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FOCUS

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INNOVATION

TAKING AUSTRALIA'S TECHNOLOGY TO THE MARKETPLACE

Contributors discuss the gulf between R&D and innovation – Australia's skill at the former and difficulties with the latter – and the need to bridge the gulf

Innovation / Research is it worth it?

1 August 2012 / 1 / Peter Young



So, the Higgs Boson has been found. Cue debate on the value of research. Media coverage has tended to take one of two lines: a university professor trying to explain what the Higgs Boson is, or a commentator running a cost per gram calculation based on the build and running cost of the Large Hadron Collider.

The value question is often wrongly put though. Rather than ‘Was it worth it?’, we should be asking ‘How is it realised?’. Finding the Higgs Boson, the discovery of graphene and mapping the human genome are all the products of very effective academic research systems. The practitioners are normally university employees and the funding is from the Research Councils (i.e. government), with occasional industrial support. The deliverable of such projects is a peer reviewed technical paper. The value of this work to society (or the tax payer, if you prefer) is in the products that the commercial sector brings to market five, ten or 20 years later.

Some might argue that research is pure science, untainted by commerce and so somewhat speculative in terms of societal benefits. Product development, on the other hand, is a carefully costed investment activity (bankers again), taking due account of future sales – and indirectly – consumer benefit. Again, this stage of the process runs pretty well. But how do you get from brilliant academic output to functioning products? Only by taking care of the middle ground, between the boffin and the buyer, and here the process is a lot less developed.

University spin-offs, government sponsored innovation agencies or deep pocketed, research minded, large corporates are three ways in which the gap is currently bridged. ‘In the UK, R&D’ tax credits are another, intended to encourage industry to pick up where academia loses interest or lacks capability. The UK Government’s budget for the TSB is a fraction of that for the Research Councils. Corporates aren’t flush with cash or big on risk at the moment, and university spin-offs will only work well for small scale ideas – provided some commercial expertise can be made available.

Making real the value of research requires that it be nurtured, supported, loved – every step of the way. Finding Higgs Bosons is the easy bit, selling them may prove to be harder.

Contributor /
Peter Young



I have worked with Arup for 16 years and currently lead Arup’s Advanced Technology and Research practice in the UK.

The projects I’ve been involved in at Arup have ranged from vibration mitigation studies on London’s Millennium Bridge to electric vehicle research programmes.

I’m a firm believer that as engineers, what we do, why we do it and the impact it has on users, industry and society is as important as how we do it.

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PHOTO: Australian Institute for Bioengineering & Nanotechnology

FOCUS

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Design thinking can drive our innovation

To achieve our potential as a nation we – including government – have to be smart, creative and nimble in securing competitive advantage.



By Catherine Livingstone

catherine.livingstone@team.telstra.com

This article was developed from the keynote address delivered by Catherine Livingstone to the ATSE Clunies Ross Awards dinner in Sydney in June.

Australia needs to get very practical and very real about the way it shapes its future to be competitive – and the nation needs to look at design thinking as a core of its innovation drive.

In the context of innovation, Australians are very capable amateurs but are increasingly facing sophisticated competitors. We need to get very specific – particularly about the key role of design in innovation and the role of design thinking.

Design thinking goes beyond form and structure and, at its most successful, leads to better social and economic outcomes. Design thinking is multi-disciplinary and has been described as happening at the intersection between art, craft, science and business savvy. Really good design has emotional appeal and meaning.

Design thinking is an intensely human process, which is why it is so culturally dependent – it progresses to technical and financial viability only after considering the human aspect.

Just think of Apple – there were other MP3 players on the market but the iPod added emotional appeal and understanding of the user's needs to functionality and immediately had a winning combination. It was not simply about the way it looked – it was very much about the way it could be used.

So why does Australia need to change its approach?

Looking at the longer-term future, we are confronted by the question: 'How does Australia retain a seat at the global table, and specifically at the Asian

table, where economic strength will be a threshold condition of participation?'

Our competitive advantage can't derive from scale or cost – and we are committed to global markets and more importantly open markets. We have to acknowledge the reality that the ability of government to assure competitive advantage through Australia-specific industry policy settings is limited.

We also have to admit, as Laura Tingle argues in a recent *Quarterly Essay* entitled 'Great Expectations: Government, Entitlement and an Angry Nation', that our expectations of government are unhelpful and constraining.

To quote Tingle: "As a nation.... we have not sat down and worked out what exactly we expect 'the government' ... to be and do. We haven't settled the idea of what we think we are 'entitled' to get from government. ... Our expectations and our sense of entitlement are confused." She's right.

Australia and Australians should have great expectations about the future. However, the time has come for us to face the fact that our great expectations should not be about entitlements received, but rather potential achieved. To achieve our potential as a nation we (including government) have to be smart, creative and

nimble in securing competitive advantage.

Traditionally, this leads to an exhortation to be innovative – but innovation is one of the most overused and least understood words in the national lexicon. Calls for innovation are like exhortations to be healthy. There is violent agreement, much virtuous intent, but no clear path to action.

So we need to deconstruct 'innovation' – recognising that, at its heart, innovation is about finding creative solutions to problems.

Patterns of innovation are acknowledged to be culturally dependant, and thus it's helpful to explore innovation in the context of the Australian culture.

There is strong anecdotal evidence that Australia has a cultural predisposition to solving problems – it seems to be something about just the way we think. Perhaps it derives from a persistent lack of resources; perhaps from ingenuity necessitated by geographical isolation; perhaps diversity of thinking deriving from patterns of inward migration; perhaps from the attitude of defiance that says 'Don't tell me it can't be done'.

Regardless, we need to progress this skill from the amateur to the professional level, and in a systematic way.

So, what is the link between innovation and design?

Calls for innovation are like exhortation to be healthy. There is violent agreement, much virtuous intent, but no clear path to action.

DESIGN THINKING

■ *Design thinking is a discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity.*

– Tim Brown, CEO of IDEO, the US-based international design and innovation consultancy

■ *Good design results in objects, places systems or services that work aesthetically, functionally and commercially.*

– The Australian Design Centre



Catherine Livingstone addresses the ATSE Clunies Ross dinner.

Innovation is fundamentally about solving problems. Design thinking is the process glue underpinning innovation. Through its discipline of upfront probing, it ensures that the problem to be solved has been correctly identified from the user perspective and then applies systems thinking to find a solution.

Failure is an option

Tim Brown identified the characteristics of good designers as empathy, integrative thinking, optimism, experimentalism and collaboration. Design thinking also assumes that failure is an option: designers can't operate where they have to succeed at all costs.

Steve Pozel, from the Australian Design Centre, says that designers have to move through fear to optimism. Nick Leeder, CEO of Google Australia, recently quoted in relation to our potential as a Silicon Beach, identified the main impediment as being our lack of tolerance of failing as a path to succeeding.

Applying the rigour of design thinking could be just the catalyst Australian business needs to help us move through our fear of failure and yet build on our ability to find pragmatic and valuable solutions.

Do other countries think this is important and believe that you can stimulate people to encourage design thinking? Absolutely!

Denmark, Finland, the UK, Ireland Singapore, South Korea, New Zealand and the US have programs directed at promoting design thinking, the majority being government policy initiatives – and many make explicit reference to the importance of design thinking to innovation.

International moves

In 2003, the New Zealand Government established Better by Design, focused on developing business capabilities by transforming thinking skills.

In 2008 the US National Design Policy Initiative was published, noting that design had a role to play in making American democratic values tangible to the people. Also in 2008, Embedded Design was written into the Finnish National Innovation Strategy and the EU published the European Design Innovation Initiative – and established the secretariat in Helsinki. In 2010 France set up a program directed at SMEs and called it Innovation-Creative Design-Marketing.

But South Korea was way ahead. Their government set up the Korean Institute of Design Promotion in 1970. Is it any surprise that Samsung, established the year before, in 1969, is now a world leader in the field of consumer electronics?

One of the most recent design policy statements comes from the 2011

report of the Design 2020 Committee of Denmark, a committee that was established to identify how design could be strengthened to contribute to growth, productivity and innovation in Denmark.

In its review of design policies globally, the Committee noted the following evolution of design policy:

- 1** First-generation policies focused on creating awareness of the importance of design outside of the traditional design sector.
- 2** Second-generation policies emphasised the dissemination of knowledge on how to use design and create better functioning markets for design services.
- 3** The emerging third-generation policies emphasise the use of design as an important tool for cultivating innovation and meeting societal challenges.

Design thinking could be just the catalyst Australian business needs to help us move through our fear of failure.

Australian initiatives

In Australia the recognition of the significance of design thinking as a platform capability is gaining momentum, but it is still only at the margin. Following the Danish evolution theory we are still somewhere between the first and second generation, with no overarching recognition or articulation at a government policy level.

There are some initiatives:

- the Creative Industries Task Force in NSW;
- the Australian Design Alliance, a not-for-profit organisation that was established in 2010 with 12 members covering approximately 80,000 practitioners aspiring to develop a culture of design in Australia;
- the University of Technology, Sydney (UTS) has redesigned its undergraduate Bachelor of Business and is evolving its Postgraduate MBA and Executive MBA programs to incorporate integrative thinking directed at tackling the complex problems faced in today's business environment;
- the University of Wollongong (UoW) has established the Smart Infrastructure Centre where design thinking is being applied to the configuration of Infrastructure Systems – such as in large cities;
- the Warren Centre for Advanced

To most people design means veneer but to me nothing could be further from the meaning of design. Design is the fundamental soul of a man-made creation that ends up expressing itself in successive outer layers.

– Steve Jobs

Engineering made the recent appointment of Professor Andy Dong to the Warren Centre Chair of Engineering Innovation.

Professor Dong is a design researcher, who regards design as one of the most complex problems for the arts, science and engineering communities; and

■ CSIRO, in its Future Manufacturing Research Flagship, is exploring the potential of design and design thinking in advanced manufacturing.

Next Steps

Education is a good place to start to apply innovation through design. Design thinking needs to be introduced into the primary curriculum from the earliest age and in secondary education we need to maintain breadth.

We also need breadth in tertiary education. The panellists on a recent episode of ABC TV's *Q&A* noted that it was concerning that Arts degrees were now so undervalued, given Arts degrees made people more human and empathetic and generally better-rounded.

We need to avoid the trap of knowing more and more about less and less. The risk of too much specialisation is too few ideas.

Professor Roy Green from UTS is a

Design thinking could be just the catalyst Australian business needs to help us move through our fear of failure.

very strong proponent of the role of design thinking in securing manufacturing industry competitiveness but it is applicable to every industry sector.

Policy formulation is also fertile ground for the application of design thinking because, by definition, it would require the inclusion of government, industry and the community, leading to better outcomes and fewer unintended consequences.

Australia must find its own path to innovation via design thinking. And, in the spirit of design-thinking principles, we need to ensure that we have correctly identified the problem to be solved.

It is not that Australia is no good at commercialisation – but it may be that we are not being rigorous enough in the application of design thinking.

We should build on our cultural endowment and do this with intent and commitment to develop deep and sophisticated skills in our ability to apply design-thinking principles. It is as much a discipline as the application of the scientific method

Government policy can facilitate

in many ways, but ultimately it is down to our individual capability. The collective outcome will undoubtedly be enough competitive advantage to secure Australia's seat at the global table.

Returning to the Danish Government report, which stated that the ultimate promise of design is to do more with less – isn't this what Australia has always been able to do? It's just the way we think.

MS CATHERINE LIVINGSTONE AO FTSE is Chair of Telstra Corporation Ltd, a director of Macquarie Group Limited and WorleyParsons Limited and has also served on the Boards of Goodman Fielder Ltd and Rural Press Ltd. She is also a member of the NSW Innovation Council and President of the Australian Museum Trust. A chartered accountant, she worked with Price Waterhouse in Sydney and London before joining the Nucleus Group and spent 20 years working in the field of implantable medical devices, including six years as CEO of Cochlear Ltd from 1994-2000. She was Chair of CSIRO (2001-06), President of Chief Executive Women (2007-08), and the Chair of The Australian Business Foundation, an independent research think tank focused on innovation-led growth (2002-05).

R&D needs to be better connected

Australian needs better-connected R&D rather than just more R&D, according to Professor Robin Batterham AO FREng FAA FTSE, President of the Academy.

Better collaboration between our researchers and people who are in the marketplace innovating would provide an avenue to improved innovation, which Australia needed badly, he said recently.

Australia was not good at linking research to commercial outcomes, standing near the bottom of OECD tables, and Australia needed to

think less about commercialising research and more about researchers supporting innovation activities.

Professor Batterham's comments previewed the June announcement of the 2012 ATSE Clunies Ross Awards, which honoured leading innovators who had taken their research to the marketplace.

"The ATSE Clunies Ross Awards are a great celebration of success in innovation – real innovation, not just creativity or bright ideas or wonderful science," Professor Batterham said.

"Real innovation is about making a change in the real world – in the marketplace or in health systems or education, or in how we treat the environment.

"The 2012 Clunies Ross Awardees all show one thing in common – they have taken on the world, the world of the technological products that shape and dominate our lives, and they have won against all takers.

"Their achievement is greater than gold in that the legacy of their endeavours carries on bringing benefits to so many. These are the ultimate achievers."

Professor Robin Batterham (right) and Professor John Boldeman, Chair of the 2012 ATSE Clunies Ross Awards Committee.





Infections and surface coatings – applying research to improve human healthcare.

Innovative, cross-disciplinary research into novel materials and surface coatings at the University of South Australia is focusing on developing strategies to eliminate the human health care issues associated with bacterial biofilms growing on the surfaces of biomedical devices.

Professor Hans Griesser, Deputy Director of the Ian Wark Research Institute and Associate Professor Krasimir Vasilev, Future Fellow at the Mawson Institute are leading teams of researchers exploring several approaches towards novel materials and surface coatings to stop the attachment of bacteria and the ensuing formation of biofilms on medical devices such as knee and hip implants, catheters, and contact lenses.

Bioactive coatings and the study of their interactions with biological systems is a key research focus for Professor Griesser's team as they also investigate how Australian desert plants can be used in antibacterial coatings for human health care devices.

Associate Professor Vasilev's team is exploring strategies for the generation of antibacterial surfaces, with the development of nanoengineered surfaces that use nano-silver to kill bacteria.

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*"Research into combating the growth of bacteria such as *Staphylococcus epidermidis* on medical devices can ease patient suffering and save billions of dollars of hospital and general medical costs worldwide."*



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More facilitation, fewer hurdles and a positive attitude

What is necessary is a belief that we can succeed and that part of trying is the recognition and acceptance that we will fail from time to time.



By Alan Finkel
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"Research converts money into knowledge; innovation converts knowledge into money," says Ramesh

Mashelkar, the former Director General of India's Council of Scientific & Industrial Research (CSIR). This is the kind of virtuous circle that we aspire to in Australia, but it often ends up as a virtuous arc, with a gap at the innovation step.

Innovation and research are tightly coupled. If we concentrate just on one or the other we won't enjoy the best possible outcomes for the country.

When you consider the metrics for how Australia has fared in this two-step process of research and innovation, the result is a mixed scorecard. Using the per capita rate of publishing scientific papers as a metric, in scientific research Australians are doing superbly well, publishing at about twice the rate of the OECD average.

If you look for a metric of technology innovation it's not easy to find. One of the best is the number of triadic patents issued. Triadic patents are those that are granted for the same invention in the US, Europe and Japan and they happen to be very expensive to prosecute.

This expense is why they're regarded as a measure of significant innovation: while companies will collect thousands of inexpensive, local-country patents to build up the numbers in their patent portfolio, they'll think much more carefully before they proceed down the triadic patent path, restricting themselves to the inventions that they regard as particularly innovative

and important to their success.

If you compare the normalised number of triadic patents, Australia holds about one-third of the OECD average.

We're twice the average on research, one-third the average on triadic patents. That's a factor of six worse on innovation compared to discovery and it is something we have to address.

There are two key factors that drive the innovation process: challenges and facilitation. If you set a challenge for a group of developers – they might be engineers or business process people – they will respond to that challenge.

The challenges have to be globally significant. The best project opportunities can be found at the interface between the disciplines, where – instead of doing something new in civil engineering or in mathematics – you do something fantastic to create, for example, zero-emission transport. Bring in the required disciplines and you're addressing a globally significant challenge. Setting the challenge is the most important step to driving innovation.

Of course, it's not enough. Companies, governments and the heads of research institutes then have to facilitate the process.

The obvious facilitator of the response to the challenge, the development process, is money. Unfortunately, when it comes to small companies and start-up enterprises, too often the available funding comes with excessive constraints. For example, it may be that a challenge is identified that will lead to commercial outcomes, and commercialisation funding is applied for, but

it takes too long – six months, 12 months, 18 months – before the grants come through or the investment decisions are made.

We also have to be less onerous in the restrictions that surround the monetary grant or investment. To facilitate product development at small and start-up enterprises, granting bodies should remove some of the requirements for matching funds and other requirements that make it difficult for early-stage innovators to get access to funding.

Money is a form of active facilitation. Other forms of active facilitation are provision of infrastructure, administrative support, buildings and technological equipment.

Legal hurdles

But there's a different kind of facilitation that's also required, which I will call passive facilitation. Passive facilitation is equivalent to the removal of hurdles. Removing a hurdle can do as much to advance a project as building a new roadway.

One example is the legal hurdle. I've seen too many projects get off to a slow start and suffer inhibited progress because of the legal hurdles that are put in place from both sides.

The failure of lawyers to understand the need to take into account commercial realities is a challenge for universities. Before students can graduate from law it should be compulsory for them to complete some units in entrepreneurialism and business practices. With adequate training in the non-legal aspects of commercialisation, lawyers will understand that in order for them to

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contribute constructively to the innovation process they have to accept that commercial considerations will always mean that risk for their clients cannot be entirely eliminated.

Another hurdle that confronts innovation is the taxation system. For example, one of the tools used very effectively in the US is the employee stock option plan that provides employees with some upside in the success of the company. In 2009, the legislation in Australia was changed such that employee stock options issued here are taxed at the time the stock options are issued.

Of course, at that time the employee has not derived any value from the options. All that he or she has been given is the possibility of sharing future value. But under the current Australian legislation, employees who receive stock options are taxed on money they've never earned. Effectively, employee stock options in this country are dead – a strong motivational weapon has been eliminated from the armory.

In contrast, in the US the tax on employee stock options only applies when the options are exercised and sold. Thus the employee can share in the company's

upside without being penalised.

Another issue is attitude. I recently returned from a vacation in Spain. I went there expecting to see doom and gloom as a result of the prominent problems besetting the Spanish economy. To my surprise, the streets were full of vibrancy – the shops and restaurants were busy and the infrastructure was in excellent condition, despite the concern growing among investors that the country was edging ever closer to a full-scale bailout.

I'm not saying we should be like Spain, but there's something to learn here. Australians often lack the kind of positive attitude that in countries like the US underpins financial investment in innovation and personal commitment to join new ventures.

Positive attitude

When it comes to innovation, positive attitude is critical. What's necessary is a belief that we can succeed and that part of trying is the recognition and acceptance that we will fail from time to time.

Fortunately, there are some superb

examples of globally significant innovation developed in Australia. The more we celebrate these examples of success the more we will be able to improve the attitude that will underpin future success.

A good example to celebrate can be found in the mining sector. In its commitment to innovation leadership, Rio Tinto has defined the mine of the future. If you like movies and you're interested in science, you've probably seen *Avatar*, or you might have seen a movie called *Moon*. In both of these movies the key industrial activity that's taking place is mining, on a fictional planet or on our satellite, respectively. The mining is done by large, autonomous machines that seem to have a mind of their own. Sadly, in both of these movies the mining machines progressively destroy the environment.

Back on Earth, Rio Tinto has also gone for high tech in its mining approach, in its case with outcomes that are actually good for the environment, while also being good for Rio's bottom line and for safety.

Rio Tinto has developed machinery that can be run with no human operators

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CONTENT MATTERS

Pilbara ore trains can be operated remotely from Perth.

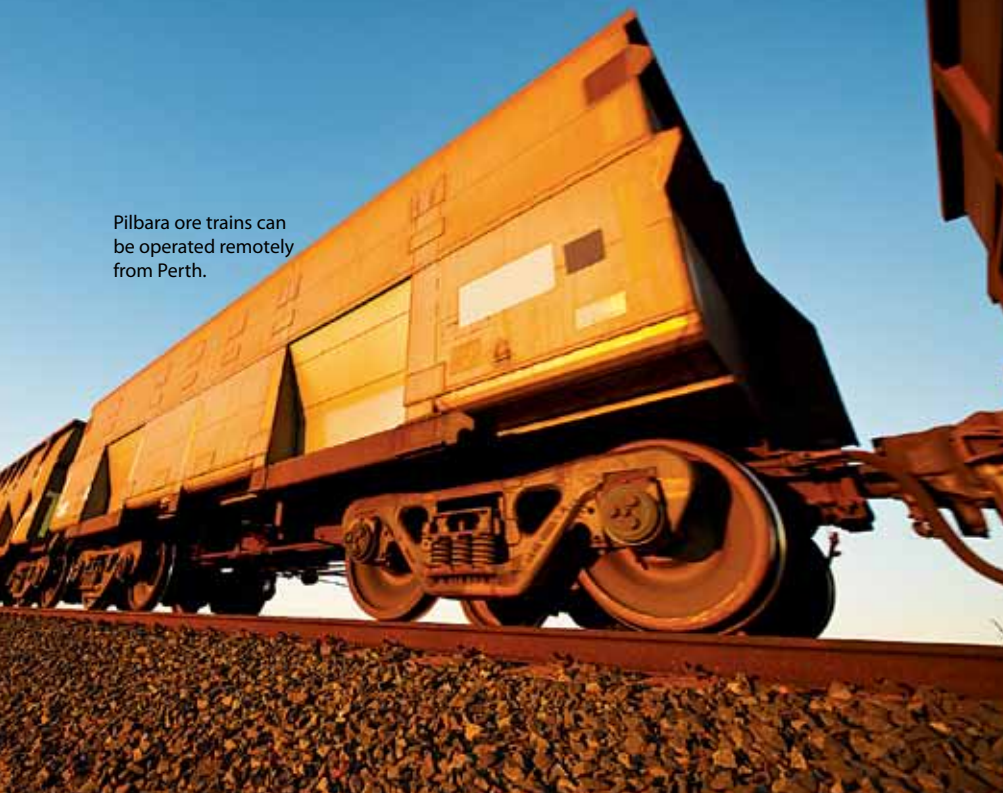


PHOTO: ISTOCKPHOTO

on site – tunnelling machines, the trucks that drive between sites, the trains that haul rocks and ore long distances or the production drills.

Some of these machines working Rio Tinto's Pilbara mines are totally autonomous and some are run by operators 1500 kilometres away in Perth,

working in rooms similar to air traffic control rooms, controlling machines that are working the mines in the Pilbara. The same kind of thing is happening in Mongolia and Arizona, other places where Rio Tinto has been rolling out the same very forward-looking technology.

That's the kind of innovation success

that leads to higher levels of productivity, and addresses a globally significant challenge. It's the kind of innovation we should celebrate and seek to duplicate throughout the nation.

This article is adapted from Dr Finkel's comments to the National Press Club in May 2012.

DR ALAN FINKEL AM FTSE is an engineer, entrepreneur and philanthropist and has served as Chancellor of Monash University since January 2008. He is President-elect of ATSE, former Chief Technology Officer of Better Place Australia and Chairman of the Australian Centre of Excellence for All-Sky Astrophysics. For 20 years Dr Finkel ran Axon Instruments, an American company that made electronic instruments used by pharmaceutical companies, and later established two magazines. *Cosmos* promotes science awareness and *G* magazine promotes environmental sustainability. He established the Australian Course in Advanced Neuroscience to provide advanced training to young scientists and the STELR secondary school science program, administered by ATSE, which is currently running in nearly 300 schools around Australia.

Engineers' report calls for innovation shake-up

Engineers Australia has called for a major revision of Australia's attitudes to innovation, saying the climate and culture in which R&D is performed – and the calibre of the people who lead and foster the environment for innovation – are more important than increased R&D funding.

It notes the expertise of the engineering profession is vital to convert innovative ideas into reality for common use and that many of the comforts humankind enjoys today have been the result of innovative engineers.

Innovation and technology have become inseparable, with engineers driving technology at the forefront of innovation, EA says, calling on all engineers to have highly developed innovative skills so they can make a better contribution to the profession and to society.

EA makes these points in its recent *Innovation in Engineering Report* prepared by an EA Innovation Taskforce, in which it identifies key barriers to innovation:

- lack of leadership and commitment from management to innovate;
- lack of resources – both time and financial;
- lack of clearly articulated market needs or challenges (to be overcome by innovative technologies);
- intellectual property (IP) held by an organisation unable to deliver on the innovation (e.g. research institutions in government procurement of infrastructure, where the IP may be retained by the relevant government, rather than the service providers who may be better placed to commercialise innovations);
- lack of innovative culture in organisations;
- unavailability of technology resources and inadequate strategic alliances, including industry/university collaborations;

- uninformed clients and customers;
- emphasis on lowest cost rather than value and outcomes;
- extreme risk averseness, especially in procurement;
- need to comply with current standards;
- complicated government policy and programs to support innovation;
- inadequate levels of skilled staff; and
- lack of financial support and venture capital, with financial institutions lending mainly against 'bricks and mortar'.

The report makes 14 recommendations, highlighting legal and regulatory frameworks, government incentives, collaboration, informed procurement and innovation promotion.

The informed procurement recommendations are:

- 1** Procurement processes need to be more collaborative, with the opportunity for customers and suppliers to work together to develop innovative solutions with the preferred outcome. As a major purchaser of goods and services, governments should play a major role in fostering innovation in procurement.
- 2** In large engineering infrastructure projects, governments should allocate a percentage of a project's value to embed an innovation framework in the delivery process and for the development of specific innovations which become a part of the legacy of the project for adoption by the rest of the industry and the world.
- 3** Outcome-based procurement should be encouraged for engineering projects (against prescriptive procurement) where suppliers would be able to contribute their ingenuity to enhance project outcomes.

Inquiries: library@engineersaustralia.org.au

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The Awards are an initiative of the Australian Academy of Technological Sciences and Engineering (ATSE). They are the only Australian headline awards for science and technology which highlight the hard work, extraordinary risks and long-term commitment needed to achieve, through commercialisation, the practical marketplace impact of applied science and technology.



The 2013 ATSE Clunies Ross Awards are now open Nominations close 24 August 2012

For more information about the nomination process or to download a nomination form, visit www.atse.org.au

We should prosper from our own ideas

Without large Australian corporates to take on the commercialisation of Australian innovation, we will remain the innovation mine for the world, which doesn't create jobs and a sustainable future.



By Peter Beattie
peter.beattie@uq.edu.au

Australia still faces challenges in turning research outcomes into job creation. Why haven't we been more successful in creating a more prosperous knowledge economy on the strength of our research? Despite the enormous economic contribution mining makes to our economy, the mining industry contributes less than two per cent of all jobs, so we need to focus on other exports.

Over the past five years the total amount of manufactured goods being exported has changed very little but the mix of these goods has changed and continues to do so dramatically. These changes are evident in the export figures.

Highly technical and sophisticated manufactured products like those produced in the scientific and specialised machinery sectors have grown strongly. These are both areas where human capital and specialised skills are important and where intellectual property protection plays a key role, leaving these industries less susceptible to 'off-shoring' to low-cost, low-salary countries.

As an example, pharmaceutical manufacturing has become our second-largest export industry, employing more than 40,000 people. In contrast, our traditional manufacturing exports of motor vehicles and construction materials are well down, having been progressively eroded to low-cost countries.

If Australia tries to compete on costs it doesn't take a Rhodes Scholar to work out our wages and salaries will continue to fall as those in developing economies rise, until equilibrium is reached. Unfortunately equilibrium will be nothing like the wealth and prosperity Australians enjoy today.

This means in the interests of new jobs, Australia needs to identify future industries that rely on intellectual property protection and constant innovation, which support

high-cost goods, salaries and income.

Cochlear is a good example of Australian research and innovation. The company listed in 1995 at \$2.50 a share and is now at \$58. It employs more than 2000. It has market capitalisation of \$3.3 billion and had 10 per cent revenue growth in 2011.

Scientific output

As a nation we punch above our weight in terms of scientific output but we need to work out why Australia isn't more successful in creating a large prosperous knowledge economy. Australia is No 2 in the world in scientific publications per capita. Therefore our narrow knowledge economy certainly has nothing to do with our scientific base, which on any measure is world class.

The 2011 Global Innovation Index, produced by the prestigious French business school INSEAD, ranks Australia 12th in terms of innovation input. This is a measure of the political, regulatory and

business environment as well as the number of skilled people and the infrastructure. We rank 31st in terms of innovation output, which is essentially the scientific and creative production of the country – the new inventions, ideas and products. So for its size Australia does reasonably well.

However, when it comes to innovation efficiency, which is the ratio of output over input, we plummet to 96 out of 125 countries assessed.

This means Australians are great at coming up with ideas but terrible at translating them into products. This doesn't mean these great ideas aren't being turned into products, jobs and income – it's just that it is happening in other countries and benefiting other economies.

Without large Australian corporates to take on the commercialisation of Australian innovation, we will remain the innovation mine for the world.

Being an innovation mine doesn't create jobs and a sustainable future. Part of our problem is that we don't

PHOTO: ISTOCKPHOTO



Turning great ideas into products, jobs and income – in Australia.

have the equivalents of Microsoft, Intel or Google. The Australian equivalents, Telstra and Optus, are not in the same league and are service-based companies with little emphasis on innovation.

Nor do we have the healthcare equivalents of Pfizer, GSK, Johnson & Johnson or Merck. CSL, Australia's largest biotech, was government funded for 75 years before privatisation. Venture capital has a role to play but the traditional venture capital model has not succeeded in Australia.

The Federal Government spends more than \$8 billion annually on research but only about 1.5 per cent of that is spent on commercialisation – translating the research into products. Almost half of the commercialisation funding goes to the automotive industry.

The real challenge is whether Australia can maintain its standard of living when the resources boom subsides.

Australia's superannuation industry has a key role to play in innovation and may offer part of the solution. Australia

has the fourth-largest superannuation pool in the world and the world's largest, per capita. The superannuation industry cannot be expected to invest in research without an appropriate return. However, the superannuation industry can't afford to ignore the development of the next generation of industries because without continued contribution growth from the next generation of employees, the superannuation industry won't continue to support superannuants in their retirement.

Superannuation

As superannuation funds grow, their challenge will be whether there is enough diversity for Australian investors. At the moment 61 per cent of ASX earnings are generated by two industries: financial and property trusts and materials, represented by 10 companies. Alarming, four banks and two mining companies account for 49 per cent of ASX earnings.

Venture capital has an important role to play but new models need to be identified that provide appropriate returns and lower

fees. One of those is the Medical Research Commercialisation Fund, a collaboration between two superannuation funds, four state governments and Australia's leading medical research institutes and hospitals.

It invests exclusively in early stage Australian medical innovation and takes advantage of the research infrastructure, trained personnel and clinical expertise that is a result of the Government's \$8 billion annual expenditure on research.

Clearly spending only about one per cent of the annual R&D budget on translation and commercialisation is not enough. In a time of relative prosperity, Australia should establish a pool of capital to invest in next-generation industries. Superannuation investment returns are taxed at 15 per cent. A fraction of a percentage of this should be invested in innovation translation and commercialisation, creating a knowledge-based economy and leading to jobs and wealth creation.

Three things need to happen:

- First, the superannuation industry should encourage government to establish such a fund to invest in next-generation industries. That will require long-term view of sustainability and growth.
- Second, we need to use the research outcomes from the automotive and defence industries in the mining services industry and elsewhere.
- Finally, we need to encourage more institutes such as the medicine-focused Translational Research Institute, which will open in Queensland later this year, to produce practical outcomes from our research.

The Australian Innovation Challenge runs again

The \$70,000 *The Australian* Innovation Challenge is being staged again seeking the nation's best ideas – in fields from environmental science to education.

The goal is to help drive game-changing breakthroughs by scientists, engineers, technologists, educators and backyard inventors to commercialisation or adoption. The awards are run by *The Australian* in association with Shell with the support of the Commonwealth Department of Industry, Innovation, Science, Research and Tertiary Education.

Dr Terry Cutler, CSIRO deputy chairman and leader of the Federal Government's 2008 review of the national innovation system, again heads the judging panel this year. ATSE Fellows among the judges are Professor Robin Batterham, Dr Megan Clark, Dr Ian Gould, Professor Mary O'Kane and Professor Veena Sahajwalla.

The awards, which are open to both individuals and teams, have seven professional categories, each carrying a prize of \$5000. The overall winner of the professional categories will receive a further \$25,000. An eighth category,

Backyard Innovation, is open to the general public and has a \$10,000 prize. Entries closed on 12 August. Finalists will be announced progressively during October and November and the winners will be announced at the end of November.

The categories are:

- minerals and energy;
- environment, agriculture and food;
- education;
- health;
- ICT;
- manufacturing and hi-tech design;
- community services; and
- backyard innovation.

Clive Mathieson, editor of *The Australian*, said the newspaper was delighted to renew the search for the nation's top innovators following the resounding success of last year's inaugural challenge, which attracted more than 300 entries.

Professor Mark Kendall and his team, from the University of Queensland's Australian Institute of Bioengineering and Nanotechnology, took out the overall prize last year for a patch to replace needles and syringes in vaccination – the Nanopatch.

PETER BEATTIE AC was the 36th Premier of Queensland for nine years and led the Queensland ALP for more than 11 years. A UQ law graduate he entered legal practice in Brisbane and later served as a union secretary and ALP State Secretary. He succeeded Wayne Goss as Queensland ALP Leader, won the 2001 election and drove the Queensland 'Smart State' initiative as Premier. After retiring from politics (2007) he served as Queensland's Trade Commissioner to North and South America before being appointed by the Australian Government as Australia's first Resources Sector Supplier Envoy. He is a director of the Medical Research Commercialisation Fund. In 2011 he was presented with an ATSE Medal to recognise his leadership in science, technology and innovative research.

Building a bridge over the 'Valley of Death'

Turnstone will fund and manage agreed technology development work at its own risk – to provide the bridge over the 'Valley of Death'.



By Alexander Gosling
alexander.gosling@invetech.com.au

It is generally accepted that while Australia is a strong performer by global standards in public sector basic research, everything falls apart after that. The next stage of commercialisation, the conversion of research outcomes into commercially validated products or processes, too often just does not happen.

Why not? There have been countless studies, but there are a few obvious generalisations:

- the research organisations have neither the skills nor the funds (nor indeed the mandate) to advance core technology and initial IP to a commercially robust offering;
- there are few major corporates in Australia that might be interested in the opportunities and capable of moving them forward from the immature state in which they are typically offered;
- the 'start-up' route faces a major obstacle in the shortage of funding in Australia for R&D and early stage business development; and
- this route is also made harder by the need typically to address remote global markets – and the challenge of acquiring real market knowledge and subsequently building effective market access channels from this situation.

An alternative model to address these problems, and more effectively link Australian research outcomes with global markets, is the 'pull' model named Turnstone, developed by Capstone Partners Pty Ltd. Capstone is a specialist company providing consulting advice and support services to IP owners and start-ups along the technology commercialisation and the 'IP to IPO' journey.

From this work, we at Capstone became keenly appreciative of the above challenges in 'pushing' an idea or new technology

into the competitive commercial world, and determined to develop an alternative system to complement the traditional route.

Many global firms now operate 'open innovation' programs, wherein they set out a wishlist of technologies they would like to source from outside the company in reasonably mature and de-risked form.

Such near-to-market solutions may be available from other corporates (and the strategy used by the big pharmaceutical companies of buying smaller companies that have completed clinical trials is a good example of this) but not usually from research institutions – and this is an acknowledged weakness in the open innovation process as it stands today.

The proposed model is designed to address this gap and work with select global firms to serve their open innovation needs more effectively. We are calling this Turnstone to underline that its function is to look for solutions to known needs.

The basis of Turnstone is a

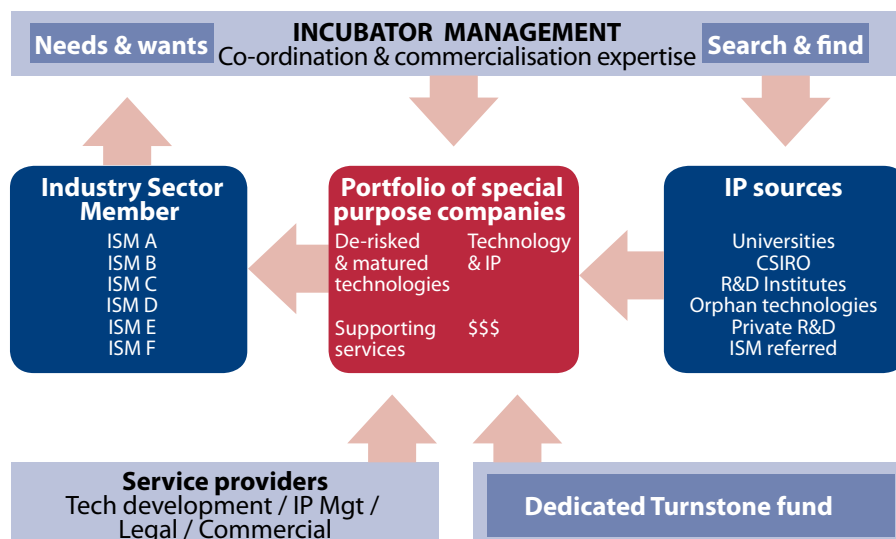
'club' of major corporates who have signed up as members – 'Industry Sector Members'. Each member, as a condition of membership:

- has exclusivity in its agreed market or industry sector (to ensure that Turnstone avoids conflict of interest in serving its various members);
- pays a modest annual retainer to secure this exclusivity; and
- shares with Turnstone on a confidential basis its Open Innovation wishlist, at least to the extent that the items on it might be available from Australia.

Turnstone then works to meet those needs, by:

- searching out from IP sources in Australia offerings that might be developed or adapted to fit one of the wishlist needs; and
- in agreement with the member concerned, securing access to the IP and developing and maturing such IP until it is 'fit for purpose'

Figure 1 TURNSTONE





Leaders in Engineering and Science

Never Stand Still

- Internationally renowned for pure and applied research with a significant history of commercial innovation.
- Strong collaborative partnerships with industry, government and prestigious institutions worldwide.
- Success in securing funding from competitive national grants, industry and the community.
- UNSW is the leader in NSW for: research activity (\$), share of top 500 commencing undergraduate students, staff to student teaching ratio, and graduate employment rates.

The Faculty of Engineering offers the most comprehensive range of undergraduate, postgraduate, research and continuing education courses in Australia, and continues to strengthen its market leadership with groundbreaking developments around complex world issues including energy, health, water, infrastructure and ICT.

The Faculty of Science administers two new ARC Centres of Excellence, for Climate System Science, and for Quantum Computation and Communication Technology.

eng.unsw.edu.au
science.unsw.edu.au



for acquisition by the member.

The Turnstone system includes the following elements:

- the club of members;
- wide ranging access to potential IP sources – typically universities, CSIRO, CRCs and other research organisations;
- established relationships with service providers to undertake the development of early-stage technologies on a contract basis, as and when required, to the point where they are ready for acquisition by members;
- a dedicated venture fund to pay for the work done by service providers to develop the technologies; and
- a management team to provide the active interface with the members and to set up and manage the development projects.

There are many organisations that offer technology search or match-making services. What differentiates Turnstone is that it will fund and manage agreed technology development work at its own risk – to provide the bridge over the ‘Valley of Death’ – without the member having to put resources or funds at risk.

This very effectively addresses the issue with the existing open innovation process.

The process

The starting point in the process is the agreed list of open innovation targets for each member. With this portfolio of targets, Turnstone’s team scans IP sources for potential matches. Where such a match is found, Turnstone reviews it with the member in question to agree what would have to be achieved in terms of de-risking, adaptation or validation of the technology to make it attractive to the member, and what the value to the member would be – that is, to reach a formal Development Agreement on the specification and corresponding transfer price for the development project.

Turnstone can now start to arrange the deal. This involves:

- reaching agreement with the IP owner as to the share of the transfer price needed in return for an option on the IP for the duration of the project and the eventual transfer of the IP rights to the member;
- selecting and reaching agreement with appropriate service providers on the cost and timescale to do the development work required, on the basis that all IP generated will

be owned by Turnstone; and

- (on condition that these agreements show the potential for a profitable project given the agreed transfer price) submitting a proposal to the management of the Turnstone Venture Fund to allocate the funds required to do the development work.

Once the deal is in place, Turnstone manages the project in close communication with the member concerned. Given the realities of development projects there will be unforeseen problems and unforeseen opportunities and the member will be involved in key decisions on project direction and trade-off choices to optimise commercial value created.

If the project succeeds in achieving the specified outcomes, the transfer proceeds at the agreed price under the Development Agreement between Turnstone and the member. If at any time Turnstone’s management concludes

than (as R&D would usually be) an expense item against the profit and loss account.

The Turnstone model is expected to be attractive to venture investors. By comparison with the more familiar option of investing in a start-up business, investing in the Turnstone Venture Fund has several important advantages:

- commercial risk is largely obviated, as we never start a project unless we have a committed buyer-in-waiting;
- time-to-exit is much shorter, typically one to two years for a Turnstone project versus five years or more for a business; and
- while there will be some failures (projects terminated), termination will usually happen early before much investment has been committed, whereas business failures typically happen late when most or all of the funds have been committed.

Turnstone is a work-in-progress and we have made progress on three main fronts:

If at any time Turnstone’s management concludes that it is unlikely the project can be successfully completed on a profitable basis, Turnstone can close the project and there is no cost or liability to the member: Turnstone bears the write-off.

that it is unlikely the project can be successfully completed on a profitable basis, Turnstone can close the project and there is no cost or liability to the member: Turnstone bears the write-off.

Balance sheet

Large corporations are familiar with company acquisitions and the Turnstone model fits with this. Each project is set up as a Special Purpose Vehicle company (SPV). The investment from the Venture Fund is injected into the SPV for shares held by the Venture Fund. The IP owner is issued shares in the SPV commensurate with its agreed share of the transfer price (the IP agreement is between the IP owner and the SPV). The funds are applied to paying the service providers, so that all new IP is owned by the SPV. On successful completion the member acquires all the shares in the SPV for the agreed transfer price. (If the project is terminated, the SPV is closed down and all IP rights revert to the IP owner.)

This mechanism offers the member the advantage of being a capital transaction that appears as a balance sheet item rather

- established contact with and interest from a number of major global firms as potential industry sector members;
- enlisted support from several universities, from CSIRO and from other potential IP sources; and
- applied for an IIF licence for the Turnstone fund.

If all goes according to plan, it will launch towards the end of 2012.

MR ALEXANDER GOSLING FTSE FIEAust, a founding director of Invetech, has been working in the field of process and product development and related R&D for nearly 40 years, developing practical experience on progressing new technologies to commercial success. He was part of the management team that led Invetech firstly to public listing (as Vision Systems Ltd) and then to its acquisition by the US Danaher group for more than \$800 million. He is currently a director of Capstone Partners, a strategy consultancy specialising in technology commercialisation, and Chairman of Metallic Waste Solutions Pty Ltd, a start up in the clean technology industry sector. An engineer and Cambridge graduate, he is Past President of both AIRG and the Australia-Malaysia Business Council and a Governor of the Warren Centre for Advanced Engineering.

Alliance contracting brings real innovation in construction

There is a fundamental contractual element that the parties will not sue each other and will strive to deliver innovation and best-for-project outcomes.



By Roger Olds
roger@rogerolds.com.au

Infrastructure is a key element of Australia's economic growth. Improved transportation is essential to the efficient movement of goods and export of our products and resources. It also impacts on our individual productivity and quality of life. Water and power are essential elements of our plans for a growing population and the threats of a reduced carbon footprint and climate change challenge us to come up with innovative solutions to deliver this growth in new ways.

The challenges do not end there. Serious issues remain in the delivery of major projects that underpin the nation's infrastructure. If we hope to deliver optimum results in bringing infrastructure projects to the marketplace we need to focus on more

innovative methods of delivery.

As I look back over three decades as a geotechnical engineer working as a consultant in the construction industry, I am excited and disappointed about the state of the industry.

When I first entered the industry in the late 1970s state and federal government authorities had strong engineering departments with a legacy of training and mentoring young engineers. These departments had the capacity and capability to deliver Australia's infrastructure needs. They had strong design and construction management capabilities and were formative in the development of the construction industry.

As the industry matured and government departments came under political pressure to cut costs they gradually

reduced their engineering capability and relied more heavily on industry to design and construct their projects. We saw procurement of major projects shift from a predominance of construct-only contracts, designed in-house, to design-and-construct contracts where the clients defined their needs and relied on industry to undertake the detailed design and construction.

Throughout this period contractual disputes were common due to the adversarial nature of construction contracts, and the difficulty of fully specifying the works needed to deliver complex projects. Many of our valuable resources were wasted in pursuit and defence of claims rather than delivering better engineering. Specifications became tired and did not match advances possible as a result of improved analytical techniques and computing power.

In the late 1990s I first became aware of a new delivery method known as alliance contracting. It had been developed in the North Sea to deliver offshore oil platforms, which had become excessively expensive and risky under conventional contracts.

Alliance contracts have some very fundamental differences to conventional contracts. In essence they involve creating a single team to deliver the project. The team includes the owner, the designer and the constructor. The contract is non-adversarial and involves risk and reward sharing between all parties. Risks are identified and insured under project specific policies.

There is a fundamental contractual element that the parties will not sue each other and will strive to deliver innovation and best-for-project outcomes. These tenets



Alliance contracting was the key to an innovative landslide-avoidance solution involving a road bridge over the sea north of Wollongong.

drive positive behavioural change compared to the adversarial contracts of the past.

Such contracts allow clients to go to market with only minimal needs identified. The alliance team – once selected – can pull together all the skills and knowledge of the alliance members and fully consider the possible solutions to meet or exceed the client needs. It becomes possible to challenge out-dated specifications and deliver state-of-the-art solutions with full cognisance of construction efficiency, quality and safety.

The alliance can embrace all elements of project delivery including community, environment and political imperatives.

In the past decade alliancing increasingly became a popular delivery method for difficult projects, and state authorities throughout Australia embraced it enthusiastically. I was personally directly involved with six alliance projects, which were extremely varied. They ranged from roads to marine reclamation and included an innovative landslide avoidance solution involving a bridge over the sea along the coastal road north of Wollongong.

In most of these projects it was the first time the client had attempted to complete a project using alliance contracting. In all cases there was an element of fear and uncertainty. However, by the end of the project each of these clients was delighted with the outcome and committed to alliance contracting as a valid procurement method.

Throughout this decade Treasury and Finance departments remained sceptical of a delivery method that did not involve a price competition to select the best

team. Every project had a fully detailed and costed design – taking account of all the risks and opportunities in the project and independently checked by industry experts selected by the owner.

With a decade of learning there was a wonderful opportunity to bring experienced practitioners together to further improve alliance contracting based on the experience over that decade.

Unfortunately the State Departments of Treasury and Finance put their heads together – with very limited experience in alliance contracting and with no consultation with the industry that had made it so successful. They commissioned a report that was not independent and used this report to argue that the only way to demonstrate value for money was to undertake alliance contracting under a price competition.

Such an approach overlooks many of the benefits and behavioural changes that pure alliances generated. These price-competitive alliance contracts are essentially design-and-construct contracts under an alternative name, and different commercial arrangement. The industry has attempted to convince these departments that this approach has destroyed a valid and successful procurement method which truly allowed the industry to be a world leader in innovative engineering and procurement.

However, these attempts have fallen on deaf ears as their political masters are swayed by the simplicity of the argument that price competition is best. The voice of the delivery organisations and the technical community cannot be heard above the

rhetoric of the Finance Departments.

I have spoken on this topic at conferences in different parts of the world and outlined the detail and outcome of the projects I have been involved with. Observers are generally astounded at the success of alliance contracts.

However, unless we can muster some political support for a review of the current situation, I am afraid we will have lost one of the most exciting technical advancements and innovative approaches we had at our disposal to deliver on Australia's pressing need for more and better infrastructure.

We can have innovation in both goods and services.

Our bureaucrats and parliamentarians simply have to recognise there is room for innovation in project delivery – as well as in product delivery – and that alliance contracting allows and promotes such innovation.

It will mean a better result for Australia.

ROGER OLDS FTSE is a geotechnical engineer who served as Managing Director of international consultancy Coffey International Ltd for 15 years until his retirement in 2011. Mr Olds holds a Bachelor of Engineering and a Graduate Diploma in Geotechnical Engineering. He joined Coffey in 1979 and has extensive operational and management experience. He headed Coffey when it twice won the prestigious BRW Client Choice Award for the best consulting engineering firm in a national survey of 11,000 professional service firm clients. Mr Olds is now consulting to the construction industry on geotechnical risk and opportunity in projects.

Two Australians nominated for Queen Elizabeth Prize

The Academy office is working on two nominations for the £1 million The Queen Elizabeth Prize for Engineering for which entries close 14 September. These will nominate two leading Australian engineers whose achievements are notable worldwide.

This global award for engineering, to be administered by the Royal Academy of Engineering, has been established to celebrate outstanding advances in engineering that have created significant benefit to humanity.

The Queen Elizabeth Prize for Engineering aims to attain the stature

of the Nobel Prizes and joins a small group of international prizes which have similar aims – the Millennium Technology Prize, with a value of €800,000 to the winner, run by the Technology Academy, Finland, and the Charles Stark Draper Prize, with a value of \$500,000, run by the US National Academy of Engineering.

It will be awarded biennially, the first award being announced in December 2012 and presented in early 2013. Self-nominations will not be accepted.

**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

Four leading Australian

Australia's leading innovators and heroes in science and technology were presented with prestigious ATSE Clunies Ross Awards in June for impacting global development in medical innovations, mining and electrical engineering.

The Awards recognise Australia's pre-eminent scientists and technologists who have bridged the gap between research and the marketplace by persisting with their ideas, often against the odds, to the point that their innovations have made broad economic, social or environmental benefits.

The 2012 ATSE Clunies Ross Award winners, whose innovations are providing real life impacts and significant economic pay-offs for Australia, are:

Professor Peter Blamey, one of the most respected 'hearing' scientists and inventors in Australia and internationally is co-inventor on more than 20 patent families mostly used in cochlear implants, headset products and hearing aids, including a lower-priced self-installable product. He is currently helping develop

and commercialise a Bionic Eye, devices for deep brain stimulation, and other bionic devices for chronic medical conditions.

Dr Gideon Chitombo, a world leader in university-based international collaborative mining research in the areas of rock breakage by blasting and underground mass and deep mining using caving methods that maximise resource potential and safety, and minimise environmental impacts.

Professor Stuart Crozier FTSE who is responsible for research and commercialisation of magnetic resonance

imaging (MRI) innovations – about 70 per cent of all MRI systems in the world since 1997 contain technology that he co-invented. His newer work is in image-guided cancer therapy and more accurate diagnostics for musculoskeletal diseases and injuries.

Sir William (Bill) Tyree Kt OBE FTSE, whose name is synonymous with electrical transformer manufacture in Australia and whose company is one of Australia's leading manufacturers of power transmission products, was awarded the ATSE Clunies Ross Lifetime Achievement Award.



ATSE Director Dr Susan Pond (left), 2012 Awards Chairman Professor John Boldeman and Sydney Lord Mayor Clover Moore.

2012 Award winners have diverse achievements

The winners of the 2012 ATSE Clunies Awards were recognised for their substantial achievements in medical innovations, mining and electrical engineering.

They exemplify the purposes of the Awards – to recognise Australia's pre-eminent scientists and technologists who have bridged the gap between research and the marketplace by persisting with their ideas, often against the odds, to the point that their innovations have made broad economic, social or environmental benefits.

The 2012 Award winners are profiled below.

Professor Peter Blamey

Professor Peter Blamey has worked on cochlear implants, hearing aids and the development of spoken language in children with impaired hearing since 1979, when he joined Professor Graeme Clark's team at the University of Melbourne.

The first patient had just been implanted with a prototype device in Melbourne and Peter's role was to investigate the hearing sensations produced by electrical stimulation of the hearing nerve.

Later, as an NHMRC Research Fellow, he showed that children born deaf could acquire spoken language in a normal manner with a cochlear



Professor Les Field, for sponsor the University of NSW Malcolm Chaikin Foundation, presents an Award certificate to Professor Peter Blamey.

implant, and the implant produced by Cochlear Ltd has had a major social impact on the lives of about 100,000 deaf children globally.

Peter is a co-inventor on more than 20 patent families, most of which have been used in cochlear implants, hearing aids and/or headset products.

The financial burden of hearing loss in Australia has been estimated

innovators honoured

The Awards were presented at a gala dinner at the Sydney Convention Centre on 14 June, with an address by Catherine Livingstone AO FTSE, Chairman of Telstra Corporation Ltd, to more than 450 eminent entrepreneurs, decision makers, government officials, researchers, academics and business leaders.

The dinner is ATSE's showcase event for the year, highlighting the success of Australian innovators and entrepreneurs in bringing technological successes to the marketplace – and the essence of innovation: that it isn't complete until it's 'on the shelves'.

The attendance of the Minister Assisting the Minister for Industry and Innovation, Senator Kate Lundy, and the Sydney Lord Mayor, Clover Moore, added to the occasion.

ATSE notes the essential contribution of Professor John Boldeman's 2012 Awards Committee, the sponsors of the awards, the winners – including two Fellows – and the ATSE team that organised the event.

These 2012 ATSE Clunies Ross Award Winners follow in the footsteps of past winners such as Professor Ian Frazer FRS



The four 2012 Clunies Ross award winners.

FAA FTSE, co-inventor of the cervical cancer vaccine; Nobel laureate Dr Barry Marshall FRS FAA, who discovered the bacteria that causes stomach ulcers; Dr Fiona Wood, inventor of spray-on skin; and Professors Martin Green FTSE and Stuart Wenham FTSE, international

leaders in silicon cell technology.

The winners joined more than 250 Year 10 students and teachers from across NSW the following day in the 'Extreme Science Experience', with hands-on activities to excite students about science and technology.

at \$11.9 billion per year and only about 20 per cent of people who would benefit are using hearing aids. Blamey & Saunders Hearing Pty Ltd is using Peter's new technologies and a new business approach to tackle these problems with a hearing aid that can be adjusted by the wearer, lowering the price of state-of-the-art hearing aids by a factor of three, thus enabling more people to improve their quality of life.

As Deputy Director (IP and Commercialisation) at the Bionics Institute, Peter is helping develop and commercialise a Bionic Eye, devices for deep brain stimulation and other bionic devices for chronic medical conditions.

Dr Gideon Chitombo

Dr Chitombo was appointed as Professor and Chair of Minerals Industry Engagement at the University of Queensland in 2009 – the world's first professorial position of engagement.

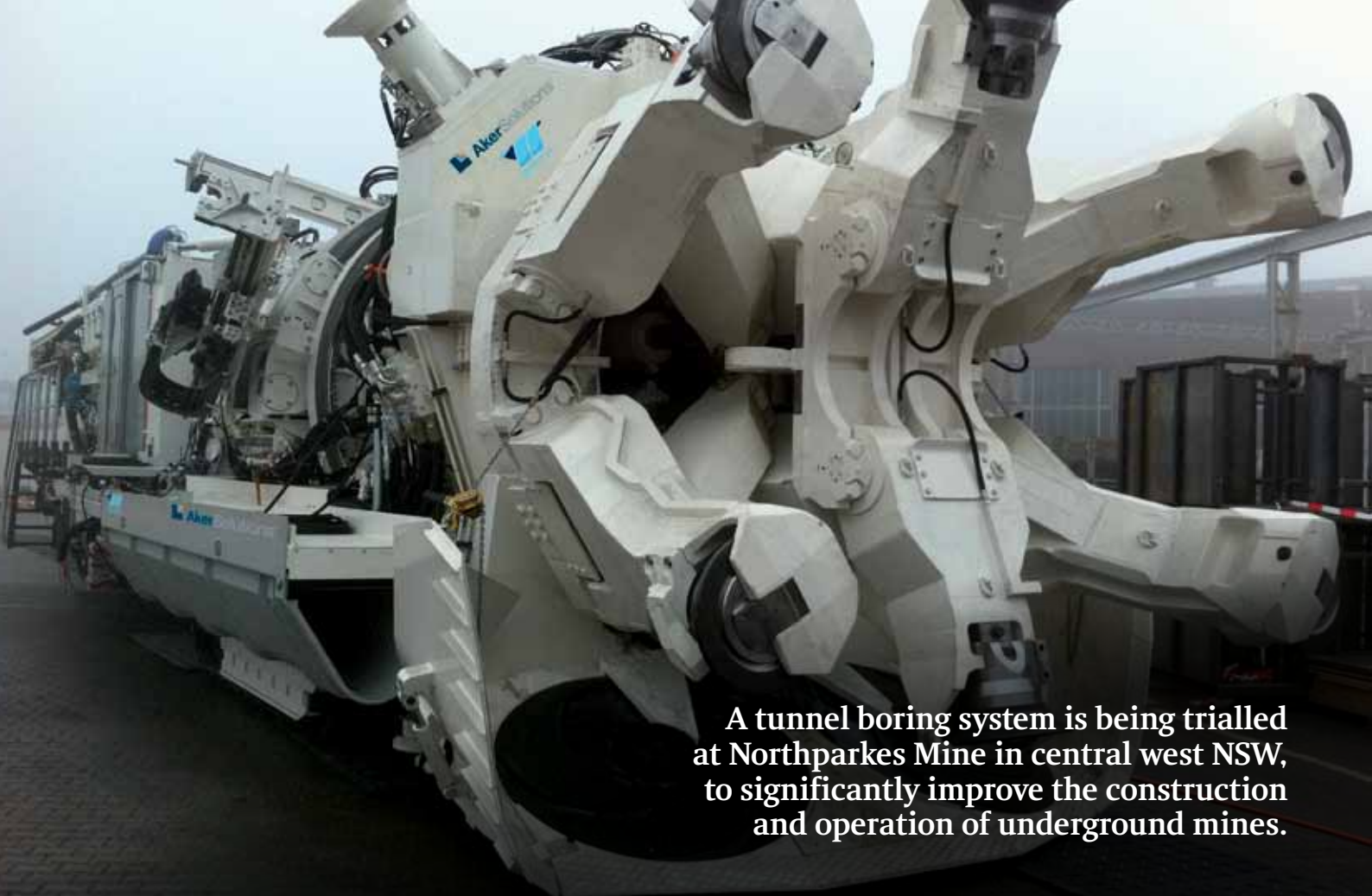
Born in Zimbabwe and moving to Australia in 1982, he has become arguably one of the leaders in university-based international collaborative mining research in the areas of rock breakage by blasting and underground mass mining using caving methods.

These are increasingly becoming the preferred methods to economically and safely mine large-scale, low-grade metalliferous mineral deposits such as copper and gold.

He was instrumental in forming the now long-standing collaborative research involving a number of the major international mining companies in Australia, South Africa, Chile, North America and Europe. The research focused on understanding of the caving fundamentals –



Mr John McGagh, for sponsor Rio Tinto, presents the Award certificate to Professor Gideon Chitombo.



A tunnel boring system is being trialled at Northparkes Mine in central west NSW, to significantly improve the construction and operation of underground mines.

At Rio Tinto, we have a long term commitment to technology and innovation.

We're proud to support Australian science through the 2012 ATSE Clunies Ross Awards and Extreme Science Experience.

As a global leader in the resources sector, we are continually working to improve the way we do business.

Our focus on innovation runs across mining, processing, asset management, strategic production planning, energy use, and project development, execution and evaluation.

And our Mine of the Future™ programme is helping us develop step change mining technologies to make minerals recovery safer, faster and more efficient.

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caving mechanics, gravity flow and fragmentation, as well as confined blasting. This research has underpinned some of the know-how, tools and practices now used by the industry (both in Australia and overseas) for block, panel and sublevel caving design and optimisation.

Gideon was instrumental in the formation of an international collaborative project designed to develop a numerical model of the blasting process for mining, regarded by his industry peers as the benchmark in the numerical modelling of the blasting process.

His current and longer-term interest is on future mass-mining methods which are likely to include large caving mines or supercaves and ultra-deep-pit mining, aimed at maximising resource potential and minimising environmental impacts.

Professor Stuart Crozier FTSE

Professor Crozier is currently Professor and Director of Biomedical Engineering at the University of Queensland. He has published more than 180 journal papers and holds 30 patents in the field of medical imaging. He has supervised more than 20 PhD students to graduation in the field.

His main research and commercialisation contributions have been to the development of applications and engineering innovation in magnetic resonance imaging (MRI). Several of his innovations have been adopted by industry and about 70 per cent of all MRI systems in the world since 1997 contain technology that he co-invented.

Stuart and his team have continued to develop innovations. One of the most recent are small and dedicated MRI systems for orthopaedic imaging, which have now been adopted by a multinational medical imaging company.



Dr Calum Drummond, for sponsor CSIRO, presents the Award certificate to Professor Stuart Crozier.



Professor Robin Batterham, ATSE President, presents the Lifetime Achievement Award to Sir William Tyree.

New technology in image-guided cancer therapy and more accurate diagnostics for musculoskeletal diseases and injuries are some of Professor Crozier's current research directions in clinical applications.

As well as being an ATSE Fellow he is a Fellow of The Institute of Physics (UK). He holds a PhD and higher Doctorate (DEng) in Biomedical Engineering.

Sir William Tyree Kt OBE FTSE

Bill Tyree (later Sir William Tyree) established his business in 1946 and in a short time the Tyree name became synonymous with electrical transformer manufacture in Australia. In 1956 he founded Tyree Industries, a public company, and about 13 years later sold his interest to Westinghouse Electric USA under a 10-year contract.

In the early 1980s, he re-entered the transformer industry and formed a company that is today one of Australia's leading manufacturers of power transmission products.

Sir William is still very active in the business and, in addition to distribution transformers, the company is now manufacturing large transformers and has formed an association with a leading transformer company based in Portugal in order to broaden the scope of transformers on offer. He is always seeking ways to progress in the world of transformers which is his first love.

Sir William is an avid believer in and advocate of education and, through The A W Tyree Foundation, has made numerous donations to universities to further engineering in Australia.

He has received many honours and accolades for his service to education and industry. These include Honorary Fellow, University of Sydney; Honorary Doctor of Engineering, University of Sydney; Honorary Doctor of Science, University of NSW; and – among his most treasured awards – the Centennial Medal of the US Institute of Electrical and Electronic Engineers.

His ATSE Clunies Ross Lifetime Achievement Award recognises his contribution to technological development in the power transmission industry over more than 60 years and his commitment to education in Australia.

ESE wins plaudits from students

By Rod Dunstan

Nearly 280 students and teachers from across New South Wales turned out for the 2012 Extreme Science Experience at the Sydney Convention and Entertainment Centre to meet with 30 scientists, including the Clunies Ross Awards winners, and take part in four workshops.

A highlight of the day, which followed the Clunies Ross Awards Dinner on 14 June, was the 'Speed Meet a Scientist' session – and it got strong positive reaction from both students and teachers.

Hosted by the ABC's Bernie Hobbs, the ESE also involved workshops with each of the ATSE Clunies Ross Award winners. It was the fifth time ESE had been organised and each event has had strong feedback from participants.

A typical quote from our feedback was: "Our students were really excited to meet their scientists...they commented that the scientists were funny, smart and really passionate about what they were investigating!"

ESE organisers had 32 out of 36 responses from its anonymous teacher/student evaluations survey and the results were very positive, with a few good suggestions on how to improve the day.

The workshops challenged and engaged the students. In Professor Peter Blamey's bionic ear workshop the participating students got a clear idea of how good

ATSE President-elect Dr Alan Finkel talks with students.



their hearing is now, how good it should be and what they can do to preserve it.

The MRI workshop with Professor Stuart Crozier was a hit with students trying to determine what fruit was in a sealed box on their workbench, and where it was in the box, using MRI imaging alone. Although few students knew what a pomegranate was, they knew what it looked like inside before they cut it open.

The mining workshop with Professor Gideon Chitombo had the students find and identify ore bodies around NSW using metal detectors and then separate and purify the six components of an ore sample.

Professor Marc Wilkins, from the School of Biotechnology and Biomolecular

Sciences at UNSW, supported the event running the Gene Genie workshop. He won enthusiastic participation after his inspiring introduction and observers said he was highly likely to meet some of the students again at UNSW and – if he decided to give up his career as a scientist – he would be hotly sort after as a football coach.

ATSE is grateful to the 2012 ATSE Clunies Ross Committee, participating scientists, the facilitators, MC Bernie Hobbs and the volunteers who made the day such a success.

Teacher comments

■ "The students from Hay and I thoroughly enjoyed the Extreme Science Experience. They had a great day and I have only had positive feedback from them. Thank you once again for paying for the flights. Only two of the students had been in a plane before. I took them to UTS on the Thursday we arrived to check out their Science facilities and then down to the Harbour Bridge and Opera House. None of them had been to the Opera House or Harbour Bridge before. Fantastic feats of engineering! Thanks once again." – Anne McNally, Hay War Memorial High School.

■ "The five students who attended extreme science were extremely(!) excited to be selected and came away from the day with new interest in pursuing some form of science as a future career. They loved



Sponsor Rio Tinto's Aaron Holmquest, from Northparkes Mines, engages his audience.

the 'meet a scientist' – heaps better than learning about them on the internet or in books!! The activities in which they participated were stimulating and sparked their interest. They all agreed that they would have liked to do the other two as well!! Thank you once again for making this possible for our students. We are very appreciative. – Vicky Donoghue, Head Teacher Secondary Studies, The Rock Central School.

Anonymous responses

- A fabulous and inspiring day.
- There was a lot on during the day and it seemed rushed at times. It would have been good for the teachers to involved in a workshop/professional development while kids were working. Great day and very motivating.
- An extremely inspiring day filled with loads of interesting food for thought! Excellent organisation! Please thank all the scientists who gave up their time to participate in this event. Our students and teachers felt thoroughly privileged to be part of this event. Perhaps the teachers could meet a scientist??? Thank you!
- This was wonderful. My students were really excited to hear from the scientists and the opportunities available. Wish this could be offered to more students.

Student feedback

- Our students were really excited to meet their scientists ... they commented that the scientists were funny, smart and really passionate about what they were investigating! Our students were most impressed with the young fellow who had developed his app and were even brainstorming other ideas for apps on the bus ride home! Each student had wanted to participate in all four workshops but totally enjoyed the ones they did on the day! Thank you!
- Great experience. Gave me lots to think and read about. Great food and company. It was good to mix with other kids with similar interests. We are not as dumb as we thought. Thanks for letting us go – it was worthwhile.
- A lot more fun than they anticipated. Did not stop talking about the event all the way home, and Nowra is a long way.

Rod Dunstan is the STELR Education Officer and organises the ESE workshops.



Awardee Professor Stuart Crozier 'speed meeting' with students.



Volunteer Nancy Jia answers students' questions.



Students fully focused during a workshop exercise.

Fellows in European trade delegation

Three ATSE Fellows played prominent roles in a recent Victorian trade delegation to Europe.

ATSE President Professor Robin Batterham AO FREng FAA FTSE, Mr Alexander Gosling FTSE and Professor Erol Harvey FTSE participated in the first Victorian Government-sponsored trade delegation focusing specifically on small technologies. It visited key small technologies centres in Norway, Germany and the Netherlands for business-to-business introductions, networking and site visits and was also the biggest delegation to attend the Commercialisation of Micro-Nano Systems (COMS) Conference in Norway.

Participants met thought-leaders and executives from companies, research institutes and universities to promote partnership and collaboration on near-term opportunities and decrease the hurdles to accessing international markets.

"In Germany we spent time at several

different kinds of institutes so we saw quite a lot of different things in the research field, but spanning that spectrum from pure research to very applied, product-focused research," Professor Harvey said.

A highlight for many of the delegates was the two days spent at Kennispark, the innovation campus, business and science park in the Netherlands.

IntelliMedical Technologies, a start-up medical device company located in Melbourne and part of the

delegation, competed in the COMS 2012 Young Technology Award, winning the People's Choice award.

** The term 'small technologies' refers to the convergence and integration of microtechnology, nanotechnology, biotechnology, ICT and advanced engineering technologies. Microtechnology is engineering on the scale of one millionth of a metre. Nanotechnology is engineering on the scale of one billionth of a metre or at the scale of a single atom.*

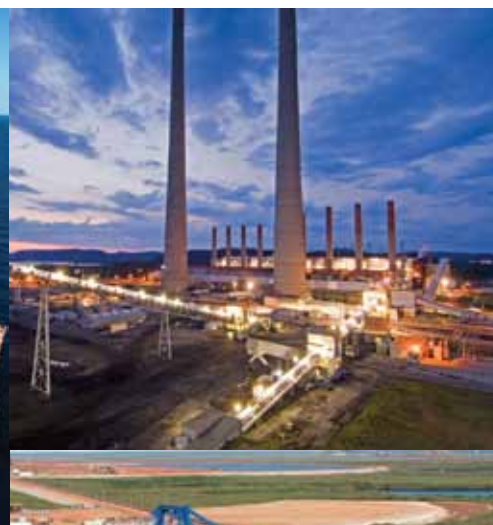


Robin Batterham and Alexander Gosling discuss technology issues at COMS.



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ATSE and AIRG focus on needs of SMEs

The Academy is co-sponsoring the Australasian Industrial Research Group's (AIRG) conference 'Innovation & Technology in Australasian SMEs' in Melbourne, starting 20 August.

The two-day event is the AIRG Winter Meeting and has a stand-out line up of speakers to examine how innovation and technology is being managed in small to medium enterprises (SMEs) across Australasia.

The meeting will seek to contrast how this is done in three different high technology SME sectors – IT, devices and biotechnology – and discussion will contrast recognised SME best practices with those in larger industrial organisations.

The event follows earlier examination of innovation issues at recent AIRG meetings on open innovation and technology crossovers.

The role of open innovation was examined in terms of how it could facilitate the rapid acquisition of new technology or of appropriate external technology resources by an enterprise in order to accelerate

innovation and commercial adoption.

AIRG's last meeting focused on technology crossovers – the effective leveraging of technologies, from all sources or across different industry sectors – as a significant opportunity for rapid, low-cost new technology adoption.

The meeting, at the Royce Hotel, Melbourne on 20 and 21 August, is supported by Ausbiotech and the Pearcey Foundation and has attracted some top-level speakers, including Academy President-elect Dr Alan Finkel AM FTSE; Dr Deborah Rathjen FTSE, CEO and MD, Bionomics Ltd; Professor Erol Harvey FTSE, CEO MiniFAB; and Mr Doron Ben-Meir, CEO Commercialisation Australia.

For further information and registration details email secretariat@airg.org.au

Government confirms ACOLA \$10 million

The Minister for Science and Research, Senator Chris Evans, has confirmed the Government's commitment, through the Australian Research Council (ARC), to invest \$10 million in the Linkage Learned Academies Special Projects scheme, with which the academies will undertake research for the Prime Minister's Science, Engineering and Innovation Council (PMSEIC) and the Chief Scientist in areas vital to Australia's future.

"The Australian Council of Learned Academies (ACOLA) will use this \$10 million investment for a series of strategic research programs selected by PMSEIC and the Chief Scientist," Senator Evans said.

"Australia's best minds will deliver their research findings to the ARC and to the Chief Scientist, who will take the work to PMSEIC.

"The research findings will give the Chief Scientist and PMSEIC a strong evidence base with which they will recommend new policies that will help secure a strong, fair and productive future for Australia.

"World-class science and research is crucial to Australia's future competitiveness. We must ensure science and research policy underpins industry and innovation and drives them to adapt to the modern economy."

Current areas of research include:

- Australia's comparative advantage;
- country comparisons in science, technology, engineering and mathematics;
- Asian literacy;
- the role of science, research and technology in lifting Australian productivity;
- new technologies and their role in our security, cultural, democratic, social and economic systems; and
- engineering energy, in particular unconventional gas exploration.

UK opens access to publicly funded research

The British Government says it will make all publicly funded scientific research available for free by 2014 – a move that would cut into the profits of academic journals and save millions of dollars for universities.

David Willetts, the UK Minister for Universities and Science, revealed the scheme in which taxpayer-funded research papers will be made free online as soon as they are available.

"Removing paywalls that surround taxpayer-funded research will have real economic and social benefits," Mr Willetts said. "It will allow academics and businesses to develop and commercialise their research more easily and herald a new era of academic discovery."

The UK plan is reported to have support from British scientists, who say journal publishers are profiting from work. Earlier this year, thousands of researchers across the world signed a declaration they would not publish their work with Elsevier, a leading Dutch publisher of science journals. In 2010, Elsevier reported a 36 per cent profit on revenues of US\$3.2 billion.

Several UK scientist groups applauded the announcement and

Research Councils UK (RCUK), which funnels public money into the medical and biological sciences, also lauded the move.

British universities are reported to pay more than \$300 million in subscription fees to journal publishers, according to *The Guardian* newspaper. However, when the new scheme is implemented, research authors will still have to pay a fee to get their work peer-reviewed and published independently online. That fee has been estimated to be about \$3200.

Mr Willetts said the new plan would cut subscription fees substantially and that he hoped competition would "bring down author charges and universities will make savings" from not having to pay online subscription charges.

• *Julian Cribb FTSE has been a strong advocate in national media for the cause of open publishing – "It is time to put the entire canon of the world's publicly funded science and technology literature online, with open access to any person who wants it."*

Technology helps beat track issues for high-speed trains

We need cutting-edge technology solutions to improve the rail track substructure necessary to support high-speed train networks in Australia.



By **Buddhima Indraratna**
indra@uow.edu.au



Installation of a geocomposite below the ballast, near Wollongong.

Australia's railway network has the potential to play a much larger role in the mixed passenger and freight operations in metropolitan areas and key inter-city routes. While capital cities are likely to accommodate most of the population growth, satellite cities, coastal cities, and regional cities will also continue to grow, albeit at different rates.

City and population growth increases the need for mass transit transport and railways need to evolve and adapt to safely meet this increase in demand and traffic capacity.

As a result of these developments, operators are now focused on high-speed trains.

High-speed rail does not yet exist in Australia, but there are proposals for high-speed rail infrastructure. The fastest trains currently in use have a maximum speed of 160 kilometres per hour operating along very limited routes

(significantly below the internationally accepted definition for high-speed rail of about 250km/h), but in practice, average speeds are far below this due to unsuitable track geometry and current conditions.

In 2010, the Australian Government commissioned a planning study into high-speed rail on an east coast rail link, focusing particularly on the corridor between Newcastle and Sydney. The report was completed in 2011 and it was estimated that a high-speed railway on the east coast would cost between \$61 and \$108 billion, depending on which route and station combination was selected.

These high-speed corridors are highly capital intensive and resource issues need to be addressed with innovative engineering designs and efficient maintenance schedules to minimise the level of tariffs, for both freight and fares. Also, safety on Australia Railways must be benchmarked against modern European

and Japanese high-speed railway systems because the safety standards in these systems has been remarkable, with no deaths due to rail accidents for decades.

In Australia, the constraints of restricted space, tight construction schedules, environmental and safety issues, maintenance costs and the longevity of earth structures have continued to demand unfailing innovation in the design and construction of essential infrastructure on soft clays.

Rail tracks undergo millions of loading cycles of varying magnitudes and frequencies during their service life. The transfer of moving wheel loads at higher speeds results in a significant increase in damage to the tracks because the quasi-static response at relatively low speeds transforms into a dynamic (vibratory) state at elevated speeds.

In trials conducted in France and Japan, high-speed tracks on flexible ballast foundations have proven to be still the safest and most economical, whereas rigid concrete pavements that may address some of the obvious soil terrain problems, may cause a sudden change of gradient between the slabs with time, thus elevating the risk of long carriage derailment at high speeds.

A field trial on the Est-Européenne line, in France, demonstrated that speeds exceeding 400km/h on ballast beds would be feasible if particle gradations (ballast and structural fill) could be optimised to minimise track degradation. Current Australian standards for ballast would not meet these stringent requirements, and will need extensive further research including large-scale laboratory testing and field monitoring to propose future revisions to Australian Standards.

This is indeed a priority area within the CRC for Rail Innovation and ARC

Centre of Excellence in Geotechnical Science and Engineering. For heavy haul trains (25 to 30-tonne axle load) the effects of critical speeds on the cyclic densification of ballast and associated deformation of the track are significant – in view of stability, safety, and operational efficiency.

For many years the design of railway tracks has remained almost unchanged, even though the demand for increased train speed and heavier freight traffic has increased. In Australia, there has been a tendency to concentrate more on the design of track superstructure, while the substructure – consisting of the ballast bed (usually about 300mm thick coarse aggregates), compacted sub-ballast and structural fill (much smaller particles) and natural subgrade (for example, foundation soil) – is essentially expected to last for many years and therefore derives little attention in conventional design methods.

Several shortcomings, such as static rather than cyclic loading and the use of overly uniform particle sizes while ignoring particle breakage during passage of trains, prevail in current design practices. This often leads to high track maintenance and interruption of rail services.

While an accurate knowledge of the substructure is important in effectively assessing a maintenance plan and associated costs, a significant part of

Research conducted at the University of Wollongong proves that geosynthetics (polymer grids) and 'shock mats' made of recycled rubber can give rail tracks a more resilient long-term performance under high-speed trains.

the maintenance budget is allocated to correcting track geometry (for example, misalignment) caused by repeated train loading. The mechanisms of drainage and filtration, interface response between layers of different gradations, time-dependent changes of the granular materials due to compaction and degradation require further understanding and quantification for upgrading existing design methods.

The heavy-haul traffic of the Queensland rail network (approximately 100 million gross tonnes a year) suffers mainly from the breakdown of ballast and intrusion of coal fines (small particles of coal). The large lateral deformation of ballast – due to insufficient track confinement, fouling of ballast by coal from freight trains, soft formation soils (clay pumping), as well as ballast breakage – are the primary causes of track deterioration. In addition, wheel-rail irregularities induce additional impact forces that may lead to failure of the track formation.

Events such as quarrying for fresh ballast in spite of stringent environment controls, stockpiling used ballast albeit with little demand for recycling, and

routine interruption of traffic to repair tracks, have been instrumental in the allocation of significant research funds to improve ballasted rail tracks in Australia, North America, Western Europe, and South-East Asia. Finding the means to reduce the maintenance costs and lengthen regular repair cycles has been a priority for most Australian railway organisations occupying one of the busiest traffic schedules in the world.

Research conducted at the University of Wollongong proves that geosynthetics (polymer grids) and 'shock mats' made of recycled rubber can give rail tracks a more resilient long-term performance under high-speed trains. Geosynthetics increase the track capacity and reduce particle degradation through internal reinforcement and reducing particle movement, while shock mats mitigate the effects of impact loads that cause ballast degradation.

Recent research findings such as the revised ballast grading for enhanced track conditions, including the benefits of increasing track-confining pressure and the use of prefabricated vertical drains installed to stabilise soft soil formations, have been applied to several tracks in Australia and overseas.

Parts of track construction at Bulli, Sandgate, and Singleton in NSW, and post-tsunami track rehabilitation work in Sri Lanka are a few examples that have benefited immensely from these research outcomes.

PROFESSOR BUDDHIMA INDRARATNA FTSE is a Civil Engineering graduate from Imperial College, London, and obtained his PhD from University of Alberta. He is Professor of Civil Engineering and Founding Director of the Centre for Geomechanics and Railway Engineering at the University of Wollongong, now a leading centre for rail track research, undertaking national and international research contracts and consulting jobs. He is also a Program Leader of the ARC Centre of Excellence in Geotechnical Science and Engineering and Coordinator of rail track projects funded by the CRC for Rail Innovation. For his distinguished contributions to the Australian Railways he was awarded the Engineers Australia Transport Medal in 2011.



Placing shock mats at Mudies Creek Bridge, near Newcastle.

ANU identifies 18 technology areas for rail

An Australian National University report identifies 18 priority opportunities for technology development for the rail supply industry in three main areas – materials and manufacturing, monitoring and management, and power and propulsion.

The report, *On Track to 2040*, by ANU Enterprise, the university's commercial arm, makes strategic recommendations in six areas: governance, standardisation and regulation, funding, collaboration, research and policy.

"We've been working with industry, government and research teams to develop a strategic plan for the rail supply industry to gauge how it can position itself and build on its competitive advantages to meet the challenges and the opportunities over the next 30 years," said ANU Enterprise's Tom Wood.

"These recommendations represent the most important actions to be taken by the industry in achieving the industry's vision of collaboration, innovation and growth.

"Today there are around 330 companies with 15,000 employees engaged directly in rail, so it's a significant manufacturing sector and the opportunities to expand are large. A challenge will be trying to remain competitive globally."

The project was conducted in collaboration with the University of Cambridge-based Institute for Manufacturing, the CRC for Rail Innovation, and Strategic Connections Group.

SLEEPERS UNDERPIN RAIL UPGRADE

A major component of the most extensive upgrade of the nation's interstate rail network in almost a century is virtually complete. It has involved the replacement of old timber sleepers with 3.4 million new Australian-made concrete sleepers.

The Federal Infrastructure and Transport Minister, Anthony Albanese, said the new sleepers would increase the network's capacity and reliability, allowing it to carry larger trains at faster speeds including during the hotter summer months. "All up, we are currently rebuilding and modernising more than a third of the nation's 10,000 kilometre interstate rail network. Our aim here is simple: we want more freight on the back of trains. This would not only take the pressure off our highways, but also reduce harmful carbon emissions and boost national productivity," he said.

"This investment in the rail network will deliver a safer more reliable track, but has also supported the local economy by utilising local and indigenous labour, as well as regional contractors and suppliers," said Australian Rail Track Corporation Acting CEO Andrew Bishop.

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Supercomputer boost to Australian research

The door to the petascale era is opening for critical Australian research in climate change, the environment and a host of other areas with the ANU signing an agreement with Fujitsu to build and install a 1.2 Petaflop supercomputer.

It will be the most powerful computer in Australia and among the largest in the world, capable of performing 170,000 calculations per second for each of the seven billion people on the planet.

The new petascale supercomputer, to be installed at the National Computational Infrastructure (NCI) at ANU, will have the computing power, memory and storage of about 30,000 dual-processor computers working in tandem.

ANU Vice-Chancellor Professor Ian Young AO FTSE said: "The new supercomputer will provide Australia with a much-needed capability to meet national challenges, particularly in areas of research where deeper insights rely upon higher performance computation."

CSIRO Chief Executive Dr Megan Clark FTSE said the new computer would take Australia's research capacity to a new level.

"This is a truly Australian partnership, aiming to boost Australian research and to tackle the big questions. The supercomputer will revolutionise Australia's research capability through advanced technology and apply that to areas of critical national priority," Dr Clark said.

NCI Chair Professor Mark Wainwright AM FTSE said: "This development is a most significant outcome of the Commonwealth, national agencies and ANU working together to create vital infrastructure for Australia's researchers. We cannot hope to meet our national challenges without access to an international-class facility of the kind being developed, and Australia cannot hope to create such a facility without the cooperative efforts and advances that ANU, CSIRO, the Bureau of Meteorology, Geoscience Australia, the Australian Research Council and six leading research intensive universities have made in reaching this agreement. This is a unique partnership."

Dr Rob Vertessy, Acting Director of the Bureau of Meteorology, said the supercomputer would provide Bureau scientists with the ability to conduct research on complex weather and climate models in support of the Bureau's warning and information services.

WLAN TEAM TAKES ANOTHER PRIZE

The CSIRO team that invented a faster system for wireless local area networking – which later became the foundation of Wi-Fi in its most popular form today – has won a European Inventor Award 2012.

Inventors Dr John O'Sullivan, Dr Terry Percival, Mr Diet Ostry, Mr Graham Daniels and Mr John Deane were named as the winners of the 'Non-European countries' category of the annual awards for the patented WLAN technology at an awards ceremony in Copenhagen in June.

The team won an ATSE Clunies Ross Award in 2010.

The technology, which has given us the freedom to work wirelessly in our homes and offices, is now estimated to be in more than three billion devices worldwide and expected to be in more than five billion devices worldwide by the time the CSIRO patent expires at the end of 2013.

This is the first time an Australian team has won the award since it was launched in 2006.



Dr Terry Percival and Dr John O'Sullivan.

PHOTO: EUROPEAN PATENT ORGANISATION 2012

The EIA is presented in five categories: Industry, Research, SMEs, Non-European countries and Lifetime Achievement. Fifteen finalists were selected across all categories from almost 200 inventors and teams who were originally nominated, by an international jury comprising leading personalities from industry, science, politics and media.

Launched in 2006, the European Inventor Award is presented annually by the European Patent Office in cooperation with the European Commission and the country which holds the EU Council Presidency at the time of the award ceremony, which this year is Denmark.

The Danish Crown Prince and Princess and about 350 economic and political decision makers, researchers, scientists and intellectual property specialists attended the award ceremony at the Royal Danish Playhouse in Copenhagen.

Synchrotron supports LHC enhancement

The discovery of a Higgs boson-like particle will see the international research effort shift focus to study its unique characteristics, with Australia's Synchrotron playing a collaborative role with CERN (The European Organisation for Nuclear Research).

Australia's highest energy particle accelerator, which broke the world record for generating the "smallest, brightest, most intense electron beam", is a test bed for the new technologies and techniques needed for the next phase of Higgs boson-related study.

One of CERN's technology experts, Dr Ralph Steinhagen, has been working with researchers at the Synchrotron in Clayton on studies aimed at increasing the precision of measurements and control of particle beams. The work will inform the 2013-14 enhancement of CERN's Large Hadron Collider (LHC).

"We broke the world record for producing the smallest, brightest, most intense beam of electrons – a billionth of a millimetre tall," Dr Mark Boland, Principal Scientist in Accelerator Physics at the Australian Synchrotron, said recently.

"It's all a matter of control, and we are also working on developing new technology to make the beam as stable as we can."

That is of interest to CERN, said Dr Steinhagen, because the characteristics of light generated at the Australian Synchrotron are in many ways very similar to the LHC but more accessible.

Testing times for teachers and teaching

The decreasing demand from better-performing school-leavers for courses in teacher education reflects lower respect for the profession of teaching as a whole.



By Don Watts (right) and Keith McNaught

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Changed employment opportunities have had a marked impact on the teaching profession. Within the past 50 years, career and study opportunities have changed dramatically and new professions have emerged from the introduction of new technologies.

For women, their participation in a range of professional career options has risen dramatically – once their options were limited to teaching, nursing and secretarial work, regardless of their ability.

Levitt and Dubner (2009, p 44) address this issue in a definitive statement: “In 1960, about 40 per cent of female teachers scored in the top quintile of IQ and other aptitude tests, with only eight per cent in the bottom. Twenty years later, fewer than half as many were in the top quintile, with more than twice as many in the bottom.”

It is likely that similar trends apply to the male population entering teacher training, given also that the entrance scores required for a range of low-demand university courses have also reduced.

The period from 1980 to 2012 would likely show an escalation of the downward academic standard for teachers, with approximately half entering on the basis of their ATAR score. Very low ATAR (Australian Tertiary Admission Rank) scores are accepted by many institutions nationally; so low that the ‘necessary’ scores require failing at least three, if not four, of the student’s ‘best’ subjects.

Given that many of these students are taking lower level courses (for example, English rather than Literature) and that many are taking no mathematics and

science courses, their upper schooling pathway is a significant issue.

The decreasing demand from better-performing school-leavers for courses in teacher education also reflects lower respect for the profession of teaching as a whole. The factors affecting the standing of teaching are complex. However, there can be little doubt that publicly available information on entry standards for the profession bears a causal relationship.

The critical first step towards increasing the standing of the profession is to have mandatory testing for all graduates, requiring them to demonstrate competence in their key teaching areas. For example, all early childhood and primary teachers should be able to successfully complete a mathematics test to a Year 10 standard and English testing that includes spelling, grammar, reading comprehension, writing and, importantly, speaking and listening skills.

While this list of capabilities might be acceptable for early childhood and primary teaching it is clearly inadequate in recognising subject mastery in the disciplines and the more sophisticated demands in respect to presentation skills from adolescent students. Determining the dimensions of such testing is a challenge to the profession that must not be railroaded by the teachers’ unions, nor the governments’ bureaucracies.

The effect of having teachers unqualified for the tasks of teaching has significant ramification in efforts to remove inequities in learning opportunities.

Too often, the weakest graduates end up

teaching the neediest students, as they are less competitive in the employment market. In reality, we all know that the most disadvantaged students need the most skilled and capable teachers. No one can teach that which they do not know themselves, nor ensure that learning is well paced, linear and sequential, if the process itself is not understood.

It must be recognised that one of the important determinants of maintaining discipline in classrooms is the quality of the teaching.

In 2006 and 2007, a teaching project took one of us to a range of ‘hard to staff’ country schools to assist teachers with mathematics. The project benchmarked all the students in these schools with a thorough testing program to provide staff with an appreciation of their necessary starting point.

Many of the students were years behind their expected level due to a combination of high absenteeism, poor teaching and lack of family support for learning. Most concerning, however, were error patterns within student work and the apparent mathematical misconceptions that punctuated their testing, demonstrating that they had been mistaught concepts on which future learning would be dependent.

One whole class completed ‘subtraction with regrouping’ by subtracting the smaller number from the larger number, and every student interview revealed they’d been taught to do it this way. At interview, discussing the teacher’s own skills with mathematics, an upper primary teacher said “I’m good when it’s easy, like times tables, but I get lost after that”.

The teacher was a mature age graduate with low academic results and poor practicum performance. The Principal acknowledged that the

We all know that the most disadvantaged students need the most skilled and capable teachers. No one can teach that which they do not know themselves, nor ensure that learning is well paced, linear and sequential, if the process itself is not understood.

appointment was based solely on the person being the only applicant. It was little wonder the students were making such limited academic progress.

Had this teacher been required to pass a testing program prior to teacher registration they would never have been placed in front of a class. It remains true that the school really struggles to find teachers. The only realistic path to attack these problems is for the system to create real and tangible incentives to teach in low-demand positions.

While this example represents the worst-case scenario, there were significant numbers of practising teachers who lacked the very knowledge, skills and concepts they were employed to teach. There are countless examples of secondary teachers teaching in an area outside their competence and training range.

Again, a testing accreditation program would challenge school administrators not to simply create timetables based on gridlines and availability – they would have to place competent teachers within the subject and year of teaching. It would be the necessary assurance for parents and students that the teachers assigned to any class were in fact accredited to teach it.

Ridiculously, the current modus operandi is that a secondary teacher can be given responsibility for any subject, as the need dictates, when in reality their qualifications are usually specific to one or two learning areas.

Female teachers, particularly at the primary level, have carried the profession for many years, but as those bright, capable and dedicated women move towards retirement age, their replacements, regardless of gender, are not their equals. This places education systems and individual schools in an invidious position of disadvantage.

It will require that university preparation programs embed far more content, not just pedagogical skills, into units, particularly for early childhood and primary teaching courses. Those trained for secondary school positions must have studied their teaching areas through majors and minors, and have specialist knowledge in any subject they are asked to teach. It will also require national quality assurance systems, used in other countries, to create a rigorous standard for teacher accreditation and licensing.

A testing accreditation program would challenge school administrators not to simply create timetables based on gridlines and availability – they would have to place competent teachers within the subject and year of teaching.

The bigger issue is how our nation makes teaching a more rewarding profession to attract the best and brightest to this noble career, particularly in the more challenging areas of teaching where teachers are in undersupply.

We propose that from the age at which students enter upper secondary schools, the best judges of a teacher's performance and the class environment are the students themselves. In most schools students want to learn and do well. They also expect their teachers to show leadership and to engage them with the subject area.

Other information exists within the school in the minds of peer teachers and parents. School Principals must be charged with bringing this information together by informally sampling all these sources of information.

But in schools working as parts of a system of schools, the freedom to use this anecdotal information is limited.

The two most critical elements on which a teacher can be reasonably judged are competence as a communicator and mastery of the material to be taught. The mastery of the teaching content

can be easily assessed. It is essential that this assessment is formally done at all levels of teacher training and before any new assignment of duties. It is our experience that without this mastery of knowledge student interest in learning is lost and class discipline is problematic.

We reject the notion that if one is taught to teach, one can teach anything. The proviso is "only if the person has mastered the content". We are aware of a recent case where a very capable primary teacher was appointed as a school's music and Indonesian specialist, on a temporary assignment. In truth, she was appointed to sustain non-teaching duties for class teachers, but the parents were never informed of her lack of content knowledge. This is a blatant lack of integrity and yet it is far from a one-off case.

The effectiveness of a teacher or lecturer as a communicator is coupled, in the first instance, with a confidence that flows from mastery of content. However, there are many skills in the baskets of assets demanded by success as a teacher communicator that can be taught or developed if awareness

ATSE's STELR program professional development workshops aim to enhance teachers' skills in science teaching.



is created by example, practical demonstrations and through seeking feedback from colleagues and students.

A good communicator must be aware of the range of communication skills that are necessary components of successful teaching. No matter what the size of one's class, eye contact must be made with selected students all the time. How else is it possible to know whether you have lost your students and that a point must be repeated for reinforcement?

A teacher must use mobility and body and arm activity as a path to attracting attention and for emphasis, and voice intonation to remove boredom. Skilled teachers realise that reading text, except for uniquely important parts of an argument or in citing special short pieces of text, is very unwise, and that humour works but is best if spontaneous.

Clearly, any implementation of the requirements defined here will have major

industrial repercussions and create very significant problems in the management of the existing teaching force. There must be a serious program of assessment of individual teachers' needs for the teaching areas in which they aspire to teach and significant investment in retraining.

The roles of the teachers' unions in these programs are critical. It is also necessary that the education bureaucracies take seriously the critical needs for replenishment in the teaching force and work to create new conditions of trust with their teachers during these processes.

This program will be costly and governments must admit to their neglect.

REFERENCES

Levitt, S. D., & Dubner, S. J. (2009). *Superfreakonomics: Global cooling, patriotic prostitutes, and why suicide bombers should buy life insurance*. New York: William Morrow.

EMERITUS PROFESSOR DON WATTS AM FTSE held a Personal Chair in Chemistry at the University of Western Australia before becoming Director of the WA Institute of Technology, Vice Chancellor of Curtin University and then Vice Chancellor of Bond University. He retired from the position of Executive Director of the Northern Territory Education and Training Authority in 1995 and since then has been an Emeritus Professor at the University of Notre Dame, Australia.

PROFESSOR KEITH MCNAUGHT is Director of the Academic Enabling and Support Centre on the Fremantle campus of the University of Notre Dame, Australia. He has taught in primary, secondary and tertiary education for 30 years and held various school leadership roles as both a Deputy Principal and Principal. Keith's doctorate was related to his passionate interest and involvement in mathematics education.

Engineering shortfall needs significant initiatives

A Senate Committee report shows that engineering supply is not meeting demand and that significant initiatives are required to address the problem, according to the Australian National Engineering Taskforce (ANET).

An ANET spokesperson said the report highlighted the detrimental impact on Australian business and the community of failures to systematically tackle the engineering skills shortage.

"Governments are challenged to get value for taxpayers' money when their own in-house engineering capability has been depleted, while the private sector faces the equally debilitating effects of having to compete for increasingly scarce engineering skills," he said.

"The problem is chronic," said ANET – which comprises the Australian Council of Engineering Deans, Engineers Australia, Consult Australia, the Association of Professional Engineers, Scientists and Managers Australia and ATSE.

"It shows that with increasing pressure from the resources sector we have limited ability to construct and maintain road, rail, electricity and water services cost-effectively. This means that taxpayers, business and communities in general will continue to pay too much for too little.

"It is also timely to be reminded of this problem in the midst of a public debate on productivity. Engineers are the creative professionals who find productive solutions to problems across all sectors of our economy. Without a fully fledged plan to rebuild our engineering workforce, sustainable productivity improvements will be impossible to find."

The Senate Education, Employment and Workplace Relations References Committee received more than 70 submissions and held hearings across the nation in its inquiry into *The shortage of engineering and related employment skills*.

Among its 12 recommendations were:

- that the Government consider creating senior technical engineering roles in the Australian Public Service to ensure that highly qualified technical engineers may continue to build upon specialist knowledge while enjoying career progression in the public sector;
- that the Government consider how it can encourage Commonwealth contractors to provide graduate and cadetship programs through its procurement processes;
- that the Government work with the Australian Workforce and Productivity Agency and employers to develop targeted policies that encourage women to remain in, or return to, the engineering workforce; and
- that the Government work with Australian Workforce and Productivity Agency to continue to develop targeted policies that encourage mature engineers to remain in or return to the workforce.

It also suggested the Government seeks recommendations from the Chief Scientist about how it can best continue to support the development of science, technology, engineering and mathematics courses and that it works through the Council of Australian Governments (COAG) to promote science, technology, engineering and maths ability in states and territories.

ANET welcomed the findings that more needed to be done to prepare students for a rewarding career in engineering by lifting participation in STEM subjects at school.

"The report is an important first step in turning around a chronic situation. Its findings are well founded. However, its recommendations need further development."

ANET called on the Government to take the findings of the report seriously and establish new methods to ensure Government investment in infrastructure was used to develop Australia's engineering workforce, lift retention rates and improve national productivity.



Orbital's Director of Engineering Geoff Cathcart with an early prototype of the Redback.

Aussie engine for US Navy drone

An Australian engineering company has won a contract to supply a new engine for pilotless military aircraft.

Perth-based Orbital Corporation has been contracted to supply its 'Redback' Heavy Fuel Engine (HFE) to American unmanned aircraft systems manufacturer AAI, a Textron Inc. company, to be fitted to a Small Unmanned Aircraft System (SUAS) scheduled to see service with the US Navy and Special Operations Command.

The contract, worth up to \$4.7 million throughout 2012, is the result of a two-year effort by Orbital to perfect a tiny two-stroke engine that can run reliably on military specified heavy fuels while meeting aggressive fuel economy, weight and noise reduction targets. The Redback is a single-cylinder engine constructed of lightweight materials that will fit in a shoebox.

Most small unmanned aerial vehicles (UAVs) currently in service use conventional gasoline-powered two-stroke engines, often criticised for noise, consumption and reliability issues. The US military and NATO are moving to phase out gasoline use, in part because of its relatively high volatility compared with 'heavier' JP5 and JP8 kerosene-based fuels.

Engineering development to reduce the Redback noise emissions included refinements to the engine block, exhaust system, speed of revolution and propeller design.

"Key to our engineering team's success with the Redback has been the use of Orbital's patented FlexDI™ fuel injection and engine management system," said Orbital's Director of Engineering, Geoff Cathcart. "FlexDI™ differs from conventional direct injection systems because it injects the fuel at comparatively low pressure and utilises air pressure to atomise the mixture as it is delivered to the combustion chamber."

Orbital is better known for its engine development work for the automotive and recreational vehicle industries. Its FlexDI™ technology has been fitted to more than 650,000 scooters, all-terrain vehicles, marine outboards and auto-rickshaws worldwide since 1996 and is considered a technical benchmark in the automotive sector.

• Orbital founder Ralph Sarich won a 1991 ATSE Clunies Ross Award for automotive engineering.

NEXT STEP FOR ARMY HAWKEI

The Australian Government has allocated \$38 million to further develop and test the next generation Hawkei Light Protected Mobility Vehicle for the Army. Thales Australia's Hawkei is a mobile, seven-tonne fighting vehicle that offers a high level of protection for the soldiers inside it,

which was selected by the Government last year as the preferred vehicle for development and testing.

Thales Australia is currently manufacturing Bushmaster Protected Mobility Vehicles at its factory in Bendigo and this manufacturing capability, and the skills of the workforce, is regarded as an important national security capability which will be required for the production of the Hawkei.

The Department of Defence has now reached an agreement with Thales Australia to develop six prototype Hawkei vehicles for further testing. The first will be delivered later this year and during 2013, the prototypes will undergo a range of testing and evaluation.

Final Government approval of the project is expected to be considered by 2015. Bushmaster manufacture is due to finish before the end of 2013. To retain critical skills in Bendigo while the design of the Hawkei is finalised and proven, the Government has announced the proposed acquisition of a further 214 Bushmasters.

This announcement is in addition to the purchase of 101 Bushmasters to support Australian Defence Force (ADF) operations in Afghanistan announced by the Government in May last year. It underlines the Australian Government's commitment to the retention of critical skills in Australia's defence industry.

The new Bushmaster vehicles will progressively replace the oldest Bushmasters in the present fleet and provide ongoing protected mobility for the command and control of artillery. Production of the additional Bushmaster vehicles will commence in October.

Production will be based on successive tranches of 50 vehicles with orders dependent on Thales meeting key milestones to develop Hawkei into a suitable vehicle for Project LAND 121 Phase 4 – a \$1.5 billion project to provide up to 1300 protected and unprotected light vehicles for the Army.

Geelong carbon fibre auto wheel launched

Geelong firm Carbon Revolution has launched its groundbreaking one-piece carbon fibre wheel – the CR9 – which delivers significant fuel savings, is much stronger than conventional aluminium or steel wheels and is up to 50 per cent lighter. The CR9 was tested in Germany at the world-renowned Fraunhofer Institute. Carbon Revolution will export most of its wheels to Europe and the US.

"This is a good news story for Geelong and Australia," the Parliamentary Secretary for Climate Change, Energy Efficiency, Industry & Innovation, Mark Dreyfus, said at the launch. "At full capacity, Carbon Revolution's new Geelong manufacturing facility is expected to produce 250,000 wheels a year and employ up to 200 skilled workers in this new high-tech manufacturing industry."

"The next step is to expand the business. Carbon Revolution is planning to build production facilities capable of producing two million wheels a year – the typical scale of conventional aluminium wheel manufacturing plants around the world," said the Federal Member for Corio, Richard Marles.

"The wheel has been in development for more than seven years, with much of Carbon Revolution's initial research and design undertaken in partnership with Deakin University," said the Federal Member for Corangamite, Darren Cheeseman.



A Carbon Revolution CR9 car wheel.

National water strategy essential

Australia will not have enough fresh water to meet the combined needs of a rapidly growing population, expanding industries and conservation of native landscapes in the mid-21st century if it fails to articulate a national groundwater strategy for the future, according to two of the nation's most eminent water scientists.

Professor Craig Simmons and Professor Peter Cook of the National Centre for Groundwater Research and Training (NCGRT) issue the caution as the National Groundwater Action Plan winds up and the latest Murray–Darling Plan proposes changes to groundwater rules.

“Though many things have been accomplished under the Groundwater Plan, much still remains to be done to secure the nation's groundwater resources into the future,” the scientists say in a discussion paper circulated among water policy and scientific experts.

They identify 12 issues that need to be addressed to achieve greater national water security. These include understanding and resolving issues surrounding the impact of coal seam gas, geothermal, mining and farming activity on groundwater resources, better understanding of the links between ground and surface waters, and resolving legal and technical questions over the storage of surplus water in underground aquifers.

“Some of the biggest challenges concern public trust and confidence issues regarding groundwater,” Professor Simmons says. “Most Australians are simply not aware that the vast bulk of our fresh water is underground, out of sight, out of mind. They do not realise it supplies much of the water we see in our surface rivers and wetlands, and hence much of our drinking water.”

The researchers argue there is an urgent need for public education and ‘mythbusting’ about groundwater, especially the widely held view that it represents a more-or-less unlimited resource for the future.

“Australia is a very old continent and many of its groundwaters are fossil – meaning they can be tens of thousands, even hundreds of thousands of years old. They take that amount of time to recharge. Any plan to make use of them needs to take their age and recharge rate into account,” Professor Cook says. “We also seek to exploit an exceptional opportunity for Australia to store more of its surface water underground, where it avoids evaporation, by deliberately recharging suitable aquifers. But many of the legal, social and public acceptance issues around this remain to be worked out.”

Another vital issue is how climate change will affect Australia's native landscapes through its effect on groundwater, they say. If aquifers contract out of reach of the deep roots of eucalypts, mallees, acacias and other important native species, whole landscapes can die.

A related issue is the intrusion of seawater into coastal aquifers as they are pumped out for human use. This could affect the viability of many coastal cities and communities that rely on groundwater, they warn.

“Then there is simply the question of whether we understand enough about our hidden groundwaters and are able to model impacts on them with sufficient accuracy to be able to manage them adequately,” Professor Cook says.

Professor Simmons adds that governance of Australian groundwater is still far from optimal, including having a common understanding of terms and of the resource itself.

“We need frameworks that connect high-level national resource management to the interests of local communities, industries and other users, in a way that makes for rational decisions and sound resource use,”



Conducting groundwater research at NCGRT using a centrifuge permeameter.

Professor Simmons says.

“When industries, communities and the environment are competing for the same water resource – as is bound to happen increasingly from now on – we need better ways for allocating the water that meet social, economic and environmental needs. The National Water Initiative provides a good basis – but it is important it is fully adopted.”

Finally, the team warn that Australia faces an acute scarcity of skilled water managers and will need to redouble its efforts to train more. “You can’t run the mining industry without geologists or agriculture without farmers. Water

is a resource vital to both and to every other facet of Australian life – and needs to be equally well planned, managed and allocated.”

The researchers have called for a group of top-level water managers, government departments and water scientists to develop a draft National Groundwater Strategic Plan that addresses these issues.

KARLENE MAYWALD HEADS NWC

Former South Australian Nationals MP and Minister for Water Security and the River Murray, Ms Karlene Maywald, has been appointed Chair and Commissioner for a three-year term from 1 July 2012. Professor Stuart Bunn, Director of the Australian Rivers Institute, was acting Chair of the Commission from 1 April 2012.

The Parliamentary Secretary for Sustainability and Urban Water, Senator Don Farrell, said Ms Maywald brought a high level of expertise in water resource management to the role.

“Karlene Maywald was SA's Minister for Water Security and the River Murray during one of the worst drought periods in living memory. She has a proven, long-standing track record in water management and is passionate about water reform in Australia,” he said.

Australian Government-nominated Commissioner Mr Robert Freeman, former CEO of the Murray–Darling Basin Authority, has

been reappointed. The two Commissioners nominated by the states and territories – Professor Bunn and Mr Chris Davis, former CEO of the Australian Water Association – have also been reappointed.



Karlene Maywald

• Professor Bunn officially launched ATSE's Sustainable Water Management report in Sydney in May and Ms Maywald was a speaker at the workshop and contributed an article for Focus 172 on Murray–Darling Basin reform.

Groundwater group studies Queensland

The Groundwater Research Group (GReG), an initiative of the National Centre for Engineering in Agriculture and Faculty of Engineering and Surveying at the University of Southern Queensland, has been established to conduct independent research to investigate the impact that the coal seam gas, mining and agriculture industries have on water in Queensland.

GReG will be led by Professor Jochen Bundschuh and Dr Elad Dafny, international leaders in the field of underground water research.

Professor Bundschuh said there was a large gap in the knowledge surrounding underground water in the region. "It's important that we build a more complete picture of the sub-surface water. At the moment no one knows exactly what the outcomes will be in relation to the use of groundwater by industries like the coal seam gas industry."

Dr Dafny said one of the most important research goals was to determine the recharge rate and connectivity of underground aquifers in order to work out exactly how much water can be withdrawn without having negative long-term impacts.

Professor Bundschuh said Queensland's Great Artesian Basin was one of the three biggest underground water resources in the world so it was vitally important to determine how it can be used at a sustainable level.

"If we contaminate this Basin there is no way to reverse it, so as a society we need to be very careful," he said.

Dr Elad Dafny (left) and Professor Jochen Bundschuh.



New approach needed to agriculture education

Agriculture industry leaders and educators have again called on the Federal Government to support the formation of a new body to overhaul the way the industry attracts, educates and retains talent.

The call came from a recent roundtable discussions in Canberra, which said agriculture had the potential to become Australia's new 'boom' industry.

The roundtable sought a new council to be responsible for completely overhauling the delivery of agricultural education, and for the implementation of a major marketing campaign to change public perceptions of agriculture. The aim of the council would be to stem the

tide of skills shortages facing the agricultural sector. The formation of such a council was a key recommendation of the report *Rebuilding the Agricultural Workforce* into reviving the agricultural workforce, commissioned last year by the Business/Higher Education Roundtable (B-HERT).

AgriFood Skills Australia, the AgriBusiness Council of Australia, B-HERT and the Primary Industry Centre for Science Education (PICSE) coordinated the roundtables.

Dr Sharon Winocur, Executive Director of B-HERT, said one of the first tasks of the council would be to identify a leader who could represent the diverse interests of the industry and drive this issue forward to an agreed vision and mission. "The industry, business, government and education representatives present agreed on a way forward that will see us reducing duplication of effort, consolidating resources and moving forward with one vision to stem the tide on this urgent industry issue."

Mr Ian Joseph, Chair of the AgriBusiness Council of Australia, said the council would help future-proof the industry by improving educational links and options so the industry could innovate, increase productivity and grow to meet global challenges such as food security.

Mr Arthur Blewitt, Chief Executive Officer for AgriFood Skills Australia, said that the council would help address many issues.

Associate Professor David Russell, National Director of PICSE said it was critical that the voices of youth fed into the industry roundtable. "To attract the future generation of professionals into agriculture, we need to continue to build networks between school students, universities and teachers through the PICSE program," he said. "Agriculture has the potential to be the next boom industry if the right approach to engagement, training and recruitment is adopted."

AUSTRALIA CAN "LEAD THE WORLD"

Australia is in a unique position to lead the world in finding viable solutions to hunger and malnutrition, according to CropLife Australia, the industry organisation representing the agricultural chemical and biotechnology (plant science) sector in Australia.

With a thriving agriculture industry that provides 93 per cent of its domestic food supply, Australia is a world leader in food production, CropLife said in a statement marking World Population Day (11 July).

Australia was embracing innovation and working solidly towards sustainable and environmentally friendly farming practices, it said. The future of food production was heavily reliant on advances in science and technology, which allow farmers to deliver more food with less resources.

Political support for science-based, efficient and effective regulation would afford Australia the opportunity to set the benchmarks for the rest of the world in innovative and progressive agriculture policy. Policy makers should be doing their utmost to encourage research and innovation, embracing new technologies and supporting their path to market.

CropLife Australia CEO Matthew Cossey emphasised the essential role played by modern sustainable agriculture in ensuring food and nutrition security as well as economic stability.

"World Population Day should draw global attention to the fact that we will have over 9 billion mouths to feed by 2050. The ratio of arable land to population is declining by 40 to 55 per cent and 1.8 billion people will be living with absolute water scarcity by 2025.

"There has never been greater pressure on global agriculture and Australia has the ingenuity, knowledge and skills needed to develop sustainable solutions and feed and nourish the future," Mr Cossey said.



Mixed farming – a protection against climate variability.

PHOTO: CSIRO

Diversify to survive, says CSIRO

Broadening their mix of agricultural enterprises could help farmers protect themselves from the long-term impacts of climate variability, according to a new report from CSIRO.

Aside from market fluctuations and changes in commodity prices, CSIRO says climate variability is the greatest threat to the long-term economic viability of dryland farms. In order to counter these uncertainties, many farmers have turned to diversification as a short-term survival strategy, but little research exists on the long-term benefits.

A recent study by CSIRO's Sustainable Agriculture Flagship in the Lower Murray region in southern Australia set out to confirm whether diversification has any real long-term benefit for farmers.

The study used advanced simulation, probability theory and soil and climate modelling, including the Agricultural Production Systems Simulator (APSIM), and found that diversification not only helps farmers to hedge their bets against commodity price fluctuations, it can also help protect them from climate variability.

The research found diversification should be considered as a long-term strategy to mitigate economic risk from climate variability, a feature of farming that may increase in future in response to climate change.

CSIRO's John Kandulu, the lead author, said diversification could reduce standard deviation by up to 52 per cent of average net returns and increase the probability of breaking even by up to 20 per cent.

"We found the greatest benefit for diversification can be achieved by those farmers in moderate rainfall areas where there is a mix of grazing and cropping, with limited benefit for those in very high and very low rainfall areas," he said.

\$400M QUARANTINE FACILITY IN VICTORIA

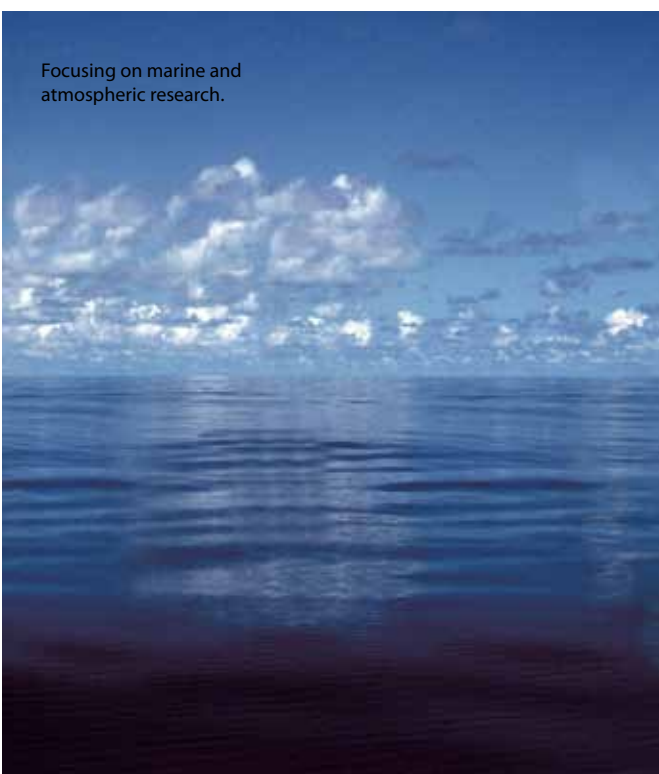
The Australian Government will build a new \$400 million post-entry quarantine (PEQ) facility on 144 hectares of land at Mickleham, on Melbourne's northern outskirts.

The Minister for Agriculture, Fisheries and Forestry, Senator Joe Ludwig, said the PEQ facility would be equipped with the newest and most advanced technology available.

"The importation of new genetic material is necessary to increase competitiveness and productivity in our agriculture sector," Senator Ludwig said. "This new facility will enable the government to continue to safely monitor the importation of animals and plant material that may pose a biosecurity risk."

The PEQ facility, which will commence operation in 2015 and be operated by the Department of Agriculture, Fisheries and Forestry (DAFF), is planned to strengthen Australia's defences against pests and diseases and will allow imported animals and plants to be held for a specified period in a quarantined environment before release into Australia.

The facility will cater for the quarantine clearance of live plants and animals including dogs, cats, horses, ruminants (such as alpacas), live birds, bees and fertile eggs for the domestic poultry industry.



Focusing on marine and atmospheric research.

New deal on marine and atmospheric research

CSIRO and the US National Oceanic and Atmospheric Administration (NOAA) have signed a series of agreements that bring together the scientific capabilities of two global leaders in marine and atmospheric research.

The agreements are designed to facilitate ongoing collaboration between the two organisations and provide a forum for new discussions about broadening cooperation and emerging issues and opportunities.

They cover research on the El Niño – Southern Oscillation (ENSO) phenomenon, ocean observations and climate variability across the Pacific, the Southern Hemisphere regional carbon cycle and ocean acidification, ecosystem-based management of marine resources and initiatives to promote scientific exchanges and collaborative workshops.

CSIRO and NOAA are Australia and the US's major national marine and atmospheric research institutions and the agreements build on a memorandum of understanding signed in Washington in February 2010.

"No more cloudy days" for solar

A new report – *Solar intermittency: Australia's clean energy challenge* – demonstrates that there are no insurmountable barriers to increasing the use of large-scale solar energy in the national grid, according to CSIRO.

The report results from a year-long, world-first study funded by the Australian Solar Institute and CSIRO, together with the Australian Energy Market Operator and the Energy Networks Association, which investigated the concerns around solar intermittency and its impact on electricity systems.

Key findings included:

- 1** We can 'fix' intermittency – with knowledge and tools, such as solar forecasting and energy management, CSIRO can provide the information required to manage solar intermittency.
- 2** We need a customised approach – there is no global consensus on managing solar intermittency. It is not uniform and different sites, regions and countries require individual solutions. Local research and demonstration pilots are required. Australia has a unique electricity network and we need unique solutions.
- 3** We need a highly flexible electricity grid – if large amounts of solar energy are to be used as a power source in the future, the electricity grid has



Solar intermittency: Australia's clean energy challenge.

to be designed or adapted for renewable energy sources, while keeping network costs low.

CSIRO and partners say they now better understand what it will take to manage solar intermittency so it is no longer a barrier to the uptake of large-scale solar energy, as CSIRO now has the foundation research required to help Australia's electricity and solar industries cost-effectively manage solar intermittency.

During the project it was found that in some cases local utilities do limit solar power generation because they fear that adding solar power to the grid will make it harder to manage their electricity system.

BLUESCOPE GOES FOR SOLAR ROOFING

The Australian Government will contribute \$2.3 million to Bluescope Steel's \$5 million development of a prototype building-integrated photovoltaic (BIPV) system – taking Australia to world leadership in putting low-cost solar power into residential and commercial rooftop design.

The company will develop a new roofing profile that joins Australian steel roofing and inverter systems with international second-generation thin-film solar technologies. It provides for the simultaneous installation of roofing and solar technology and allows new buildings to adopt the design. The technology will be capable of generating energy for the electricity grid.

Announcing the \$2.3 million Emerging Renewables Program grant, the Minister for Resources and Energy, Martin Ferguson, said the grant

would allow the mass deployment of this technology across residential, commercial and industrial rooftops in Australia.

"The prototype will be easily scaled up to the operational stage ensuring future BIPV systems can be cost-effective without Government subsidies," he said. "This project will help make Australia a world leader in BIPV development, particularly for thermal roofing featuring flexible thin-film technology."

Australia's installed rooftop photovoltaic capacity increased from 23 to 1450 megawatts between 2008 and 2012 and is expected to grow to more than 5100MW by 2020 and 12,000MW by 2031.

WAVE ENERGY FOR NAVAL BASE

The Department of Defence and Carnegie Wave Energy have signed power supply and grid connection agreements that will allow Defence to purchase all the electricity produced by a wave-power facility to be established on Garden Island, near Perth, the home of HMAS Stirling, Australia's west coast submarine base.

The project will create 25 jobs within Carnegie and 100 more in manufacturing and construction by making use of the powerful Indian Ocean swell off Garden Island to help power the biggest naval base in Australia. Construction of the wave-power facility at HMAS Stirling is expected to start later this year, with wave-driven power expected to be supplied before the end of next year. The project will provide HMAS Stirling with up to 1.25 megawatts of power a day.

COMCAR TRIALS BATTERY-DRIVEN COMMODORE

COMCAR, the Australian Government's national car-with-driver operation, has made automotive history becoming the first Australian car fleet to trial a fully electric Australian car designed with battery switch technology.

Developed by Melbourne-based consortium EV Engineering, the electric Holden Commodore has been designed with the capability to switch its depleted battery for a fully charged one.

The trial of this zero-emissions vehicle will enable COMCAR to consider the viability of introducing electric vehicles into its fleet as older vehicles are decommissioned.

"A two-week trial around the clock will help COMCAR determine the suitability of electric cars for its 146-car fleet and how these vehicles meet government environmental objectives," Special Minister of State Gary Gray said.

"EV Engineering is building seven proof-of-concept electric Holden Commodores with the assistance of a \$3.5 million grant from the Australian Government's New Car Plan for Greener Future. We're delighted to be part of this project and to have the chance to trial one of these innovative cars."

COMCAR will evaluate the vehicle across a range of measures including energy efficiency, Green Vehicle Guide rating, passenger comfort, practicality and luggage capacity. The electric car has a range of up to 160 kilometres and is powered by a 145kW/400Nm motor. So far, 14 public charge spots have been installed in the ACT.

FERGUSON BACKS WAVE POWER WITH GRANTS

The Australian Government has invested nearly \$20 million in wave power projects, according to the Minister for Resources and Energy, Martin Ferguson.

Announcing a \$5.6 million grant for BioPower Systems Ltd's \$15 million bioWAVE™ Ocean Pilot off the coast of Victoria and just under \$4 million to Oceanlinx Ltd's \$7.2 million Commercial Wave Energy Demonstrator off the coast of South Australia, Mr Ferguson said Australia was becoming a major global developer of wave energy.

"Including a grant for Carnegie Wave Energy, the Australian Government has now contributed close to \$20 million to new wave energy technologies through the \$126 million Emerging Renewables Program," Mr Ferguson said.

"This makes us one of the world's largest supporters of wave energy, with a diverse range of technologies in development. Wave energy is still very much an emerging technology and this funding will position Australia as a global leader in developing this technology.

"Australia's wave energy resources are considered to be among the best in the world, with the area between Geraldton in Western Australia and the southern tip of Tasmania able to provide more than 1300 terawatt hours per year, or about five times Australia's total electricity requirements."

BioPower's bioWAVE™ unit is designed to survive the severe forces of the Southern Ocean while generating up to 250 kilowatts of electricity, transported to the grid via subsea cable. Following assembly of the 400-tonne unit in 2013, the pilot is scheduled to operate to late 2015. The project has also received \$5 million funding from the Victorian Government.

The bioWAVE™ is mounted on the seafloor, with a pivot near the bottom. The array of buoyant floats, or 'blades', interacts with the rising and falling sea surface (potential energy) and the sub-surface back-and-forth water movement (kinetic energy). As a result, the pivoting structure sways back and forth in tune with the waves, and the energy contained in this motion is converted to electricity by an onboard self-contained power conversion module, which contains an hydraulic system that

converts the mechanical energy from this motion into fluid pressure, which is used to spin a generator.

Oceanlinx's 1-megawatt capacity GreenWAVE is a shallow water technology with no underwater moving parts. It employs Australian-designed oscillating water column, turbine and conversion components and is scheduled to be connected to the grid by subsea cable from late 2013.

Gas exports to triple

Australian gas markets are expected to undergo significant change over the short and long term, particularly in eastern Australia, through a rapid increase in LNG exports from the middle of this decade, according to the latest Bureau of Resources and Energy Economics (BREE) Gas Market Report.

Over the next five years, Australia's wholesale gas prices could increase substantially as prices converge towards international prices once LNG exports from Gladstone commence around the middle of this decade and also from higher production costs.

"Higher gas prices in eastern Australia should support investment in gas supply and ultimately result in an increase in gas production, which in turn would put downward pressure on gas prices," said Professor Quentin Grafton, BREE's Executive Director and Chief Economist.

International gas markets are also expected to experience change through strong increases in consumption, the application of new technology and changes to pricing and trade patterns.

BREE expects global gas consumption and trade to increase over the next two decades, largely in non-OECD economies, underpinned by strong economic growth and diversification of electricity generation away from coal to gas.

Australia is expected to play an important role as an LNG exporter, with exports increasing from about 20 million tonnes currently to more than 63 million tonnes in 2016-17 and continuing to increase until the end of this decade.

"Gas will increasingly become the fuel of choice in many developing economies due to its low carbon emissions relative to other fossil fuels and because of its versatility as a fuel that can be used in electricity power generation and for direct heating," Professor Grafton said.

PHOTO: BIOWAVE SYSTEMS PTY LTD





The Lidar set-up at Lake Turkana.

Aussie technology helping wind power in Africa

Australian laser technology is poised to bring a huge improvement to the lives of tens of millions of East Africans.

A state-of-art lidar (laser radar) system acquired by the CRC for Contamination Assessment and Remediation of the Environment (CRC CARE) to help prevent dust and atmospheric pollution in Australia is being used to perfect the design of what could become the world's largest wind farm, at Lake Turkana in northern Kenya.

The first stage of the vast project will have 365 turbines producing 300 megawatts of power, possibly growing as large as 2000MW in future. It is located in one of the remotest and poorest desert regions on Earth.

"It's an absolutely massive project – in renewable energy terms it's the equivalent of discovering a major oil field. It will supply 20 to 30 per cent of all Kenya's power needs and potentially neighbouring East African countries," says Mr John Sutton, of CRC CARE and Curtin University, who developed the sophisticated lidar analytical technology.

The Doppler lidar instrument was originally developed to measure wind-shear at airports, but the CRC CARE research team developed algorithms that enabled it to analyse pollution plumes in the atmosphere. These are currently being employed to help industry to reduce dust and other forms of air contamination in Australia.

"We have been collaborating with scientists at Arizona State University to extend the laser radar technology to wind energy applications," Mr Sutton says.

The \$775 million Lake Turkana Wind Power Project is the largest single development in Kenya's history, with energy generation due in 2014. The first stage alone will make it the largest wind-farm in Sub-Saharan Africa.

"It's in really unusual country, very hot, dry and windy – like parts of Australia. At Turkana the jet stream is channelled between two mountain ranges and blows at a steady average of 11 metres a second, day and night," Mr Sutton explains. "The project needs detailed models and maps

of the wind flow over this complex terrain to design the farm and place the turbines in the best locations."

The team used a pulsed coherent Doppler lidar 'wind tracer', which uses a laser beam to scan and measure wind vectors by bouncing light off wind-borne dust particles, over an area of up to 400km².

"Our technology was able to measure the wind field at points every 100 metres across the entire landscape every 10 minutes with precision. The results were used to validate the models being used to design the wind farm.

"This is truly powerful technology. The wind farm means the economies of Kenya and East Africa can now accelerate their economic development. That in turn will bring a profound change to the lives and opportunities of millions.

"For example, it helps large miners dramatically reduce the cost of monitoring and controlling dust pollution from mining, stockpiling and ship-loading activities. Basically, it enables us to study atmospheric processes – whether for the purpose of preventing industrial pollution, detecting windshear at airports or for generating energy – more efficiently."

SOLVENT CUTS CCS COSTS

A solvent similar to baking soda is the centrepiece of a new carbon capture system that can reduce the cost of capturing carbon dioxide from power stations by at least \$20 per tonne compared to current technology.

The UNO MK3 system, developed by the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC), integrates several research streams to substantially reduce separation costs, as well as greatly improve its environmental footprint.

CO2CRC Chief Technologist Barry Hooper said CO2CRC capture research focused on three aspects of carbon capture to make improvements to the overall system: the separation medium, the right equipment and integration with power plant operations.

The first aspect of UNO MK3 is a separation system using potassium carbonate, a solvent similar to baking soda, which reduces energy requirements by up to 20 per cent, he said. The unique precipitating process also eliminated the need for SO_x and NO_x removal, a significant capital cost, while producing a byproduct that can potentially be used in fertiliser manufacture.

Fit-for-purpose equipment designed by CO2CRC – such as its patented concentric concrete columns, which are smaller and cheaper to build than stainless steel columns – has also reduced costs

The third thread is heat and process integration. By integrating the capture process into the power station, CO2CRC has been able to reduce the system's energy use by at least 25 per cent.

"UNO MK3 is now in demonstration phase, with current projects at lab and pilot scale and a work program planned out to full scale demonstration. With its ability to be applied to pre- and post-combustion sources, particularly Natural Gas Combined Cycle plants, we see real promise in this technology for reducing greenhouse gas emissions," Mr Hooper told the 37th International Technical Conference on Clean Coal and Fuel Systems in Florida.

"The goal of the CO2CRC research program is to reduce capture costs by 50 to 70 per cent compared to current technology. The research outcomes culminating in UNO MK3 tell us we are very close to making this a reality," he said.

Edwina Cornish now Monash Provost

Professor Edwina Cornish FTSE, currently the senior Deputy Vice-Chancellor at Monash University, has been appointed foundation Provost of Monash from 3 September.



Edwina Cornish

The Provost will be the Vice-Chancellor's core deputy, and will oversee all academic operations of the university. The Deputy Vice-Chancellors and Deans will report through the Provost to the Vice-Chancellor.

Dr Alan Finkel AM FTSE, Monash Chancellor, said the establishment of a Provost post would bring the Monash University senior structure into line with most other universities "operating at the level to which we aspire" and would also allow the Vice-Chancellor, Professor Ed Byrne, to pay more attention to strategic initiatives.

"I regard the establishment of a Provost role as a robust basis upon which to meet the challenges of the future without neglecting the university's core business," he said.

TWO WIN SCIENCE EDUCATION AWARDS

Susanna Greig has won the 2012 PICSE/Dow AgroSciences Science Education Officer Professional Development Award.

Susanna, who has worked with PICSE (the Primary Industry Centre for Science Education) for seven years and is based at the University of New England, said she was honoured to have been recognised.



(From left) the Hon Sid Sidebottom, Parliamentary Secretary for Agriculture, Fisheries and Forestry, Susanna Greig, and Dow AgroSciences Research and Development Leader for Australia and New Zealand Dr Matt Cahill.

"I'm really committed to supporting teachers to promote the science supporting agriculture to their students," she said. "I'd like to know more about how, within the new (national science) curriculum, the science supporting agriculture will be incorporated into the science classroom."

Alana Johnson (18), from Tamworth, won the 2012 PICSE/Dow AgroSciences Travelling Scholarship Award, which includes an all-expenses paid placement at the Dow AgroSciences Global Discovery Research Station in Waireka, New Zealand.

"I'm really excited about winning this award," she said. "At the moment I am thinking about agronomy but this travel prize will really help me see what the options are."

The awards, now in their second year, are available to outstanding students who have participated in PICSE scholarship programs and to PICSE Science Education Officers who help provide support and resources to science teachers.

Sleep disorder device gets CA grant

Chronic sufferers of sleep disorders know the havoc disruptions to circadian rhythms (the biological clock) can play on sleep. Insomnia and other sleep disorders can cause anxiety and depression, while chronic insomnia is a leading cause of workplace injury.

Two sleep psychologists from Flinders University have invented a simple device that can help and commercial availability may be nearer through a \$137,875 Proof of Concept grant from Commercialisation Australia, which builds on an earlier \$20,200 Skills and Knowledge grant. The new funding will be used to demonstrate the commercial viability of this technology to prospective lead customers in export markets.

The Re-Time Light Therapy Device can assist in the treatment of misaligned circadian rhythms, jetlag, winter blues and shift work sleep disorders and the funding for its further development was among 26 projects for which Commercialisation Australia has announced another \$9 million in funding to entrepreneurs and researchers, on top of the \$97.1 million already provided over the past two years, which is assisting 248 innovative businesses.

The new funds will support 24 new participants and extend additional funds to two both Re-Time Pty Ltd and another existing

participant, Voztec Pty Ltd.

Commercialisation Australia CEO, Mr Doron Ben-Meir, said Australian inventions could only make a difference once they made it to market. Commercialisation Australia was a key plank in this process.

"Commercialisation Australia provides an injection of funding and skills at a point in the business cycle when it is difficult to attract resources from the private sector," he said.

The biggest grant in the latest round went to WA's HiSeis Pty Ltd, which will receive \$2 million to develop high-definition 3D seismic services for mining exploration. Tritium Pty Ltd, from Queensland, will receive \$1.1 million to develop advanced rapid charging for electric vehicles.

Electronic health record now available

Australians can now register for a Personally Controlled Electronic Health Record (PCEHR), which is planned to bring key elements of patients' health information together in a unified, electronic record.

The PCEHR system gives registered users and their healthcare providers access to a summary of their medical history. The intention is to allow for healthcare providers to make better and more efficient decisions regarding patient treatment.

PARLIAMENTARY FRIENDSHIP GROUP

The Parliamentary Friends of Women in Science, Maths and Engineering was launched at Parliament House, Canberra, in June.

Established by Kelly O'Dwyer, Federal Member for Higgins and Amanda Rishworth, Federal Member for Kingston, it aims to shine a spotlight on existing opportunities for women in the industry and how those opportunities can be boosted to help Australia achieve its full potential.

It seeks to promote careers in science, celebrate the achievements of women in the industry, foster relationships between the industry and political representatives and consider barriers to participation.

Dr Elizabeth Blackburn, Australia's first female Nobel Laureate, was a special guest at the inaugural event. The Minister for Science and Research, Senator Chris Evans, told the audience providing opportunities for women in science was crucial to ensure the future productivity and global competitiveness of the country.

KIRA WINS WOMEN IN ENGINEERING AWARD

Kira Evans is the 2012-13 winner of the Thiess–Minerals Council of Australia Women in Engineering Scholarship.

Kira is studying a Bachelor of Petroleum Engineering and Mining Engineering combined degree at the University of Adelaide, where she has held many student leadership roles, including ambassador for Adelaide University's Women in Technology Day. Her immediate career goal is to graduate and work toward a First Class Mine Manager's Certificate.

Now in its fifth year, the award is open to all female undergraduate engineering students studying in Australia and provides \$8000 a year for the final two years of study.

Thiess, the integrated construction, mining and services company, and MCA, the national body representing Australia's mining and minerals processing industry, aim to advance the role of women in the resources sector through the award.

MCA has also announced it will fund two scholarships to the Australian Institute of Company Directors (AICD) company directors course to help increase the leadership credentials of women in the minerals industry. The scholarships, worth \$9200 each, include registration for the course, one year membership of the AICD and travel and accommodation expenses.

Kira Evans and
Opposition Leader
Tony Abbott.



The PCEHR – available since July – has been a major focus of the Australian Government's National e-Health Strategy.

The PCEHR system will provide the necessary infrastructure, standards and specifications to enable secure access to the registered user's health information drawn from multiple sources.

Suppliers of e-Health systems will be able to enhance their products and services to become conformant with the relevant standards and specifications and support healthcare organisations in accessing the PCEHR system.

Cretan diet "simple and easy"

A 'Cretan' diet can help avoid heart disease and assist type 2 diabetes sufferers, according to a Melbourne researcher.

"The Cretan diet has the lowest death rate from heart disease," says Associate Professor Catherine Itsiopoulos of the Centre for Dietetics at La Trobe University, adding that research has also shown marked improvement in condition amongst those who suffer type 2 diabetes.

"The diet is abundant with plant food and low in meat fat, and can be very simple and easy to implement.

"After three months on a Cretan diet the (research) participants

found not only had their blood glucose levels improved but also general wellbeing; they report an increase in mood and energy as well as looking healthier," Dr Itsiopoulos says.

"The staple fat in a Mediterranean diet for thousands of years has been olive oil. It is a monounsaturated fat so helps to improve the balance of good and bad cholesterol and extra virgin olive oil is rich in anti-oxidants."

Dr Itsiopoulos has established 10 key principles for implementing a healthy Mediterranean-style diet into any type of cuisine:

- 1 Use olive oil as the main added fat (60 millilitres per day);
- 2 Eat vegetables with every meal (include 100 grams leafy greens, 100g tomatoes and 200g other vegetables per day);
- 3 Include at least two legume meals (250g serve) per week;
- 4 Eat at least two servings of fish (150 to 200g serves) per week and include oily fish;
- 5 Eat meat (beef, lamb, pork and chicken) less often and not more than once per week;
- 6 Eat fresh fruit every day and dried fruit and nuts as snacks or dessert;
- 7 Eat yoghurt every day but cheese in moderation;
- 8 Include wholegrain breads and cereals with meals;
- 9 Consume wine in moderation (1 to 2 glasses per day) always with meals and don't get drunk; and
- 10 Only have sweets or sweet drinks on special occasions.

Sustainable development the key to CSG

Balancing the importance of environmental protection and the need to mandate sustainable land practices with the economic benefits of a lucrative resource industry is a fragile, complicated process.



By Samantha Hepburn
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The coal seam gas (CSG) industry is booming in Australia. Since the start of the 21st century, the industry has increased dramatically and, given the significant reserves predicted to exist in the eastern states, this expansion is likely to continue as demands in the domestic and export market increase.

It is estimated that the export value of the liquid natural gas (LNG) industry has increased more than four-fold in Australia over the past decade and is now worth nearly \$11 billion.

In light of this, one of the most significant issues facing Australia today is the development of a responsive and balanced regulatory framework, capable of properly evaluating the myriad economic, environmental and social issues that underpin this progression.

Coal seam gas is a non-renewable energy resource that is a byproduct of coal. It is a 'pure' and 'non-toxic' gas and for this reason has attracted a lot of commercial interest. During the process of coal formation,

biogenic and thermogenic methane gas forms and much of this methane remains trapped in the microspores of the coal in areas known as coal 'seams' or 'cleats'.

The methane gas is contained within the coal seams by water from groundwater aquifers. In order to extract the gas from the coal seam, it is necessary to drop the pressure in the seam and capture the gas by removing the water. This is achieved by pumping the water out of the groundwater aquifer. This removed water is known as 'associated water'.

Historically, CSG was ventilated out of coalmines as it was the cause of most mining explosions. However, following increased global awareness of CSG as a viable energy resource in its own right – as well as the development of more efficient technology for its extraction – the commercial utility of CSG has rapidly expanded.

Environmental concerns

Coal seam gas mining involves the removal of vast amounts of water. It can also involve the injection of chemical additives into this

water. This extraction process generates three major environmental concerns which have associated industry and community impacts.

First, the removal of large amounts of groundwater can significantly affect aquifer levels and, in some cases, deplete them completely. The reduced availability of groundwater can significantly affect agricultural and rural industries reliant upon this water supply. This is a particular concern for agricultural industries within NSW and Queensland, where the majority of coal seam gas mining is concentrated.

Second, unlike ordinary water, 'associated water' has a high saline content and may during the CSG process have had further chemical constituents added to it. In light of this, it is vital that the disposal of 'associated water' be properly dealt with. The danger of releasing polluted water into adjoining waterways and contaminating domestic water supplies is a major concern. US research has established that the release of 'associated water' into the surrounding landscape can have a devastating impact.

Study says carbon price will stay

The future of the Carbon Tax may be uncertain, but a carbon price is here to stay, according to research from the Australian National University.

The research, by Dr Frank Jotzo of the Crawford School of Public Policy, surveyed the views of Australian large emitters, carbon financiers and carbon market experts and found that 79 per cent think that there will be a carbon price in 2020, but 38 per cent think the current scheme will be repealed by the end of 2015. Of those who expect the scheme to be repealed, half think that a carbon price will be reinstated in Australia by 2020.

"The research shows a pervasive uncertainty about the future of Australia's carbon pricing mechanism. But most respondents think that the carbon price is here to stay. The result is a powerful one in light of the current deep political division in Australia between parties supporting carbon pricing, and parties rejecting it," Dr Jotzo said.

The study also found significant variation of predictions about the

future carbon price.

"The average expected carbon price for the first three years of Australia's scheme is near the fixed price of \$23 per tonne of carbon dioxide equivalent," Dr Jotzo said. "But it then falls to a predicted \$11 per tonne for 2016, before rising back to \$22 per tonne in 2025. A majority of respondents expect a price floor to be in place.

"Averages, though, mask a huge variation of expected outcomes. While 20 per cent of respondents expect a zero effective carbon price at 2020 and 2025, at the other end of the spectrum 20 per cent of experts expect a carbon price of \$35 tonne or more in 2025."

Larger emitters were already taking actions to reduce emissions, despite the political uncertainty, Dr Jotzo said.

"The majority of Australia's major carbon-emitting companies have already taken action to reduce their emissions, and even more expect to make such investments over the next three years."

Third, the increasing prevalence of hydro-fracturing ('fracking') as an enhanced method of extraction during CSG mining has the potential to cause significant environmental damage. Hydro-fracturing is the artificial stimulation of coal seams and involves injecting a combination of water, sand and chemicals into the seam. Hydro-fracturing, utilised in some CSG projects currently operational in Australia, is known to increase the flow of CSG gas and therefore provide enhanced commercial benefits. This process can, however, radically deteriorate groundwater aquifers and is also the primary cause of chemical pollutants within associated water.

Regulatory framework

These environmental concerns have the potential to significantly affect the Australian landscape and have not gone unheeded in the emergent regulatory framework. The draft code of conduct for CSG mining, introduced by the NSW Government in March this year, following on from the decision by that State to enter the National Partnership Agreement on Coal Seam Gas (NPACSG), explicitly mandates the evaluation of the impact of groundwater aquifers which will be effected by specific CSG mining applications.

Further, the new independent scientific committee formed pursuant to the NPACSG has the power, at the request of the relevant Commonwealth or State authority, to undertake expert scientific research to examine the impact of CSG mining on significant water resources. This committee also has the power to commission regional water assessments in high priority areas affected by CSG mining.

The existing regulation of CSG mining in Queensland and NSW is extensive.

In Queensland relevant acts are: the *Environmental Protection Act 1994 (Qld)*; the *Petroleum Act 1923 (Qld)*; the *Petroleum and Gas (Production and Safety) Act 2004 (Qld)*; the *Water Act 2000 (Qld)*; and the *Water Supply (Safety and Reliability) Act 2008 (Qld)*. In NSW the relevant legislation is: the *Petroleum (Onshore) Act 1991 (NSW)*; *Environmental Planning and Assessment Act 1979 (NSW)*; and the *Water Management Act (2000) (NSW)*.

In addition, the Commonwealth provides some regulatory protection under the *Environmental Protection and Biodiversity Conservation Act 1999 (Cth)* (EPBC). The EPBC was introduced



Coal seam gas issues raise strong community reaction.

with the aim of promoting greater environmental regulation over matters of national environmental significance and it endorses the broad goal of 'promoting ecologically sustainable development through the conservation and ecologically sustainable use of natural resources. It aims to achieve this by applying an environmental assessment regime to matters of 'national environmental significance'.

The EPBC will, however, only apply where it can be established that the application has or will have a significant impact upon a matter of national environmental significance which include world heritage properties, national heritage places, wetlands of international significance, nationally listed species and ecological communities, nationally listed migratory species, nuclear actions, and the Commonwealth marine environment but not the protection of groundwater reserves.

Future directions

Balancing the importance of environmental protection and the need to mandate sustainable land practices with the economic benefits of a lucrative resource industry is a fragile and complicated process. It can only be achieved, if at all, with a full arsenal of state and regulatory controls, the backing of strong and independent research committees and the initiation of proper stewardship.

The regulatory developments introduced in Queensland and NSW to date attempt to promote informed decision-making. Appropriate authorities are required to be fully and accurately appraised of all relevant research and statistics concerning

the predicted effects of CSG mining, prior to any approval being granted.

These shifts in regulatory perspective are vital if the possibility of long-term and irreversible damage to the landscape, to ground water aquifers, to adjoining waterways and also to rural and agricultural industries are to be avoided.

These are cogent community concerns – as recent protests in Sydney and Queensland have demonstrated – and must not go unheeded.

Any dilution in the evaluation process will undermine ecological integrity and cause, as recently outlined by the Ruckelshaus Institute on Environment and Natural Resources, in its report on water production from coalbed methane, "the depletion of vital natural resources causing future economic destruction".

The regulation of coal seam gas in Australia must focus upon sustainable development – a paradigm that extends beyond immediate economic goals towards long-term viability and the optimal usage of both renewable and non-renewable resources.

ASSOCIATE PROFESSOR SAMANTHA HEPBURN is a member of Deakin University's Centre for Rural Regional Law and Justice. With legal qualifications from Monash and LLM and PhD from the University of Melbourne, she is a barrister and solicitor of the Supreme Court of Victoria. She is based at Deakin's Burwood Campus. Her teaching interests are property and land law, Native Title, water rights, indigenous environmental law and propertisation of carbon interests.

Starfish impact led to internet development

High-voltage surges in power lines revealed the potential as a weapon to disable electronics in weapons of war from great distances.



By Brian O'Brien
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Nuclear explosions are serious matters, exciting much community concern. But on 9 July 1962 – just 50 years ago – the explosion above the Pacific Ocean, at an altitude of 400 kilometres, of a 1.4-megatonne nuclear device code-named Starfish had a welcome outcome.

About 70 times more powerful than the Hiroshima and Nagasaki bombs that ended the Pacific War, Starfish created an electromagnetic pulse (EMP) that turned off traffic lights and turned on burglar alarms in Hawaii, 1400km away.

That pulse started a technological march which, a generation later, brought the world the magnificent civilisation-changing internet. Nobody was hurt by Starfish, it was a 'Peaceful Pulse'.

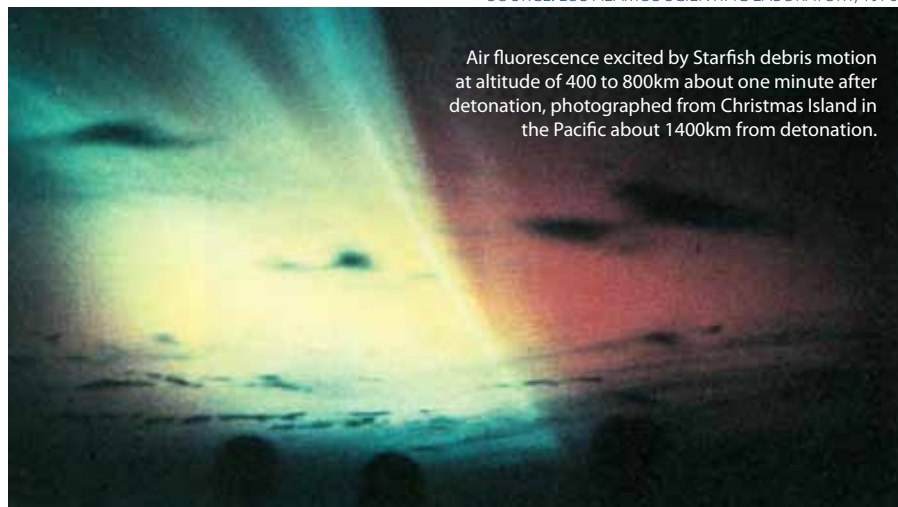
Admittedly, a not-so-welcome Starfish effect was the globe-circling band of 1025 high-energy, fission-debris electrons trapped in the Earth's magnetic field. They caused radiation damage and degradation of solar cells powering half a dozen satellites and thence their failure in a week to a month.

My favourite little satellite, Injun 1, kept operating at 1000km altitude. I got involved with Starfish when Injun 1 discovered this artificial radiation belt (O'Brien, Laughlin and van Allen, *Nature*, (London), Vol.195, pp.939-943, 8 September 1962). Possibly the largest global radiation contamination to date, its early peak intensity caused a heavily-shielded Geiger counter in Injun 1 to count 1000 times faster. Because Injun 1 had already made 10 million measurements in the area, we could make the only before-and-after measurements. And I had one of the times of my life.

The EMP was caused when Starfish high-energy gamma rays knocked

This article was written because discovery of the Higgs boson seems so remote from the community. The 50th anniversary of Starfish gave an opportunity to link technological and science to everyday community life with this note about how the internet was born while the Baby Boom generation was giving way to Generation X. This is a snapshot of one parcel of synergies of science, technology and the military. Seven years after Starfish, men walked on the Moon, with more glorious synergies and messages about Spaceship Earth. Two generations later, with five Apollo experiments dead on the Moon, I wonder how the splendid Square Kilometre Array, reaching towards the Big Bang, will fire community and youthful imaginations, visions and then dreams. But for now there is the Higgs boson, or something very much like one.

SOURCE: LOS ALAMOS SCIENTIFIC LABORATORY, 1976



Air fluorescence excited by Starfish debris motion at altitude of 400 to 800km about one minute after detonation, photographed from Christmas Island in the Pacific about 1400km from detonation.

(Compton) electrons out of atoms at about 30km altitude. These electrons spiralled around the Earth's magnetic field lines and created up to 50,000 volts per metre surge in conductors in line-of-sight of the detonation.

Starfish caused a larger-than-planned EMP, when high-voltage surges in power lines blew fuses and damaged electrical devices in Hawaii. The potential as a weapon to disable electronics in weapons of war from great distances was more apparent.

The Pentagon commissioned the Advanced Research Project Agency (ARPA), which organised UCLA and

Stanford computers, then other more distant computers into survivable networks to communicate directly with each other by dividing a stream of information into 'package blocks'.

Then came mathematic theoretical bases for packet switching, and ARPANET grew interconnected networks with about 200 host computers by 1981. Within CERN (The European Organisation for Nuclear Research), in March 1989 computer scientist Tim Berners-Lee wrote 'Information Management: A Proposal' to help keep track of and manage all components and construction of the Large Hadron Collider.

One result, announced in July, is the Higgs boson, or something like one. Another is the internet.

A lovely feature about an EMP convinces me, as do many things in physics, that the Lord God has a divinely wicked sense of humour. An EMP consists of three pulses with the first lasting about a nanosecond, which can penetrate copper shields and the like. This is ignored by slow, old-fashioned vacuum tube electronics. But modern semi-conductor devices, priding themselves for being so fast, try to react

During the 1970s, it was discovered that integrated solid-state circuits are 10 million times more likely to be knocked out than vacuum tube systems (*Science*, Vol.213, p.1228, 11 September 1981). Secrecy was eased 20 years after Starfish and three articles in *Science* in 1981 provide fascinating stories (*Science*, 29 May, p.1009; 5 June, p.1116; and 12 June, p.1248).

Three months after Starfish, the US and the USSR engaged in the Cuban missile crisis for 13 days, the closest the world has come to a nuclear war. Each nation exploded two high-altitude nuclear devices during the crisis, on 20 and 26 October, before it ended on 28 October. Each exploded another on 1 November.

All but one was about 20 times more powerful than Hiroshima. Treaties of reconciliation began, but the arms race and the space race continued.

It may be thought-provoking that on 20 June the first Starfish attempt failed, the erratic rocket was blown up by range safety at 30,000 feet and fragments landed on tiny Johnston Island, just one kilometre long and 200 metres wide.

PROFESSOR BRIAN O'BRIEN FTSE is Adjunct Professor of Physics at the University of Western Australia and has run his environmental and strategic analysis consultancy since 1978. At 23, he was the first PhD from Harry Messel's School of Physics at Sydney University, became Deputy Chief Physicist, Australian National Antarctic Research Expeditions, and later Assistant Professor at the State University of Iowa. His team there built the first satellite to use digital telemetry, Injun 1, launched in 1961. He is Principal Investigator for the record-holding longest active experiment on the Moon, his Dust Detector on Apollo 12. He was the first Australian to be awarded the NASA Medal for Exceptional Scientific Achievement. He was the first Director and Chairman of Environmental Protection in WA (1971-77).

Unmanned aircraft to the ResQu

Unmanned aircraft could provide vital intelligence to help Australian authorities fight natural disasters, such as the 2011 Queensland floods, thanks to a \$7 million project underway in Brisbane.

Project ResQu brings together the nation's top aerospace experts from Queensland University of Technology (QUT), Boeing Research & Technology-Australia, Boeing subsidiary Insitu Pacific and CSIRO.

Associate Professor Duncan Campbell, Director of the Australian Research Centre for Aerospace Automation (ARCAA) at QUT, said the project was a world-leading one that would fast-track research to help unmanned aircraft become airborne for routine operations sooner.

ARCAA will contribute to the Civil Aviation Safety Authority's review of the regulations governing operation of unmanned aerial vehicles (UAVs).

Project ResQu will enable the fast-tracking of research to fit unmanned aircraft with smart technologies to enable them to both sense and avoid other aircraft and to land safely in emergencies. These are currently the two key technical impediments to the greater use of unmanned aircraft in civilian airspace.

"As a result of our research, unmanned aerial vehicles (UAVs) fitted with cameras will be able to help pinpoint communities and people in need of rescue during natural disasters and to regularly monitor the health of the environment such as finding invasive weeds in rainforests.

"This potentially life-saving technology will not only help provide accurate information during disasters but also enable air rescue crews to better target their response."

He said had UAVs been able to fly in civil airspace during last year's Queensland floods, they could have played a critical role in assisting in the disaster response.

"Because they can fly for extended periods of time in conditions considered too dangerous for manned aircraft, they are ideally suited to search and rescue activities as well as flood mapping, conducting damage assessments and delivering aid to remote communities," he said.

A UAV in its ARCAA van.

PHOTO: CSIRO



Engineer to Marvellous Melbourne laid our foundations



By Ian Rae

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The remark by R.H. Tawney that a historian needed a stout pair of boots has been repeated often enough, most recently in Australia by Edward Duyker and Weston Bate. ATSE's Victorian Fellows of the Academy can take up the challenge by exploring some of the handiwork of William Thwaites (1853–1907), whose contributions to 19th century civil engineering in Australia have engrossed his biographer, Dr Robert La Nauze FTSE.

A walk in Port Melbourne, for example, could take in Esplanade East, Esplanade West and Lagoon Reserve (Melway 57 C3-4). Further down the bay there is a path along the Elwood Canal that leads to streets named Foam, Wave, Spray and Tide (Melway 67 D3).

In both cases, Thwaites was the engineer whose plans saw the drainage and transformation of a degraded wetland, in the one case because of pollution and the other because of flooding of residential areas.

There were 'swamps' to be drained in non-metropolitan places too, like Condah, Koo-Wee-Rup and Moe. While "today we might be more concerned with the loss of much of this wetland habitat" La Nauze says, "at the time its drainage was a triumph of Victorian engineering".

The engineering was Victorian both in the temporal and the academic sense since Thwaites was a product of the University of Melbourne and he was appointed in preference to overseas and interstate competitors to be engineer-in-chief to the fledgling Melbourne and Metropolitan Board of Works. An "inspired choice" says La Nauze. In celebration of this rejection by the Board of the traditional 'colonial cringe', 100 engineers held a dinner in Thwaites' honour.

There are other Thwaites-evocative spots within easy reach of us in Melbourne.

Construction of the outfall sewer aqueduct over Kororoit Creek, Melbourne, 1885.



For a special vignette, peep under the Walmer Street pedestrian bridge between Abbotsford and Kew to see the pipe that conveyed water from above Dight's Falls (and therefore beyond the reach of the Yarra's salt wedge) to the Botanic Garden. Or head up past Whittlesea and take a look at the Wallaby Creek aqueduct that brings water across the dividing range to Toorouroung reservoir and thence to Yan Yean.

Perhaps the most important sites are the old sewage Pumping Station at Spotswood, now the home of Science Works, and the Federation Trail, a bicycle and walking path along line of the (now disused) outfall sewer that runs from Brooklyn to Werribee.

Thwaites' most significant work involved the least glamorous but arguably the most important role that could be played by a civil engineer – reticulation of sewage. The plan for a system of deep tunnels and the eventual discharge of the waste to a treatment plan at Werribee is usually ascribed to the British engineer James Mansergh, who was brought to the colony as adviser in 1889.

Mansergh proposed three possible schemes, one of which we now know bore a strong resemblance to a plan advanced earlier by Thwaites, and which was available to the visiting consultant. It was this one that the Victorian Government chose and it was Thwaites who was commissioned to implement it and to make small modifications to it. The book includes some

great photographs of the tunnelling work.

It's a fascinating story that Rob La Nauze has to tell. If I have a criticism it is that, while he has mastered the business of ferreting out the detail of lives, actions and times, he probably included too much of that detail in his account. The end notes are especially good and more could have been moved to there I think.

Having had a go at it myself, I'm all for practitioners turning to write about the history of their subjects and if that means a bit of excess detail, it's a small price to pay for the engineering insight that we find in the Thwaites story.

Rob La Nauze is perfectly placed to bring it to us – an engineer himself with a fine record of service in the public and private spheres, son of a leading Australian historian and custodian of the Thwaites family papers.

Engineer to Marvellous Melbourne. The Life and Times of William Thwaites, Robert D La Nauze. (Australian Scholarly Publishing, 2011, paperback, xiv + 217 pages, \$39.95)

PROFESSOR IAN RAE FTSE, an Honorary Professorial Fellow at the University of Melbourne, is a former Technical Director of ATSE. He was President of the Royal Australian Chemical Institute (2006-08) and has served for more than a decade as a technical adviser to the United Nations Environment Program.

ATSE INFOCUS

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10 Fellows on Queen's Birthday Honours list

Medical researcher Professor Ian Frazer and botanist Professor Stephen Hopper headed a list of 10 ATSE Fellows honoured in the 2012 Queen's Birthday Honours, both being named Companions of the Order of Australia (AC).

Professor Ian Young, Professor Tamarapu Sridhar, Mr Jerry Ellis, Dr Owen Denmead and Dr Michael Halmagyi were named as Officers of the Order (AO).

Dr Glen Kile, Emeritus Professor Jennifer McComb and Dr Frank Care were honoured as Members of the Order (AM).

Professor Ian Frazer AC FRS FAA FTSE, world-famous medical researcher, was honoured for eminent service to medical research, particularly through leadership roles in the discovery of the human papilloma virus vaccine.

Professor Stephen Hopper AC FTSE, plant conservation biologist and Director of the Royal Botanic Gardens in London, was honoured for eminent service as a global science leader in the field of plant conservation biology.

Professor Ian Young AO FTSE, Vice Chancellor of ANU, was honoured for his achievements in tertiary education through management, research and international collaboration.

Professor Tamarapu Sridhar AO FAA FTSE, a renowned chemical engineer from Monash University, was honoured for his service to tertiary education, particularly chemical engineering.

Mr Jerry Ellis AO FTSE, former BHP Chairman, was honoured for his service to business and commerce, particularly mining, the environment, education and philanthropy.

Dr Owen Denmead AO FTSE, CSIRO crop and soil scientist, was honoured for his environmental research in crop and soil sciences, ecology and micrometeorology.

Dr Michael Halmagyi AO FTSE, prominent Sydney neurologist, was honoured



Ian Frazer

Stephen Hopper

for his services to neurology as a clinician, educator and contributor to research.

Dr Glen Kile AM FTSE, ATSE Victorian Chair and forestry expert, was honoured for his service to forest science.

Emeritus Professor Jennifer McComb AM FTSE, former WA Division secretary and agronomist, was honoured for her service to plant science.

Dr Robert Care AM FTSE, a London-based Arup Group Board member and Chair and CEO of Arup's UKMEA region, was honoured for his services to engineering.

ERIC'S LIFETIME AWARD FOR COASTAL RESEARCH

Professor Eric Wolanski FTSE, Adjunct Professor in James Cook University's School of Marine and Tropical Biology and Principal Research Officer in the Australian Centre for Tropical Freshwater Research, has been awarded the Estuarine & Coastal Sciences Association (ECSA) Lifetime Achievement Award – the first time it has been presented.

Professor Wolanski was presented with the award in front of almost 600 scientists from 54 countries at a gala dinner in Italy during ECSA's 50th international conference.

ECSA, which dates back to 1971, is an international organisation dedicated to the promotion and advancement of multidisciplinary research into all aspects of estuaries and coasts and the application of science and technology for sustainable environmental management.

The award reflects Professor Wolanski's achievements in marine science over his lifetime, including seven books, his 12-volume *Treatise on Estuarine and Coastal Science*, and 350 publications in estuarine and coastal science with co-workers in 13 countries.

Professor Wolanski said he was at the event as an invited plenary lecturer and as the representative of two international scientific societies – Japan's International Centre for Environmental Management of Enclosed Coastal Seas (EMECS) and Land-Ocean Interactions in the Coastal Zone (LOICZ). He is a board member of both.

Earlier this year Professor Wolanski published what is believed to be the world's most comprehensive work on estuarine and coastal science. The collection of 12 books – *The Treatise on Estuarine and Coastal Science* – has more than 350 authors from across the world, runs to about 6000 pages and took about four years to complete.

Professor Wolanski also officially launched *The Treatise* at the conference.

He said it was a "complete surprise" to receive the award and described the accolade as a "wonderful thing". It was particularly humbling that it was the first award since the organisation's beginnings.

"When I looked at the prominent scientists in that crowd there, I thought 'I really don't think I'm that good' and I know I blushed," he said.



(From left) Professor Victor de Jonge, Institute of Estuarine and Coastal Studies, University of Hull, Professor Geoff Millward, University of Plymouth and President of ECSA, and Professor Eric Wolanski at the ECSA award presentation.

Fellows again prominent in Top 100 Engineers listing

Nearly 25 per cent of Australia's "most influential" engineers are Fellows of ATSE, according to Engineers Australia's 2011 Top 100 Engineers listing. Three of the 24 engineers honoured are women.

Published in *EA Magazine*, the Top 100 lists engineers in seven categories: Academia/Research, Associations, Consulting, Industry, Innovation/Expertise, Politics and Public Service.

ATSE dominated the **Academia/Research** listing, providing seven names in a category of nine – Professor Hugh Durrant-Whyte FRS FAA FTSE (CEO, NICTA), Professor Peter Lee FTSE (VC, University of Southern Cross), Professor Max Lu FTSE (Senior Deputy VC and Deputy VC Research, University of Queensland), Dr Adi Paterson FTSE (CEO, ANSTO), Professor Stuart Wenham FTSE (Director, ARC Photovoltaics Centre of Excellence, University of NSW), Professor Ian Young AO FTSE (Vice Chancellor, ANU), Professor Alex Zelinsky FTSE (Chief Defence Scientist and CEO, DSTO).

ATSE Fellows contributed 11 names to the list of 46 comprising the biggest category (**Industry**). These were: Mr Leigh Clifford AO FTSE (Chair, Qantas), Dr Bob Every AO FTSE (Chair, Wesfarmers), Dr Peter Farrell AM FTSE (Chair and CEO, ResMed), Mr James Graham AM FTSE (Group CEO, Gresham Partners), Dr Andrew Liveris FTSE (Chair, President and CEO, Dow Chemical), Mr George Maltabarow FTSE (MD, Ausgrid), Ms Susan Murphy FTSE (CEO, WA Water Corporation), Mr Doug Rathbone AM FTSE (CEO, Nufarm), Dr Chris Roberts FTSE (CEO, Cochlear), Mr Julian Segal

FTSE (CEO, Caltex), Dr Zhengrong Shi FTSE (CEO and Chair, Suntech Power Holdings).

Mr John Grill FTSE (CEO, Worley Parsons) was the only Fellow named among 13 in the **Consulting** listing and Professor Karen Reynolds FTSE (Professor of Biomedical Engineering, Flinders University) was the sole name among six in the **Innovation/Expertise** category.

In the **Public Service** listing, three ATSE Fellows were named: Dr Geoff Garrett AO FTSE (Queensland Chief Scientist), Mr Menno Hennevel FTSE (MD, Main Roads WA) and Professor Mary O'Kane FTSE (NSW Chief Scientist and Scientific Engineer). In the **Associations** listing, ATSE President Professor Robin Batterham AO FEng FAA FTSE was named.

The 2011 selection panel of four included:

- Mr Paul Douglas FTSE, former CEO of SKM and Professorial Fellow, University of Melbourne; and
- Dr Michael Sargent AM FTSE, an electrical engineer and former Chair of ATSE's International programs, a Director of the Australian Energy Market Operator and a former President of Engineers Australia.

LAWRIE MULLER LED DAIRY TECHNOLOGY

Mr Lawrence Muller OAM FTSE, an internationally renowned dairy technologist, died in Melbourne on 7 January, aged 89.

Mr Muller started his career as a bacteriologist and dairy technician in Queensland and later headed CSIRO's dairy division. He joined the Academy in 1983, nominated – ironically – by Dr Keith Farrer, who died in June.

He won the silver medal of the Australian Society of Dairy Technology twice (1963 and 1963) for published papers and its gold medal for meritorious service in 1982. He won the Dairy Industry Association of Australia's J I Scarr Gold Medal in 1983 for meritorious service.

After joining the Department of Agriculture and Stock in Brisbane in 1938 he gained experience in chemistry and microbiology, undertook evening studies, served in the RAAF 1943-45 and completed a BSc at the University of Queensland in 1947.

He spent 10 years in various dairy industry roles in Queensland before joining CSIRO in 1958. In 1980 he became Assistant Chief of the

Division of Food Research and a Fellow of the Australian Institute of Food Science and Technology.

His ATSE Fellowship citation

notes his "distinguished career" in dairy technology and his leadership in the production of recombined milk and the application of membrane technology in milk production. "Mr Muller has been very active in international dairy technology and his contributions are widely recognised overseas," it added.

He was president of the Dairy Industry Association of Australia, represented CSIRO on the Australian Dairy Research Committee and Chairman of the Dairying Standards Board.

In his modestly written, brief 2003 autobiography, *Thought for Food*, provided by his daughter Marilyn Cimeria, he noted the support he received from those he worked with: "My career really involved applying a scientific approach to thinking out solutions for the technological problems in dairy product production.

"The process worked pretty well, especially during my period with CSIRO, where I was well supported by a great and growing team of scientists to whom I pay tribute; I could not have done it on my own.

"I also pay tribute to the industry leaders who gave me so much support (he noted in particular Dr Keith Farrer) and were frequently responsible for making it possible to achieve satisfactory results."



Laurie Muller



Geogre Maltabarow



Susan Murphy



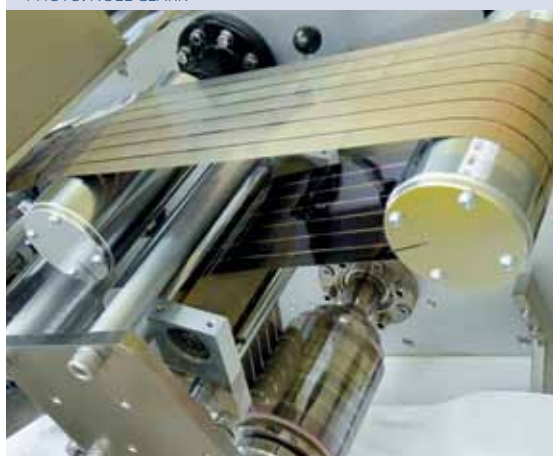
Karen Reynolds

Andrew Holmes wins a Royal Medal

Professor Andrew Holmes AM FRS FAA FTSE, Victoria's inaugural VESKI Innovation Fellow, has been honoured as one of only three recipients of the 2012 Royal Medal – making him the only Australian in 10 years to receive the award.

Three Royal Medals, also known as the Queen's Medals, are awarded annually by The Queen on the recommendation of the Council of the Royal Society for the most important contributions in the physical, biological and

PHOTO: NOEL CLARK



The Mini-Labo printer housed at CSIRO Clayton, Victoria, prints polymer-based solar cells on plastic.



Andrew Holmes

applied or interdisciplinary sciences.

Professor Holmes is a member of the VESKI (Victorian Endowment for Science, Knowledge and Innovation) Board of Directors, a CSIRO Fellow, a University of Melbourne Laureate Professor of Chemistry at the Bio21 Institute, a Distinguished Research Fellow at Imperial College in London and Foreign Secretary of the Australian Academy of Science.

He is recognised for his contributions at the interface of the materials and biological sciences that will lead to outcomes which will benefit society. He played a pioneering role in the field of applied organic electronic materials.

In the late 1980s he established a collaboration with University of Cambridge physicists which led in 1990 to the discovery of light-emitting polymers. Professor Holmes led the Chemistry team in that collaboration for 14 years. These polymers have applications in solid state (LED) lighting, flat panel displays, transistors and solar cells.

In Australia Professor Holmes leads

the Victorian Organic Solar Cells Consortium involving the University of Melbourne, CSIRO, Monash University and industry partners. The Consortium aims to deliver efficient flexible printed solar cells for low-cost applications in electricity generation and benefits from a strong collaboration with the Imperial College Doctoral Training Centre in Plastic Electronics.

Professor Holmes was an undergraduate at the University of Melbourne and completed

a PhD at University College London. He was at Cambridge for 32 years then moved to Imperial College from where he was given long-term leave of absence to be seconded to the University of Melbourne.

In 2004, Professor Holmes returned to Victoria as an ARC Federation Fellow and inaugural VESKI Innovation Fellow at the University of Melbourne's Bio21 Molecular Science and Biotechnology Institute and at CSIRO.

Professor Holmes said it was an honour to receive the Royal Medal and be recognised in the area of organic electronic materials and for

collaboration with cell biologists.

"It's exciting to work in polymer chemistry, an area that can lead to a diverse range of applications from the development of more energy-efficient products to the greater understanding of biological processes. Having a strong international collaboration at Imperial has also strengthened our opportunities abroad," Professor Holmes said.

Dr Calum Drummond FTSE, Executive of CSIRO's Manufacturing, Materials and Minerals Group and an ATSE Director, said: "I am delighted that the Royal Society has awarded Andrew this very prestigious medal in recognition of his immense contributions to materials chemistry and its application to energy-efficient and sustainable products, as well as bio-related applications.

"CSIRO greatly values the role that Professor Holmes has played in bringing together university groups and CSIRO to conduct research in areas that have the potential to provide enormous economic, social and environmental benefit for Australia."

KADAMBOT SIDDIQUE TAKES HACKETT CHAIR

Winthrop Professor Kadambot Siddique AM FTSE has been named to take the prestigious Hackett Professor of Agriculture Chair at the University of Western Australia.

Professor Siddique is Director of UWA's Institute of Agriculture and Associate Dean Research at the UWA's Faculty of Natural and Agricultural Sciences.

He takes over the Hackett Professor of Agriculture Chair from Professor Alan Robson AM FTSE, who relinquished it when he retired as UWA Vice-Chancellor last year.

UWA Vice-Chancellor Professor Paul Johnson said the prestigious Chair was offered as formal recognition of Professor Siddique's outstanding leadership in agricultural education and research over the years.

"It is also offered as an expression of thanks for his collegiality and the tireless work Professor Siddique has done in promoting the University and the Faculty at regional, national and international levels," Professor Johnson said.

Professor Siddique has 27 years' experience in agricultural research, teaching and management in Australia and overseas. He has developed a national and international reputation in crop physiology, production agronomy, farming systems and genetic resources, and breeding research in cereals, grains, pasture legumes and oilseed crops. His pioneering research on chickpeas has contributed to Australia's chickpea industry, now worth \$300 million a year.

Professor Siddique has published more than 200 scientific papers, review articles and book chapters and is on the editorial board of several international scientific journals. He has trained many MSc and PhD students and is a visiting professor in several overseas universities. He has developed an extensive network of scientists in Australia and Europe as well as in China, India, Turkey, Syria, Iraq, Iran, Saudi Arabia, Oman, Malaysia, East Timor, Nepal, Bangladesh, Pakistan, Canada and the US.

Kadambot Siddique



Foundation Vice President Keith Farrer dies at 96

Foundation Fellow and Honorary Fellow Dr Keith Farrer OBE FTSE, who died in Melbourne on 6 June, aged 96, was a giant in the food technology industry.

He was a driving force behind the establishment of the Academy and served as its Foundation Vice President. The Academy's book *ATSE 1975-2005: The First 30 Years* details much of his role in the Academy's establishment.

He was one of the original six-member steering committee of the Australian Industrial Research Group (AIRG) that took up the challenge for the establishment of an applied science academy. He chaired the Executive Committee of the formation Council, established in July 1974 and was a signatory of the original Academy's Memorandum of Association dated 31 October 1975.

At the first meeting of the Council following incorporation, he was elected Vice President, serving with Sir Ian McLennan (President), Sir John Holland (Treasurer) and Dr (later Professor) Howard Woner (Secretary).

Dr Farrer was educated at Hobart High School and Carey Baptist Grammar, Melbourne. He maintained lifelong links with Carey, serving on its Council from 1941 to 1986, when he was appointed an honorary member. He served as its secretary (1960–65)

and vice president (1973–79).

He graduated from the University of Melbourne with a BSc (Chemistry and Metallurgy) in 1936, an MSc (Chemistry) in 1938 and a DSc (Biochemistry) in 1954. He achieved an MA (History) at La Trobe University in 1977.

He spent 43 years with Kraft Foods Limited starting as a research chemist (1938), becoming senior research chemist (1945) and then from 1949 to 1981 serving as the senior technical officer for Kraft's total R&D effort and science matters. He was Manager Research and Development from 1949 to 1976, then served as Chief Scientist until he retired in 1981.

He is widely acknowledged for his work in developing Vegemite as an important source of vitamin B1 during his time at Kraft. Dr Farrer was proud of the R&D work that he and his team at Kraft undertook which, among other things, saw Vegemite included in rations for Australian servicemen during World War II.

"We extended this work to other B-group vitamins, riboflavin, niacin (nicotinic acid) and folic acid and we were able to tell paediatricians how much there was of these factors in the product, so they were able to write Vegemite into the diets of young children," he said in a 2003 interview.

"We also worked on gas chromatography, a method of separating the constituents of gaseous components. I discerned that this



Keith Farrer

was going to be fairly important and that no food company could really exist without a gas chromatograph because it dealt with extremely low concentrations of substances and was very powerful in assessing contaminations of all kinds and their effect on flavours."

Following a 1956 visit to the US, Dr Farrer became convinced of the need for the scientific control of packaging, which led Kraft into gas chromatography-based packaging and his subsequent oversight of chemistry, microbiology, food technology and packaging.

His professional interests and service were extensive. He was a foundation member of the AIRG (1964). He was President (1974–77) before being appointed an Honorary Member in 1980. He was a Fellow of the Royal Society of Chemistry and the Royal Australian Chemical Institute, serving as Victorian Branch President and Institute Vice President. He was

SIR GREGORY WINTER WINS INTERNATIONAL AWARD

British biochemist Sir Gregory Winter Kt CBE FRS FTSE, a Foreign Fellow of the Academy since 2002, has shared the prestigious international prize, the Prince of Asturias Award for Scientific and Technical Research, with Scripps Research Institute Professor Richard Lerner.

Sometimes called the 'Spanish Nobel Prize', the Prince of Asturias Award is bestowed for findings that "represent a significant contribution to the progress and welfare of mankind". Sir Gregory studied Natural Sciences at Trinity College, Cambridge, and undertook his PhD studies at the Laboratory of Molecular Biology (LMB) at the Medical Research Council (MRC), an institution of which he has been deputy director.

Within the LMB, Sir Gregory has been one of the leading biochemists in innovative techniques for creating monoclonal therapeutic antibodies and one of the pioneers in the development of techniques for the humanisation of these antibodies, a key step for the human

immune system not to identify them as foreign agents.

He holds numerous patents and, in addition to being scientific adviser to several genetic engineering

firms, was the founder in 1989 of Cambridge Antibody Technology, a biotechnology company promoted by the LMB to market these antibodies, including adalimumab for treating rheumatoid arthritis and Crohn's disease.

He also founded the companies Domantis in 2000 and Bicycle Therapeutics in 2009. He became Master of Trinity College recently. He has received the Louis Jeantet Prize for Medicine (Switzerland, 1989), the Emil von Behring Prize (Germany, 1990), the Milan Award (Italy, 1990), the Scheele Award of the Swedish Academy of Pharmaceutical Sciences (1994), the King Faisal International Prize in Medicine (Saudi Arabia, 1995), the Biochemical Society Award (UK, 2006) and the BioIndustry Association Award (UK, 2008).



Sir Gregory Winter

also a Fellow of the Institute of Food Science and Technology and was a Foundation Fellow, President and Life Fellow of the Australian Institute of Food Science and Technology.

Following his retirement he lived in Britain for some years, serving as the Australian representative on the executive council of the Centre for Agricultural Bioscience International (CABI), formerly the Commonwealth Agricultural Bureau, a not-for-profit international organisation providing information and applying scientific expertise to solve problems in agriculture and the environment.

Dr Farrer was remembered at a memorial service at Carey Grammar, attended by a number of ATSE Fellows, where a jar of vegemite stood alongside his five books and sporting trophies and medals on the table at the front of the hall.

Keith was pivotal in the setting up of the ATSE and as a Foundation Fellow I was well aware of his efforts to establish the Academy. He was Convenor of the steering committee which led to the establishment of ATSE and then a foundation Vice President during the challenging period of establishing the Academy. Keith had always been active in supporting Australian science and in his role as Chief Scientist at Kraft Foods Ltd was instrumental in the establishment of the great Australian icon Vegemite. He also pioneered small-portion

packaging of food, as used in airline travel. In his earlier career Keith had contributed greatly to the Royal Australian Chemical Institute and was president of the Victorian branch in 1957. He managed to combine his intense involvement in the science of food technology with his committee work and with his contributions to the history of Australian science. He gave unstintingly of his time for the benefit of us all.

– Professor David H. Solomon AM FRS
FAA FTSE, Foundation Fellow

I came from Scotland in 1968 to marry in Hobart and join the CSIRO State laboratories in Stowell Avenue, Battery Point. Torry Research Station, Aberdeen, from whence I came, had a staff of 300 and our food group (in Hobart) had a staff of 10. Without Keith's help every inch of the way we could never have achieved the successes we have had. His care for all our team, several without degrees, meant that all were treated with equal respect and kindness and all managed to publish. He was a shining example who will long be remembered by all of us.

– Dr June Olley AM FTSE,
Foundation Fellow

Keith was a prolific author in retirement of books about food issues after spending a professional career in Kraft Foods. I had a lot to do with him in the 1990s when he represented Australia on the Executive Council of CAB International (CABI). I greatly enjoyed his company over the years, especially when I spent three years as the Chair of the Executive Council of CABI.

– Dr John Radcliffe AM FTSE

MAX HATHERLY A WORLD LEADER IN METALLURGY

Professor Max Hatherly FTSE, who died in NSW on 15 September 2011, aged 88, was known nationally and internationally as a metallurgist and spent most of his career at the University of NSW.

Professor Hatherly, a Fellow since 1984, worked for Rylands Bros and the Defence Standards Laboratories between 1940 and 1964, before he joined the university as a lecturer in 1955 – the year he completed his MSc in metallurgy.

He served as senior lecturer and Associate Professor before being appointed to a personal chair as Professor of Physical Metallurgy in 1982.

His reputation was “based on more than 60 research papers contributing to a new and better understanding of deformation and crystallographic texture in ferrous and non-ferrous metals,” his Fellowship citation notes.

“His new observations on the role of massive shear bands, microbands and twinning in deformation and the formation of recovery twins, has attracted many overseas workers to his laboratory. Much of his work has commercial significance.”

He was a Fellow of the Institution of Metallurgists and member of the Australian Institute of Metals, whose Silver Medal he won in 1982. He served both organisations in various capacities and was also a member of the Metals Society.

He was a forensic consultant in metallurgy for the NSW Police for 30 years and also consulted widely on heritage matters. He was a member of the technical advisory group of the Heritage Council of NSW.

He also served in various roles both the Standards Association of Australia and the National Association of Testing Authorities.

He gave many conference presentation and lecture in Australia and overseas during the 1970s and 1980s.



Max Hatherly

JOHN WRIGHT JOINS 'ASK AN EXPERT'

Dr John Wright FTSE, an ATSE Director, has been appointed to the 'Ask an Expert' team of the Clean Energy Solutions Center (CESC). The CESC was designed by, and is supported by a partnership between, the Clean Energy Ministerial and the United Nations

interagency energy mechanism (UN-Energy).

Through the Ask an Expert program, administered by the American National Renewable Energy Laboratories (NREL), the CESC assists countries around the world on clean energy and energy efficiency initiatives.

Dr Wright, who retired 18 months ago after more than 35 years with CSIRO, is regarded as one of Australia's leading climate and energy experts. He joined the organisation as a research scientist in the Sydney laboratories of the then Division of Mineral Chemistry and became Director of the CSIRO Energy Transformed Flagship before taking on his final role as CSIRO's Sustainable Energy Advisor.

John Wright

PHOTO: CSIRO



Graeme Clark praises *Organic Bionics*

Legendary Australian Scientist Professor Graeme Clark AC FRS FAA FTSE has praised a new book from pioneering researchers at the ARC Centre of Excellence for Electromaterials Science at the University of Wollongong.

Speaking at the recent launch of *Organic Bionics* in Melbourne, Professor Clark commended the book for its unique approach to the subject.

"There is a need to apply the new science of bionics to medicine," Professor Clark said. "*Organic Bionics* actually brings bionics science together with the clinical outcomes, the applications."

Associate Professor Robert Kapsa from St Vincent's Hospital, Melbourne, co-author of the book along with UOW's Professor Gordon Wallace FTSE, Associate Professor Simon Moulton and Dr Michael Higgins, said the book was inspired by Professor Clark.

"Graeme is the inspiration for the book. He is a bionics pioneer, having restored hearing to over 250,000 people worldwide with the Cochlear implant," Professor Kapsa said.

The first text of its kind, *Organic Bionics* focuses on the emerging interdisciplinary research area at the interface between materials science and biomedicine. It delves into areas of application for bionic developments including advanced bionic

ears, spinal cord repair, muscle repair, bionic eyes and infection control, as well as emerging applications including neuromuscular repair, epilepsy and pain management, and bone regrowth.

During the launch, Professor Wallace emphasised the importance the ARC Centre of Excellence for Electromaterials Science team places on working with collaborators including clinicians and end-users, to create a research model that works towards real applications and devices.

"This book is about excellence not only in science but in team building," Professor Wallace said. "It is about collaborators, mentors and inspirations we've encountered along the way."

Organic Bionics is published by scientific, technical, medical and scholarly publishers John Wiley and Sons.

TOM SPURLING

Professor Thomas Spurling AM FTSE has been reappointed to the Board of CSIRO. Professor Spurling has worked in senior positions at CSIRO for more than 33 years and spent more than a decade as a university professor. He is well known for his services to chemical



(From left) Simon Moulton, Gordon Wallace and Graeme Clark at the launch of *Organic Bionics*.

science through his contributions to national innovation policies, strategies and research, as well as for his role in developing professional scientific relationships within the Asian region.

MARTIN COLE

The Code Of The Pharaoh is the title of Dr Martin Cole's 208-page novel available through Dymocks for \$24.95. The synopsis says: *Archaeologists stumble upon an Egyptian hieroglyphic code that leads them in a race around the world deciphering more clues on their quest to discover the lost secret of an ancient machine that could grant immortality. A wealthy inventor is determined to keep the secret for himself and will stop at nothing to force their cooperation, to recreate a fully working machine. Find out what happens when this ancient design is finally re-energised.*

WOMEN IN TSE

KATHY HIRSCHFELD JOINS UN WOMEN BOARD

Ms Kathy Hirschfeld FTSE has joined the board of UN Women in Australia, which supports the goals of UN Women globally

– including increasing the representation of women in leadership, eliminating violence against women, improving women's economic empowerment and participation



Kathy Hirschfeld

of women in peace processes.

She has also been appointed to the Board of ASC Pty Ltd, which is responsible for maintenance of Australia's Collins class submarines and building three new air warfare destroyers.

JUDY RAPER ON ANSTO BOARD

Professor Judy Raper FTSE, Deputy Vice Chancellor (Research) at the University of Wollongong, has been appointed to the Board of the Australian Nuclear Science and Technology Organisation (ANSTO) for a four-year term.

Professor Raper, a chemical engineer, previously was the Division Director of Chemical Bioengineering, Environmental and Transport System at NSF in the US.

Prior to this secondment, she was

Department Chair, Chemical & Biological Engineering, at the Missouri University of Science and Technology and Dean of Engineering at the University of Sydney.

ANSTO is home to Australia's only nuclear research reactor, supporting Australian science and each year provides more than 500,000 patient doses of nuclear medicines to Australians.



Judy Raper

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The Australian-first UQ Career Advantage PhD Program aims to accelerate career development and enhance employability through advanced, professionally focused training for PhD students.

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The UQ Career Advantage PhD Program is available to all students commencing a PhD at UQ from 2013.

The Federal Government's 2010 Excellence in Research for Australia (ERA) survey confirmed The University of Queensland as one of the nation's top two universities, measured on a combination of research quality and breadth. ERA reported that research at UQ is above world standard in more broad 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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