cereals and dairy products and 460 million tonnes of meat, he said.

"It's a shocking indictment of the global food system," Dr Smith said, "that

in the 21st century most of the world's population have sub-optimal diets," with 870 million going to bed hungry, two billion vulnerable to food insecurity and one billion with diets that do not meet all their nutritional requirements – while another billion suffer the effects of over-consumption.

Some 500 million smallholders support more than two billion people, Dr Smith said. In South Asia, for example, more than 80 per cent of farms are less than two hectares. In sub-Saharan Africa, smallholders contribute more than 80 per cent of livestock production.

He also noted how competitive smallholders can be. In India, at least 70 per cent of the milk produced comes from smallholders and India is now the largest dairy producer in the world. In East Africa, Kenya's one million smallholders keep the largest dairy herd in Africa (larger than South Africa); Uganda has the lowest-cost milk producers globally; small-scale Kenyan dairy producers get above-normal profits of 19 to 28 per cent in addition to non-market benefits (insurance, manure, traction) of a further 16 to 21 per cent.

"Livestock are a source of nutrient-dense animal-source foods that can support normal physical and mental development and good health; an income stream that enables the world's billion poorest people to buy staple foods and other household essentials; and a means of underpinning soil health and fertility and increased yields, thereby enabling more sustainable and profitable crop production," Dr Smith said.

"But in doing so, if not managed well, livestock production can harm the environment. The sector is a significant source of greenhouse gases, for example, and can be detrimental to human health with the transmission of diseases from livestock to people.

"The many goods and services that livestock provide can and must be produced in ways that are less damaging to the environment and with reduced risk to public health, whilst also supporting sustainable livelihoods for hundreds of millions of the world's poorest citizens, who currently have few other options."

BNI MAY CUT GHG EMISSIONS

Scientists addressing the 22nd International Grasslands Congress, in Sydney in September, offered new evidence that a potent chemical mechanism operating in the roots of a tropical grass used for livestock feed has enormous potential to reduce greenhouse gas (GHG) emissions.

Referred to as 'biological nitrification inhibition' (BNI), the mechanism markedly reduces the conversion of nitrogen applied to soil as fertiliser into nitrous oxide, the most powerful and aggressive GHG, with a global warming potential 300 times that of carbon dioxide.

"Nitrous oxide makes up about 38 per cent of all GHG emissions in agriculture, which accounts for almost a third of total emissions worldwide," said Dr Michael Peters, who leads research on forages at the Colombia-based International Center for Tropical Agriculture (CIAT). "BNI offers what could be agriculture's best bet for keeping global climate change within manageable limits.

"Livestock production provides livelihoods for a billion people, but it also contributes about half of agriculture's GHG emissions. BNI is a rare triple-win technology that's good for rural livelihoods as well as the global environment and climate. It defies the widespread notion that livestock are in the minus column of any food security and environmental calculation."

Scientists at CIAT and the Japan International Research Center for Agricultural Sciences (JIRCAS) have collaboratively researched BNI for the past 15 years. "This approach offers tremendous possibilities to reduce nitrous oxide emissions and the leaching of polluting nitrates into water supplies, while also raising crop yields through more efficient use of nitrogen fertiliser," said Dr G V Subbarao, a senior scientist at JIRCAS.

"The problem is that today's crop and livestock systems are very 'leaky'. About 70 per cent of the 150 million tons of nitrogen fertiliser applied globally is lost through nitrate leaching and nitrous oxide emissions; the lost fertiliser has an annual estimated value of US\$90 billion."

GOING DEEPER FOR SOIL CARBON STORAGE

Many surface soils in WA are already storing as much carbon as they can, according to University of Western Australia research done in collaboration with the Department of Agriculture and Food WA (DAFWA) and grower groups.

The research found that in south-west WA, the top 10 centimetres of soil was often storing as much carbon as possible under current climate and management. But changes to management practices that increase organic carbon in soil may offset greenhouse gas emissions and improve soil fertility and plant growth.

"Although our research showed that many surface soils are saturated with carbon, this isn't the end of the line for soil carbon storage," Professor Daniel Murphy says. "There is potential for soils between 10 and 30cm below ground to store more carbon under certain conditions. Our findings suggest that these layers could theoretically store twice as much carbon as they are currently. We need to investigate management practices that can increase the amount of carbon stored in soil at this depth."

New research at UWA will assess the potential of existing and emerging management practices to increase carbon storage at these depths. "The aim of the project is to provide farmers with options to overcome constraints to carbon storage in WA agricultural soils," says Associate Professor Deirdre Gleeson, who is leading the team of researchers from UWA, DAFWA, CSIRO in Adelaide and La Trobe University in Melbourne.

Aviation fuel bodies link

National aviation and aerospace industry association, Aviation/Aerospace Australia (A/AA), has joined with the Australian Initiative for Sustainable Fuel (AISAF) to advance the development of domestic and international markets, with AISAF joining the Association.

Dr Susan Pond AM FTSE, Adjunct Professor in Sustainability at the United States Studies Centre, will continue to lead the program, taking the title of Program Chair – AISAF within the A/AA structure.

"A/AA applauds the influential work of Dr Susan Pond as the leader of AISAF and the important roles played by the AISAF Steering Committee, the US Studies Centre at the University of Sydney and the Australian Government in the establishment of this initiative 12 months ago and stewardship of its rapid development," says A/AA Executive Director Paul Fox.

The partnership was integral to developing a sustainable aviation and aerospace industry in Australia.

Dr Pond says the partnership with A/AA provides AISAF with additional capacity to connect with the aviation industry and export markets.

"Sustainable fuels represent a major industrial development opportunity for aviation and for Australia," Dr Pond says.

SENSOR START-UP STAYS IN AUSTRALIA

A University of NSW spinoff company with a promising optical sensor technology has declined a \$10 million offer from Chinese investors to move offshore, opting instead to pursue their start-up dream in Australia.

"It was an attractive offer, but in the end we wanted to keep this adventure going in Australia," says Professor Francois Ladouceur from the UNSW School of Electrical Engineering and Telecommunications.

Professor Ladouceur and his UNSW colleagues Dr Zourab Brodzeli and Dr Leonardo Silvestri are the founders of start-up company Zedelef, which is commercialising a new optical sensor that could have applications for the oil and gas, and electricity industries.

Their piece of hardware converts electrical signals from devices such as microphones and pressure sensors so they can be read optically. This means the signals can be transmitted via optical fibres, which allows the

sensors to be distributed over very long distances as an array and means the signals can be read remotely.

"You can connect chains of the sensors and they could be distributed over hundreds of kilometres, along a pipeline for instance, to monitor things like flow rate, pressure and even corrosion," Professor Ladouceur says.

Furthermore, the sensors are passive, meaning they require no power. "This means they are inherently safe," he says, "which is important for manned environments, particularly with oil and gas monitoring, where electronics pose a considerable risk."

The group says the technology also has applications for the electricity industry to monitor transmission voltage across the network, and for national security.

The lucrative Chinese offer would have required the company to be established outside Australia. And while a Chinese manufacturing base would have meant more rapid production of their technology, the team was concerned it might lose control over the technology and its underlying intellectual property.

X-RAY VISION DETECTS UNSEEN GOLD

Powerful X-rays can now be used to rapidly and accurately detect gold in ore samples, thanks to a new technique developed by CSIRO – one that could save Australia's minerals industry hundreds of millions of dollars a year.



An eight-kilogram gold nugget.

Working with Canadian company Mevex, CSIRO has conducted a pilot study that shows that gamma-activation analysis (GAA) offers a much faster, more accurate way to detect gold than traditional chemical analysis methods.

This will mean mining companies can measure what's coming in and out of their processing plants with greater accuracy, allowing them to monitor process performance and recover small traces of gold – worth millions of dollars – that would otherwise be discarded.

GAA works by scanning mineral samples – typically weighing around half a kilogram – using high-energy X-rays similar to those used to treat patients in hospitals. The X-rays activate any gold in the sample, and the activation is then picked up using a sensitive detector.

According to project leader Dr James Tickner, CSIRO's study showed this method is two to three times more accurate than the standard industry technique, 'fire assay', which requires samples to be heated up to 1200°C.

"The big challenge for this project was to push the sensitivity of GAA to detect gold at much lower levels – well below a threshold of one gram per tonne," he says.

Dr Tickner explains that a gold processing plant may only recover between 65 and 85 per cent of gold present in mined rock. Given a typical plant produces around A\$1 billion of gold each year, this means hundreds of millions of dollars worth of gold is going to waste.

"Our experience suggests that better process monitoring can help reduce this loss by about a third," he says.

Last year, Australia produced more than \$10 billion worth of gold. A five per cent improvement in recovery would be worth half a billion dollars annually to the industry.

Now that the research team has proved the effectiveness of the technique, the next goal is to partner with local and international companies in order to get a full-scale analysis facility up and running in Australia.



Dr Zourab Brodzeli (left) and Professor Francois Ladouceur.



ATSE
INFOCUS

NUMBER 180
OCTOBER 2013

Graeme Young is SA Scientist of the Year

Flinders University's world-leading gastrointestinal expert, Professor Graeme Young FTSE, has been named South Australia's Scientist of the Year for 2013.

The Professor of Global Gastrointestinal Health was awarded the prestigious accolade at the SA Science Excellence Awards – the



Graeme Young

state's premier event to honour outstanding achievers in science and research – at the Adelaide Town Hall.

It is the second consecutive year that an ATSE Fellow and Flinders University academic has taken out the title, with Professor of Biomedical Engineering Karen Reynolds FTSE named SA Scientist of the Year in 2012.

The judging panel commended Professor Young for his instrumental role in developing the National Bowel Cancer Screening Program, as well as for his tireless efforts as the lead investigator on a major international project to prevent infant deaths from diarrhoea in developing countries.

He was also acknowledged for his key role in establishing the Flinders Centre for Innovation in Cancer, a leading cancer centre in Australia housing world-class care and survivorship services alongside innovative cancer prevention and early intervention research.

Accepting the award, Professor Young – a Fellow since 2008 – said he felt privileged to be part of research that has directly influenced healthcare systems on a global scale.

"Science is one of the main ways in which we can improve society and enrich lives, including that of other societies less fortunate and less empowered than us," Professor Young said at the awards ceremony.

"I am truly privileged to have been involved in several scientific endeavours where our initial solutions have progressed, with modification and refinement, through to the point of proving benefit to not just our community but the global community," he said.

In 1997 he was appointed as foundation Professor of Gastroenterology at Flinders University and Regional Head of Gastroenterology and Hepatology at Southern Adelaide Health Service. In 2002, he was additionally appointed as Director of Development at the Flinders Centre for Innovation in Cancer.

In 2005, he became Head of the Flinders Cancer Control Alliance, subsequently the Flinders Centre for Cancer Prevention and Control (FCCPC) and now Flinders Centre for Innovation in Cancer (FCIC). In 2011, he became Professor of Global Gastrointestinal Health at Flinders University while relinquishing his clinical appointments.

In 2009, he was awarded the Distinguished Research Prize of the Gastroenterological Society of Australia and was elected a Fellow of the American Gastroenterological Association (AGAF). In 2007, he was named South Australian of the Year in Health for his screening research and the role he played in the establishment of the National Bowel Cancer Screening Program – and recognised as one of the 50 most influential people in South Australia.

ATSE SIGNS MOU WITH RiAus

The Academy's South Australian Division has signed a two-year Memorandum of Understanding with the Adelaide-based Royal Institution of Australia (RiAus) to cooperate in community programs and facilities hire.

It was signed in August by the SA Division Chair, Mr David Klingberg AO FTSE, and RiAus General Manager Mr Bradley Abraham.

Under the MoU both signatories will seek to leverage each other's resources to create a contemporary science-focused community engagement program. They will seek to develop an annual program but also take advantage of other opportunities with shorter lead times.

It also engages both parties to work jointly to obtain sponsorship through corporate or government sources.

RiAus will offer selective free use of its facilities at The Science Exchange in Adelaide where there is mutual benefit.



SA Division Secretary Meera Verma looks on as David Klingberg (centre) and Bradley Abraham sign the MoU.

Peter Schwerdtfeger was a meteorological pioneer

Emeritus Professor Peter Schwerdtfeger FTSE, who was elected to the Fellowship of ATSE in 1988, died in Adelaide on 20 August 2013, aged 77. His funeral service at the Heysen Chapel, in Adelaide on 10 September was attended by several hundred friends, family and former academic, professional and community organisation colleagues, including Academy Fellows, many of Peter's former students and present and retired staff of the Bureau of Meteorology (BoM).

The many family and institutional



Peter Schwerdtfeger

speakers at the service included the Vice-Chancellor of Flinders University, Professor Michael Barber FAA FTSE, and Peter's long-time ARA (Airborne Research Australia) colleague Dr Jorg Hacker.

Peter was born on 23 December 1935 in Gottingen, Germany, and migrated to Australia with his parents, Hans and Hanna Schwerdtfeger, in August 1939. After gaining his BSc and MSc from the University of Melbourne and a PhD from McGill University in Canada, and periods at the University of Cologne and the University of Alaska, he was appointed to the Meteorology Department in Melbourne where he played a key role in developing observational field work and starting a sophisticated micrometeorological program at the Mt Derrimut Research Station.

In 1971, Peter was appointed as Professor of Meteorology at Flinders University. He took pride in being the first Professor of Meteorology at an Australian university and, at the time of his appointment, one of the

youngest (if not the youngest) professors at any university in Australia. As Director of the Flinders Institute of Atmospheric and Marine Sciences (FIAMS), he built up a strong team of meteorologists and oceanographers and a large group of enthusiastic 'hands-on' graduate students, many of whom went on to key roles in the BoM and elsewhere in national and international meteorology.

Peter was an observational and experimental meteorologist to his bootstraps and he developed many original approaches to radiation and micrometeorological measurement and data interpretation. He was also passionately committed to the environment in its many dimensions and was a keen gardener and amateur architect.

He was inaugurator and long-term President (1983 to 2009) of the Alexander von Humboldt Fellows Association in Australia and built strong links with the Humboldt Foundation in Germany. He was a driving force in developing the use of small aircraft for meteorological and other remote-sensing programs and, according to Jorg Hacker, whom he recruited to what was to become ARA, Peter was in his element "out in the field messing around with instruments". He learned to fly relatively late in his career and he and Jorg, in two aircraft, made a formidable team.

He was also involved in many community and government advisory roles including chairing the South Australian Country Fire Service in the early 1980s and membership of the Antarctic Science Advisory Committee (ASAC) in the 1990s. He served on the BoM Advisory Board 2001–04 and, at the request of the Minister, he represented the Board on the Australian Delegation to the 2003 World Meteorological Congress.

Peter was a real polymath and a powerful example of the breadth of perspective of Humboldtian science. He loved music and, as noted at his funeral service, he had "an uncanny ability to use the English language". He also had a great 'big picture', applications-oriented approach to big social and technological challenges and was, surely, the ultimate authority on towing Antarctic icebergs as a potential

source of fresh water for lower latitudes.

Peter Schwerdtfeger had a wide circle of friends and professional colleagues across the international meteorological community and he and his wife Arija built strong links into their local community.

Peter was a unique Australian 'character', with occasional maverick tendencies and a strong European heritage imbued with the best traditions of German science. He was a 'twinkle-in-the-eye' enthusiast and a greatly liked and admired mentor of young scientists. His passing leaves them with many fine memories but something special will remain missing, for at least a generation, from the Australian meteorological scene.

*Obituary written by Professor John Zillman AO
FAA FTSE*

Fellows in brief

PETER LEE

Southern Cross University Vice-Chancellor, Professor Peter Lee FTSE, is the new Chair of The Regional Universities Network (RUN), taking over from RUN's inaugural Chair, University of Ballarat Vice-Chancellor Professor David Battersby. Professor Lee is former Deputy Vice-Chancellor of the University of South Australia and joined the Academy in 2009. "Regional universities are a force for transformation of both individual lives and the communities in which they are located. It will be a privilege to Chair the Regional Universities Network for the next two years," he said.

CATHERINE LIVINGSTONE

Telstra Chair Ms Catherine Livingstone AO FTSE, a Fellow since 2002, was the subject of a major cover profile in the latest edition of *Australian Financial Review's Boss* magazine. It traced her role as Telstra Chair and her earlier roles, including CEO of Cochlear, Chair of CSIRO and directorships of Rural Press, Goodman Fielder, Macquarie Bank and Worley Parsons.

ALAN ROBSON

Professor Alan Robson AO FTSE, Emeritus Professor, Earth and Environment Faculty of the University of Western Australia, was a keynote speaker at the 22nd International Grasslands Congress in Sydney in September, addressing the plenary session 'Australian grassland research at the crossroads'.

Peter Schwerdtfeger was a driving force in developing the use of small aircraft for meteorological and other remote-sensing programs and ... was in his element "out in the field messing around with instruments".

Iven Mareels honoured by Belgium



The Belgian Ambassador, Mr Patrick Renault (left) and Professor Iven Mareels.

Professor Iven Mareels FTSE, Dean of Engineering at the University of Melbourne, has been named a Commander in the Order of the Crown of Belgium for meritorious services to the Belgian state in the area of furthering engineering and science.

He was presented with the honour in Melbourne recently by the Belgian Ambassador to Australia, Mr Patrick Renault. The Order of the Crown was created by Leopold II, second king of Belgium in 1897, and is awarded by Royal Decree, on the birthday of the King of Belgium.

"I am extremely pleased to have been awarded the Order of the Crown. As well as being a proud Belgian, I am also a proud Australian," Professor Mareels said.

"I have been involved in the promotion of science, mathematics and engineering for most of my working life. I acknowledge we have come far in our understanding of the sciences but I know there is much more to do."

Professor Mareels was born in Aalst, Belgium. He obtained a Masters of Electromechanical Engineering from Ghent University, Belgium, in 1982 and a PhD in Systems Engineering from the Australian National University in 1987.

From 1996, he was a Professor of Electrical and Electronic Engineering in the Department of Electrical and Electronic Engineering at the University of Melbourne. In June 2007 he became Dean of the Melbourne School of Engineering.

Professor Mareels has received several awards in recognition of his research and

teaching. He was a recipient of a 2008 ATSE Clunies Ross Award for his work on smart irrigation systems.

He has been a Fellow since 2000 and is a Fellow of the Institute of Electrical and Electronics Engineers (USA), a member of the Society for Industrial and Applied Mathematics, a Fellow of the Institute of Engineers Australia, and a Foreign Member of the Royal Flemish Academy of Belgium for Science and the Arts.

ALAN PEARSON UNLOCKED PAPER- MAKING SECRETS

Pioneer Tasmanian newsprint developer Mr Alan Pearson OAM FTSE was one of small band of scientists who unlocked the secret of successfully making paper from Tasmanian hardwoods.

A Fellow since 1978, Mr Pearson died at New Norfolk, Tasmania, on 2 July, aged 90. He spent 43 years with Australian Newsprint Mills, retiring in 1987 as Research Manager.



Alan Pearson

Born at Temora, NSW, and educated in Armidale before attending the Armidale campus of the University of Sydney (attaining a BSc in 1943 and an MSc in 1954), he began his long career in the paper industry as a research chemist at Australian Newsprint Mills (ANM) Ltd at Boyer, near New Norfolk, Tasmania, in 1944, where he worked for his entire career.

After graduating he went, under wartime manpower regulations, to work at Boyer as a research chemist on the production of newsprint from eucalypt pulp.

Australian Newsprint Mills (now Norske Skog Boyer) had been turning out paper since 1941, but it did not match international standards. Between 1952 and 1957 the ANM scientists developed the cold soda process, which improved both the strength and brightness of the paper produced.

When started in July 1957, "cold caustic soak" developed at Boyer was the first successful use of this process in the world and it continued to be used until 2009.

Mr Pearson travelled extensively, visiting mills around the globe, attending conventions, participating in study tours and presenting many papers. After retiring in 1987 he continued lecturing and consulting in New Zealand, South Africa and Canada until 1996. He was recognised worldwide for his work, receiving an international Pulp and Paper Manufacturer's Award from the Technical Association of the Pulp and Paper Industry (TAPPI) in the US in 1975 and the Australian Pulp and Paper Industries Technical Association (APPITA) L.R. Benjamin Award in 1976.

In 1989, Mr Pearson received the Advance Australia Award for his contribution to science, the Centenary Medal in 2001 and the Medal of the Order of Australia in 2003 for his services to science and to the community. He was actively involved in serving the community until as recently as 2011. He was a founding member of the Small Bore Rifle Club, Tennis Club and Aquatic Club and was president of the ANM Sports and Social Club for 32 years.

He served as deputy warden on the New Norfolk Council for two terms in the early 1980s, was chairman of the Royal Derwent Hospital Board from 1983–99 and convener of the Southern Midlands Health Forum.

Information sourced from New Norfolk News, RACI Tasmania and Engineering Heritage Australia.



Graeme Clark

Cochlear legend gets US honour

Australia's bionic ear pioneer has been recognised for his contributions to clinical medical research with a major US award.

Laureate Professor Emeritus Graeme Clark AC FRS FAA FTSE is a recipient of the 2013 Lasker-DeBakey Clinical Medical Research Award by The Albert and Mary Lasker Foundation in New York. The Lasker-DeBakey Award honours investigators whose contributions have improved the clinical treatment of patients.

Professor Clark was awarded the prize for the development of the modern cochlear implant – a device that bestows hearing to individuals with profound deafness.

Professor Clark shared the prize with other bionic ear pioneers, Ingeborg Hochmair of Austria and Blake Wilson of the USA.

Professor Clark and his team developed the world's first multi-channel cochlear implant at the University of Melbourne during the 1970s, with the first human implant procedure taking place in August 1978.

"It is an honour to be named with two others, one from the USA and the other from Austria, for a defining involvement in the development of the modern Cochlear Implant. It has been estimated that these have been implanted in approximately 360,000 severely to profoundly deaf people. This makes it the first device to restore a human sense. I wish that staff and patients could all share in this award. It has been a

truly collaborative effort," Professor Clark said.

Professor Clark accepted the award at a ceremony in New York in September.

Other Australians who have been recognised by The Lasker Awards include Sir McFarlane Burnett (1952), Professor Don Metcalf (1993), Professor Barry Marshall (1995) and Professor Elizabeth Blackburn (2006).

The Lasker Awards are among the most respected science prizes in the world. Since 1945, the Awards Program has recognised the contributions of scientists, physicians and public servants who have made major advances in the understanding, diagnosis, treatment, cure and prevention of human disease.

The Lasker Awards have become popularly known as 'America's Nobels' as 83 Lasker laureates have received the Nobel Prize, including 31 in the past two decades.

CALUM DRUMMOND MOVES TO RMIT

ATSE Director Dr Calum Drummond FTSE, after 26 years with CSIRO, will become Deputy Vice-Chancellor (Research) at RMIT University in January. He is currently the Group Executive for Manufacturing, Materials and Minerals for CSIRO and the senior executive responsible for Victoria.

The Group

of some 1300 researchers and research support staff for which he has responsibility is based in physical sciences (chemistry and physics), biological science (molecular and cell biology) and engineering (chemical, civil, mechanical, electronic and electrical), with an emphasis on delivering outcomes for the Australian manufacturing and minerals sectors.

Immediately prior to this Group Executive appointment, Dr Drummond was Chief of CSIRO Materials Science and Engineering (CMSE), one of CSIRO's largest Divisions. Prior to this appointment, Dr Drummond was seconded from CSIRO to be the inaugural Vice-President of Research at CAP-XX, an Intel portfolio company. CAP-XX develops supercapacitors for consumer electronic products and the automotive industry.

Dr Drummond has a PhD in Physical Chemistry and a BSc and BScEd, both with first class honours, from The University of Melbourne. He has held an ARC Federation Fellowship and an ARC Queen Elizabeth II (QEII) Fellowship, as well as being awarded numerous medals for his research and research leadership.

Dr Drummond's personal research interests are in the area of advanced materials, including their application to energy storage and biomedical products. He is author of more than 200 publications including four invited book chapters, more than 150 refereed journal papers, nine patents and 54 CSIRO reports for companies. His refereed journal papers have received more than 5500 citations and the Thomson Reuters ISI Essential Science Indicators has listed Dr Drummond in the top one per cent of chemists globally.

Dr Drummond has recently served as a member of the Australian Government's Future Manufacturing Industry Innovation Council, the Textile, Clothing and Footwear Industry Innovation Council, and the Steel Industry Innovation Council.

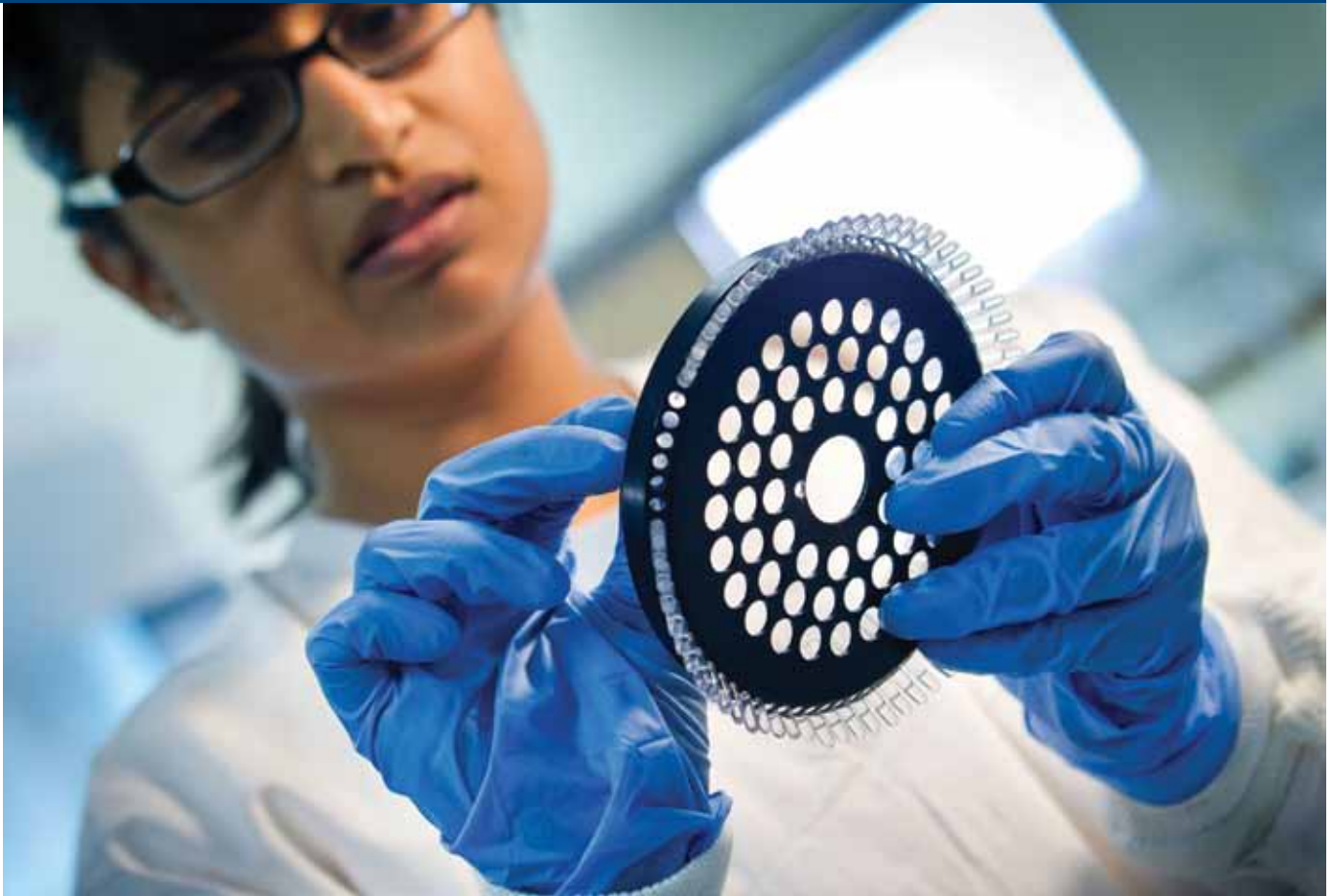
He was also recently Chair of the Australian Government's Expert Working Group for national research infrastructure in frontier technologies and is a current member of the Resources Sector Supplier Advocate Forum.

Calum Drummond



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dream large



THE KEY TO A NEW, CLEAN WORLD OF ENERGY: BETTER POWER STORAGE



The biggest global trend in energy and technology in the past decade has been towards expanding renewable power generation. Solar, wind and wave power are now producing enormous amounts of energy – making inroads into the world's reliance on fossil fuels. But the inefficiency of existing power storage technologies is a serious bottleneck, slowing the global advance towards a renewable, sustainable future.

A collaboration between one of China's (and the world's) largest steel companies and four leading Australian universities is working towards an answer. The Baosteel Australia Joint Research and Development Centre (BAJC) is developing a new battery that can run electric vehicles. Using innovative technology, researchers at the Centre aim to produce a composite of sulphur (an electrical insulator) and carbon (a conductor) with excellent stability and energy content to improve high-energy batteries. Other potential applications of the technology include storage of power generated from renewable sources, and emergency power for disaster-hit areas.

BAJC is a collaboration between Baosteel, The University of Queensland, The University of New South Wales, University of Wollongong and Monash University. The Centre brings

the knowledge and skills of leading university researchers together with Baosteel staff to develop new energy, advanced metallurgical materials and sustainable environmental technologies.

The partnership is bringing research achievements and outcomes forward to benefit the community, locally and internationally. The relationship between the university researchers and Baosteel staff allows successful research outcomes to be translated and brought to market through Baosteel's business.

The Federal Government's 2012 Excellence in Research for Australia exercise confirmed The University of Queensland as one of the nation's top two universities, measured by the quality of its comprehensive range of specialised research fields. ERA reported that research at UQ is well above world standard in more specialised fields than at any other Australian university: this reflects UQ's leading global role in many areas of discovery. UQ's outstanding critical mass offers researchers significant interdisciplinary capability.

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