INNOVATION IN ENGINEERING

REPORT

June 2012

ENGINEERS AUSTRALIA INNOVATION TASKFORCE

ENGINEERS
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1 INTRODUCTION

1.1 Overview

The Engineers Australia Innovation Taskforce has been established to guide the development of a report and policy statement on innovation, including R&D in the engineering profession. The report has a focus on reviewing Australia's performance in this area and how government policies and programs can be improved to encourage further business investment in innovation in engineering. The Taskforce Members are:

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The Taskforce has released a Discussion Paper as the first step in the process to develop Engineers Australia's position statement on innovation.

Engineers Australia members contributed to this discussion by responding to a range of questions (see **Appendix 1**). In addition to these questions, members were invited to make any comments or suggestions about the issues covered in this report or to raise other issues they would like to have seen included in the final report and policy statement. The Taskforce considered all comments received from the membership and consolidated these into this report.

1.2 Defining innovation in engineering

Innovation in engineering is much more than research and development. It encompasses an end-to-end process, such that it extracts value through implementation. Innovation involves:

- creating or generating new activities, products, processes and services
- seeing things from a different perspective
- moving outside the existing paradigms
- improving existing processes and functions
- disseminating new activities or ideas
- adopting things that have been successfully tried elsewhere

Innovation covers the area from minor quality improvements to 'cutting edge' products and services[1].

[1] This definition of innovation is based on the definition used in the Engineers Australia submission to the Review of the National Innovation System, April 2008.

1.3 Why is Engineers Australia concerned with innovation?

Innovation is extremely important to a country as it is closely related to productivity. Although there are a number of avenues to increased productivity, innovation is the most significant factor (DIISR, 2011). In the absence of sustained innovation, the rate of growth in labour-constrained economies will ultimately fall to zero. Innovation can drive productivity improvement across all industrial sectors (Gans J, 2003:8). Many industries essential to the economic growth of the country such as construction, mining, telecommunications and manufacturing require significant engineering. By focusing on innovation in industries relevant to engineering, it is possible to increase productivity and contribute to the economic prosperity of the nation.

> *Creativity* is seeing what everyone sees and thinking what no one else has thought before
>
> *Invention* is transforming those new thoughts into tangible ideas
>
> *Innovation* goes even further, involving preparedness to mix with the commercial world to turn novel ideas into products (Engineers Australia, 2011b)

The expertise of the engineering profession is vital to convert innovative ideas into reality for common use. Many of the comforts humankind enjoys today have been the result of innovative engineers. Examples include electrical appliances, transportation, buildings, telecommunications and urban infrastructure. Innovation and technology have become two inseparable words in the annals of human history. Engineers drive technology and are therefore at the forefront of innovation.

Engineers Australia considers it essential that all engineers have highly developed innovative skills so they can make a better contribution to the profession and to society (Engineers Australia, 2008). One of our guiding principles is to stimulate and learn from the creativity and innovation of our members (Engineers Australia, 2010). In addition, skills relating to innovation are embedded in our competency standards for the engineering team (Engineers Australia 2011a). Engineering innovation has also been identified as one of the essentials of performance for professional engineers and is included in the protocol developed by the Warren Centre for Advanced Engineering and industry and professional engineering organisations (Warren Centre, 2009).

2 THE INNOVATION ENVIRONMENT

2.1 Australia's performance

A decade of policy neglect has hurt Australia's innovation performance, making us less productive and competitive, and reducing our ability to meet the needs and aspirations of Australian families and communities (DIISR, 2009).

The Global Innovation Index and other publications, such as the Global Competitiveness Report, allow comparisons to be made between Australia's innovation efforts and those of other countries. **Table 1** shows Australia's innovation rankings in three different surveys.

Table 1: Australia's Innovation Rankings

Country Ranking	INSEAD Global Innovation Index Rankings 2011	World Economic Forum Global Competitiveness Report 2011-2012: Innovation	ITIF Benchmarking EU & US Innovation and Competitiveness 2011
	1. Switzerland	1. Switzerland	1. Singapore
	2. Sweden	2. Sweden	2. Finland
	3. Singapore	3. Finland	3. Sweden
	4. Hong Kong (SAR), China	4. Japan	4. United States
	5. Finland	5. United States	5. South Korea
	6. Denmark	6. Israel	6. United Kingdom
	7. United States	7. Germany	7. Canada
	8. Canada	8. Singapore	8. Denmark
	9. Netherlands	9. Taiwan, China	9. NAFTA*
	10. United Kingdom	10. Denmark	10. Netherlands
	11. Iceland	11. Canada	11. Japan
	12. Germany	12. Netherlands	**12. Australia**
	13. Ireland	13. United Kingdom	13. Belgium
	14. Israel	14. Korea, Rep.	14. France
	15. New Zealand	15. Belgium	15. Ireland
	16. Korea, Rep.	16. Austria	16. Germany
	17. Luxembourg	17. France	17. Austria
	18. Norway	18. Qatar	18. EU-15*
	19. Austria	19. Iceland	19. EU-25*
	20. Japan	20. Norway	20. Czech Republic
	21. Australia	21. Luxembourg	21. Estonia
	22. France	**22. Australia**	22. Hungary
	(Dutta Ed., 2011)	(WEF, 2011)	(Atkinson & Andes, 2011)
			* See report for explanations

While the rankings suggest Australia is performing reasonably well overall, the factors that contribute to the ranking give insight into what we are doing well and how we can do better as a country. For example, in the Global Competitiveness Report, Australia ranks well in the "Quality of scientific research institutions" (13th) and "University-industry collaboration in R&D" (14th). However, in terms of "Government procurement of advanced technology products" and the "availability of scientists and engineers", Australia is well behind our global competitors at 50th and 60th respectively (World Economic Forum, 2011).

The mediocre performance relating to innovation in Australia is often attributed to our relative wealth arising from the resources boom. However, we cannot assume that this will continue forever. In order to be prosperous in the long term, we need to be become a knowledge-based innovative economy where we can compete with other countries. However, this takes time. For example, Singapore began focusing on becoming an innovative country in the 1980s and 1990s by starting programs such as PS21 (Public Service for the 21st century) (Fernando, 2004). It is feared that Australia has already delayed too long and that there is an urgent need to concentrate on our efforts to be more innovative.

The Australian Innovation Report 2010 stated that:

> *Australia is relatively weak with regard to business R&D directly funded by government with the proportion of firms that develop product innovations which are new to the market, being ranked towards the bottom of the group of OECD countries. (DIISR, 2010:46)*

2.2 Barriers to innovation

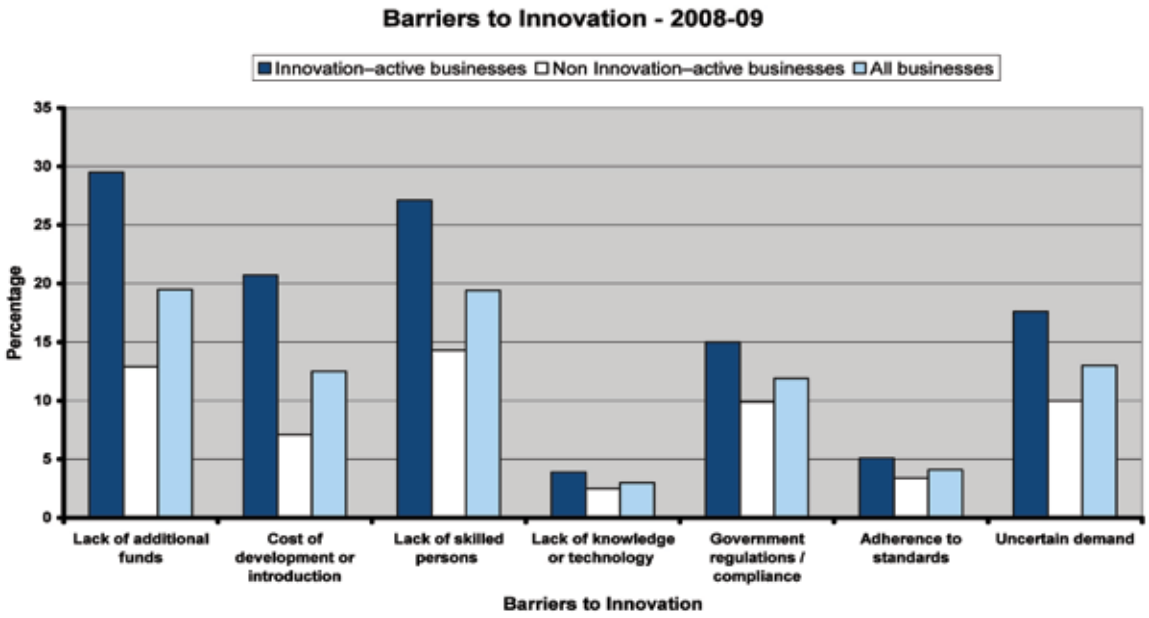
> *Technological innovation arises from unexpected breakthroughs in technological R&D and from deliberate refinement of materials and processes. All of these give rise to opportunities. Once again the challenge is to assess the potential reward against the assessed risk. More R&D funding ... is by no means the most important factor; much more important is the climate and culture in which the R&D is performed and calibre of the people who lead and foster the environment for innovation. (Engineers Australia, 2011b)*

Engineers Australia members have identified the following 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, 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
- Lack of financial support and venture capital with financial institutions lending mainly against 'bricks and mortar' (Engineers Australia, 2011b, 2009:11-12 & 2008:1)

In addition, **Figure 1** shows data from the Australian Bureau of Statistics (ABS) on the main barriers to innovation for businesses. According to the ABS, in 2008-09 only 40 per cent of Australia businesses had undertaken any form of innovative activity. To improve the participation of businesses in innovation activities, barriers to innovation need to be addressed.

Figure 1 - Barriers to Innovation (Australian Bureau of Statistics, 2010a)



2.3 Skills and education

> *A quality education in science, maths and technology is needed to produce the new generation of innovators and technology-literate citizenry to find solutions to the societal and global issues that we face. (Cutler, 2008:49)*

If Australia wants to be a highly innovative knowledge-based economy we need to ensure that future generations will be more innovative. The submission by Engineers Australia Queensland Division to the Queensland Government's Smart State initiative pointed out that:

> *Conventional education systems do not provide adequate incentives and encouragement for students to develop their creative skills. Some attributes of creative children often frustrate those teachers who do not know how to recognise them. Deliberate programmes need to be introduced for students to develop their creative skills. Creative young talent should be identified and developed (Engineers Australia Queensland Division, 2004).*

This submission recognised that it is important for teachers to be trained in developing creative skills in children and for all educational institutions, from primary schools to universities, to promote, encourage and foster a culture of innovation.

Members of Engineers Australia are supportive of government incentives being used to develop programs to educate students on how to recognise and develop innovative ideas.

3 ISSUES FOR GOVERNMENT

3.1 Legal and regulatory frameworks

> *Innovation regulation "...can be either a useful support, facilitating the invention and diffusion of standards; or it can be an impediment, blocking the creation and spread of new products and services." (NESTA, 2011)*

A significant responsibility of the Australian Government with regard to the national innovation system is to establish the legal and regulatory framework to govern and protect innovation activities. Regulation can be seen as an incentive for businesses to invest in innovation and a means for protecting rights resulting from innovation activities. This includes the protection of intellectual property through laws relating to patents, trademarks, designs and copyright. Australia has obligations to comply with agreed international standards on the protection and exploitation of intellectual property rights, particularly through the World Trade Organization's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS).

The Australian Innovation Report 2011 showed that large numbers of businesses are making use of available intellectual property protections to safeguard their rights (see DIISR, 2011:67). However, while in some ways intellectual property can protect innovation, it can also have an inhibiting effect. The Cutler Review stated that:

> *Because new knowledge always builds on old knowledge, the property rights we have erected to encourage innovation can actually obstruct it.*
>
> *This is particularly so where intellectual property rights are too easily granted, and where they are ambiguously defined, so that innovators are uncertain as to what innovations might be subject to the prior claims of patent holders. (Cutler, 2008:83-84)*

The Government has introduced the *Intellectual Property Laws Amendment (Raising the Bar) Bill 2011* into Parliament in recognition of this. The Explanatory Memorandum to the Bill states that "particular concerns have been raised that patents are granted for inventions that are not sufficiently inventive, and that the details of inventions are not sufficiently disclosed to the public". Accordingly, the Bill amends the *Patents Act 1990*, the *Trade Marks Act 1995*, the *Copyright Act 1968*, the *Designs Act 2003* and the *Plant Breeder's Rights Act 1994*.

In addition to these legislative changes, the Advisory Council on Intellectual Property has released an issues paper on the Review of the Innovation Patent System. The purpose of the review is to "...investigate the effectiveness of the innovation patent system in stimulating innovation by Australian small to medium business enterprises..." (Advisory Council on Intellectual Property, 2011:5).

In an increasingly globalised world, the products of innovations of Australian companies are being sold worldwide. Government could give consideration to reviewing the patent application process to assist organisations to achieve worldwide protection if they are successful with obtaining an Australian patent. For example, technical and funding support for selected patent applications for worldwide protection would assist in providing valuable protection for companies as they build their markets.

The protection of new technology and research is essential in order to maximise innovation outcomes in Australia. Engineers are in an ideal position to assist governments to improve the legal and regulatory environment by relating their experiences as innovators.

3.2 Government incentives

Two hundred and twenty one programs supporting innovation in firms were identified comprising 31 percent Australian Government and 69 percent State and Territory Governments. Australian Government programs account for 90% of the total expenditure for these programs, which is approximately $3.7 billion per annum. (Cutler, 2008:158)

Government programs cover the whole spectrum of innovation, from supporting innovation culture, capacity building, knowledge creation, commercialisation and market development to encouraging investment. Determining whether the allocation per area is sufficient or whether the right industries/sectors are targeted is challenging.

Examples of these programs include Enterprise Connect, research and development (R&D) Tax Credits, Commercialisation Australia and the Innovation Investment Follow-on Fund. As an example related to a sector, the budgeted 2011/2012 financial support from the Australian Government related to transport, telecommunication and other infrastructure is valued at $345.3 million.

With such a large number of programs it is reasonable to expect that many businesses, especially small to medium enterprises (SMEs), are unaware of the assistance available for innovation. A rationalisation and simplification of funding incentives across the country is the logical answer and communicating the existence of such resources is vital to reaching businesses of all sizes. Long-term stability of policies is also highly desirable as many innovations have a long gestation period between concept and commercialisation, sometimes taking decades to accomplish.

R&D continues to be an essential element of the Australian innovation system, providing a foundation for much of our future innovation. According to the OECD (2009:37-38), "Formal innovation activities, such as R&D, are important for developing novel products and processes, new competences and new knowledge that can diffuse to other firms". Australia's gross domestic expenditure on R&D as a percentage of GDP was 2.21% in 2008-09, with business investment in R&D during the same period amounting to 1.34% of GDP (OECD, 2010a). Government incentives for investment in R&D are of critical importance to innovation inputs and outcomes.

One of the main ways that the Government supports business R&D is through the R&D Tax Credit. In 2010 the Government undertook to change this incentive program. The new R&D tax incentive provides a tax offset for expenditure on eligible R&D activities and for the decline in value of depreciating assets used for eligible R&D activities. The two core components of the new R&D incentive are:

- A 45 per cent refundable R&D tax offset for eligible entities with a turnover of less than $20 million
- A non-refundable 40 per cent R&D tax offset for all other eligible entities (Explanatory Memorandum to the *Tax Laws Amendment (Research and Development) Bill 2010 (Cth) and Income Tax Rates Amendment (Research and Development) Bill 2010 (Cth), 2010).*

Dr Nicholas Gruen of Lateral Economics (2011:10) considers that the increased rates of assistance are an improvement on the previous 125 per cent tax concession which contributed very little, if anything, to stimulating business R&D.

According to members of Engineers Australia (Engineers Australia, 2011b), other forms of financial support are desirable including tax incentives for those financing innovative ventures. This could include, for example:

- a taxation holiday on profits generated from new innovations for a specified number of years
- higher rates of depreciation on equipment required to exploit a novel idea
- incentives paid to researchers and organisations relating to their commercialisation success
- using a percentage of Australia's Future Fund to finance commercialisation of innovations that are likely to produce high returns for Australia.

The currently limited pool of domestic venture capital could be expanded by making investments in Australian ventures more attractive to overseas investors. The experience of members of Engineers Australia is that payroll and other taxes are also a barrier to increasing staff numbers in small innovative companies (2011b).

3.3 Collaboration for innovation

Australia's innovation system is handicapped by fragmentation, duplication and a lack of coordination. Business-to-business and research-to-business links are poor. We rank last in the OECD on rates of collaboration between firms and universities. (DIISR, 2009:59)

An increased focus on encouraging collaboration between businesses and universities, TAFEs and other publicly funded organisations such as the CSIRO is highly desirable. SMEs, in particular, are often unaware of the benefits that can be gained from collaboration, let alone the assistance and facilities available through research organisations. The CSIRO and its National Research Flagship programs make a significant contribution to collaboration. They are also an important development in setting research directions and committing longer term funding to them. Government support for such activities needs to be maintained and not curtailed due to fiscal pressures.

The Cooperative Research Centres (CRC) Program is another Government initiative that is an important medium for collaboration between researchers in the public and private sectors and end users. Engineers Australia is a long-time supporter of the CRC program and believes that funding for CRCs should continue into the future. It was disappointing that the program received cuts to its funding in the May 2011 Budget. Engineers Australia understands that at present there are over twenty-five CRC applications in train with only four able to be funded. A number of these CRC applications are existing CRCs seeking further funding based on their success to date. Each CRC has an educational component in which future scientists and engineers of the highest quality can be developed. Reducing the CRC funding thus strikes at the heart of creating a viable pool of potential researchers/innovators with advanced scientific training.

Strategic linkages between organisations with complementary skills and competencies are a critical factor in successful innovation systems. Knowledge systems are complex, and mapping the key components of what goes to constitute a successful whole is vital in understanding the connections between knowledge workers and operational components such as design, production and marketing. In engineering companies, the vital networks required are those to do with accessing leading edge design and research skills, venture capital, angel and private investment, as well as export and domestic marketing. These networks facilitate both the generation of new ideas and their advancement to market (Engineers Australia, 2008:11).

Priority industries for innovation investment could be identified so that an appropriate network of companies and services can be developed. This would make the limited investment in innovation in Australia more effective by developing niche industries in areas where Australia already has a significant knowledge base and could become a world leader, for example, solar energy, bio-medical engineering, water and mining engineering and services.

An option for improving innovation linkages between small and medium enterprises and the research community was proposed by the Cutler Review, based on a Dutch model. This involved the introduction of a pilot linkage voucher scheme through the existing Enterprise Connect and COMET programs. Under the scheme, SMEs would identify an opportunity for collaboration with the assistance of the Enterprise Connect and COMET programs. The voucher would then fund collaboration between an SME and a public research organisation.

By comparison, the United Kingdom is trialling an innovation voucher scheme called 'Creative Credits'. Creative Credits aims to address systemic failures linked to a lack of collaboration in innovation. The focus of the scheme is on encouraging business-to-business innovation amongst SMEs. This is achieved by providing businesses with credits worth £4000, which they must match with at least £1000, to spend with creative firms on a variety of creative services (NESTA, 2011:6). Other good examples of schemes which foster collaboration between researchers, manufacturers and commercial enterprises include the USA Small Business Innovation Research (SBIR) scheme, The UK Knowledge Transfer Partnership (KTP) scheme and the Innovation Interchange that has a focus on the global infrastructure industry and was first established in Australia (See **Appendix 3: Case Studies**).

Another scheme in place in the United Kingdom is the *Innovation Funding Incentive* scheme (IFI) introduced by the regulatory body Ofgem which is discussed in more detail **Appendix 2**. In this scheme the energy regulator has recognised that innovation has a different risk/reward balance compared to an energy network's core business. The IFI is intended to provide funding for projects primarily focused on the technical development of the energy networks, to deliver value (e.g. quality of supply, safety, environmental, financial) to end use customers. The conditions for the energy sector in Australia are similar to those in the United Kingdom so it is highly likely that such a framework for funding would succeed in Australia.

3.4 Informed procurement

> *Consumers today have increasing opportunities to influence the design, introduction and trajectory of new products and services in both the private and the public sector. They also have the ability to directly influence innovation and encourage the development of new technologies. (OECD, 2010c:75)*

It is said that innovation is not an event, but a campaign. A potential untapped source of consistent innovation opportunity is in the planning, design and delivery of our infrastructure. Infrastructure Partnerships Australia (2009:6) estimates the nation's economic infrastructure investment task in the coming decade at some $800 billion. It is worthy of consideration to mobilise our engineering (and allied technical) workforce to focus more on innovation. This could be supported by government incentives as a percentage of the capital cost of works, whereby this amount is allocated to the capacity building, supporting systems and implementation of innovation through the delivery of these projects.

Informed clients and consumers have an important role in encouraging innovation. Knowledgeable clients support competition and innovation through informed purchasing and demand for new and improved products and services. According to West (2009:13), "Innovation usually begins with a customer problem, not a technical discovery". A role for government is to be involved in the development of consumer awareness and education programs that help to equip consumers to become active participants in the innovation process and enable them to make informed choices (OECD, 2010c:12). This may include programs that seek to overcome issues such as behavioural biases, reluctance to accept new innovations and purchasing products and services on the sole basis of price.

It is noted that the Department of Defence, through the Defence Industry Innovation Centre, Defence Science and Technology Organisation (DSTO) and the Defence Priority Industry Capabilities (PIC) program, is aiming to provide support to industry to help organisations produce innovative products for the Australian Defence Force.

Governments are also key clients to many businesses and can have a significant impact on driving innovation through their purchasing power. The OECD (2010c:113) considers that, as a large-scale purchaser of goods and services, the public sector is in a strong position to promote innovation by being an informed and demanding buyer. The Government has committed to fostering innovation through its purchasing choices. This is seen in the Government's commitment to "drive innovation in the private sector by being a demanding and discerning customer" (DIISR, 2009:54).

However, feedback from members of Engineers Australia indicates that government procurement is highly risk averse and conservative, and that purchasers are unwilling to take on innovations for fear of failure. For example, member feedback states,

> *Engineers by nature are quite timid and generally offer only precisely what has been asked for. We need to encourage engineers to analyse and challenge a brief, distill the outcomes really being sought and to offer solutions that may be technically non-compliant with the brief but better at achieving the outcomes. (Engineers Australia, 2011b)*

Greater collaboration between customers and suppliers and a move to functional specifications for engineering projects will foster innovative solutions.

Another member states,

> *The biggest impediment to innovation in Australia is the culture taking the conventional approach and never daring to do things differently in case they fail. We should celebrate failure also but only if we ensure that all lessons are made plain for all to see and then we work to avoid making the same incorrect decisions in the future. (Engineers Australia, 2011b)*

It will be necessary for the Government to monitor and evaluate its success in stimulating innovation through its purchasing decisions.

3.5 Promoting innovation

> *...while the world has changed drastically and organisations pride themselves for having a process for everything, the process of innovation remains ad hoc, unsystematic, piecemeal, seat of the pants, and, ... heavily dependent on luck" (Tucker, 2003).*

If a country wants to be highly innovative, innovation should come from all sections of society: children, teachers, employees, employers and research organisations. Innovations should not be restricted to high-level cutting-edge technology, but should include all products, services and systems from minor improvements to major breakthroughs. Governments must take this message to all sections of society.

Innovation can be characterised in a number of ways. In broad terms, it can be divided into the type of innovation that is technological (product and process) or non-technological (corporate and marketing) (OECD, 2010c:19). Technological innovation involves the development of new technology, whereas corporate innovation encompasses innovation as a culture that permeates organisations.

The Australian community is generally unaware of the innovations that have been developed in Australia and much can be done to celebrate achievements of Australian engineering innovations. For example, developing and promoting a national award for innovation in engineering which could be awarded by the Prime Minister's Science, and Engineering Innovation Council during Engineering Week.

There is a popular myth that the innovation process is the exclusive province of a creative few and people need to be naturally creative or imaginative to be innovators. By creating an environment conducive to innovation that provides encouragement, training and resources, innovative skills can be sharpened in people. The UK Cabinet Office (2003) has said that "Only half of all innovations are initiated at the top of organisations". By promoting corporate innovation, both employees and employers can work together in identifying and implementing ideas beneficial to an organisation, boosting its productivity and increasing revenue.

Encouraging corporate innovation was one of the key recommendations in Engineers Australia's submission to the review of the National Innovation System. It stated that:

> *Focusing on corporate innovation, in addition to technical innovation, allows a large number of people to get involved and contribute to innovation. Corporate innovation is harnessing innovative ideas of employees in enterprises, which includes creating a conducive environment for employees to generate innovative ideas, capturing, developing and using those ideas (Engineers Australia, 2008).*

This statement recognises that whatever actions are taken and whatever money is spent on innovation, if employees in organisations and institutions are not interested in creative and innovative activities, the end result will be less than desirable. Therefore, it is equally important to promote an innovative culture within all organisations, both private and public.

4 RECOMMENDATIONS

Legal and regulatory frameworks

1. Government could give consideration to updating Australia's intellectual property laws to provide support for new and emerging technologies and to implement measures to assist organisations to achieve worldwide protection if they are successful in obtaining an Australian patent. This would provide valuable protection for companies as they build their worldwide markets.

Government incentives

2. Long-term stability in tax incentives is highly desirable due to the long period between concept and commercialisation. The current system of frequent changes in policy and incentives results in confusion and higher costs for all organisations.
3. There needs to be a reduction in the number of organisations providing grants and financial support for innovation without reducing services provided to industry. Emerging companies require a single point of contact (for state and federal programmes) and simplified access to support available for innovation.
4. Consideration should be given to expanding the level of financial support available to Australian innovations. These could include, for example:
    a. Additional taxation and other incentives to organisations that are commercialising innovations,
    b. Using Australia's Future Fund to finance commercialisation of projects that are likely to generate high returns for Australia,
    c. Additional tax incentives for financial institutions to finance innovative ventures at reasonable rates without reliance on 'bricks and mortar' as collateral,
    d. Expanding the limited pool of domestic venture capital by making investments in Australian ventures more attractive to overseas investors.

Collaboration for innovation

5. In allocating funding for co-operative ventures, priority industries should be identified so that the limited investment in innovation is more effective in developing niche industries in areas where Australia already has a significant knowledge base.
6. Cooperative Research Centres (CRCs) are supported, however the manner in which the value of Intellectual Property (IP) is captured needs to be reviewed, especially where innovations are commercialised. The current system is legally complex, and alternative models, including those from the USA, should be considered.
7. Support mechanisms from other countries including the USA and UK should be adapted for Australia. A voucher system to access financial support as advocated in the Cutler Review, similar to the Dutch model, is supported.

Informed procurement

8. 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, the government should play a major role in fostering innovation in procurement.

9. 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.

10. 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.

Promoting innovation

11. Australian innovations in engineering should be promoted and celebrated by:

    a. Developing and promoting a national award for innovation in engineering which could be awarded, for example, by the Prime Minister's Science, and Engineering Innovation Council during Engineering Week (similar to the Prime Minister's award for Science during Science Week).
    b. Promoting innovations in engineering via social media and the internet, for example, with a suitable web space
    c. Establishing a trade show, to showcase Australian engineering innovations with invitations to overseas venture capitalists to invest in Australia
    d. Drawing on the expertise of engineers in innovation with a formal nomination process via Engineers Australia to the various government committees and councils involved in innovation including the Innovation Councils established by AusIndustry, Commercialisation Australia, the boards of organisations running the COMET program and similar.

12. Engineers Australia can promote and support innovation in engineering with:

    a. Suitable web space on its "Make it So" web page – demonstrating how innovations in engineering have significant effects on everyday life
    b. Encouraging the establishment of Division-based committees to promote engineering innovations at the local level
    c. Holding suitable events during Innovation Month, held in May each year throughout Australia;

13. The Australian Bureau of Statistics should develop statistical information on the level of activity in innovation in engineering.

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APPENDIX 1: QUESTIONS FOR MEMBERS

1. In responding to these questions, please tell us your engineering discipline and type of organisation (e.g. SME).

2. How can governments best support and promote innovation? For example, through funding programs such as the CSIRO Flagship programs and Cooperative Research Centres, rewards and recognition or other incentives.

3. Is government investment in innovation sufficient? How can it be focused to provide most value to Australia and ensure more effective engagement from the Australian engineering profession?

4. Is there a preferred model in engineering procurement that enables innovation to flourish, from building a culture, to openness to new ideas on projects, all the way to commercialisation of ideas with industry wide application?

5. How can the engineering profession better engage and access the variety of government incentive programs?

6. What are the barriers to the engineering profession to commit to both corporate and technological innovation?

7. Do you have systems or programs in your company to encourage innovation? For example, invention identification, encouraging creative thinking, triaging of ideas, or the like?

8. Has your company ever licensed a technology to or from another company or institution? Explain the reasons why you have licensed the technology or why you have not considered licensing technologies and if there have been any barriers in doing so.

9. Has your company ever engaged with Australia's intellectual property system by filing a patent, design, or trademark? Are there any barriers to the system for engineers?

10. In your industry, are there any regulatory frameworks that create additional barriers for developing a product or process to market in Australia or overseas (for example requirement for approval by TGA for a pharmaceutical, safety approval requirements etc.)?

APPENDIX 2: INNOVATION FUNDING INCENTIVE (UK)

As part of the Distribution Price Control Review (DPCR) and Transmission Price Control Review (TPCR), Ofgem has introduced the Innovation Funding Incentive (IFI) mechanism. IFI was consulted on as an integral part of the DPCR and TPCR proposals and was widely supported by a large majority of consultees. The primary aim of the incentive is to encourage network operators to apply innovation in the technical development of their networks.

The Office of Gas and Electricity Markets recognises that innovation has a different risk/reward balance compared with a network operator's core business. The incentives provided by the IFI mechanism are designed to create a risk/reward balance that is consistent with research, development, demonstration and deployment.

The IFI is intended to provide funding for projects primarily focused on the technical development of the networks, to deliver value (e.g. financial, quality of supply, environmental, safety) to end consumers.

The detail of the distribution networks operators' IFI mechanism is set out in the Special Licence Condition C3, Standard Licence Condition 51 (for the Distribution Licences). The electricity transmission licensees' IFI mechanism is set out in the special licence condition J5 Part 3 or special licence condition D5 part 2, and standard licence condition B16 Part C. The gas transmission licensee's IFI mechanism is set out in Special Condition C8B and Special Condition C14B. They can be summarised as follows.

- A network operator is allowed to spend up to 0.5% of its combined distribution network revenue or its combined transmission network revenue (subject to a minimum of £500,000) as the case may be on eligible IFI projects.
- Network operator IFI expenditure that is internal expenditure will be allowed as part of the total IFI expenditure accrued by the network operator.
- The network operator is allowed to recover 80% of its eligible project expenditure via the IFI mechanism within the network operator's Licence.
- Ofgem will not approve IFI projects but network operators will have to openly report their IFI activities on an annual basis. These reports will be published on the Ofgem website.
- Ofgem reserves the right to audit IFI activities if this is judged to be necessary in the interests of customers.

In Ofgem's review of IFI and subsequent open letter response of 14th February 2007, the Authority agreed:

- A commitment to extend the DPCR4 IFI scheme until the end of DPCR5 with a flat pass through rate of 80%;
- The removal of the 15% cap on internal IFI expenditure for both distribution and transmission licences when requested to do so by a licencee;
- To work with the industry to review and revise the guidance documents by which IFI is controlled and managed; the result of which was the production of a Good Practice Guide.

Source: Energy Networks Association Limited is a company registered in England & Wales No. 04832301.

APPENDIX 3: CASE STUDIES

FINISAR AUSTRALIA – DEVELOPMENT OF WAVELENGTH SELECTIVE SWITCH TECHNOLOGY

"Ideas are easy, implementation is hard!" (Guy Kawasaki)

Finisar Australia's innovative product development has enabled it to progress from the local venture capital-funded start-up company, Engana Pty Ltd, to a local subsidiary of a multinational company in just ten years. With revenues of over $100m per year and a global market share in excess of 40 per cent for its Wavelength Selective Switch technology, Finisar Australia is building a high profile in engineering innovation.

Established in 2001 to develop and manufacture optical subsystems for reconfigurable optical networks, Engana (as the company was then known) soon began R&D on the concepts which now form the Dynamic Wavelength Processor (DWP) family of Wavelength Selective Switches. Crucial to its success was the use of Liquid Crystal on Silicon as the key optical switching element which originated within Engana and was patented by the company in the course of its commercialisation process.

Finisar's approach to product development has seen it feature in the Engineers Australia Sydney Division Excellence Awards in 2011. Finisar won four of the awards on offer, including the prestigious Bradfield Award for achievement of the highest level of engineering excellence. In awarding the prize to the DWP, the judges were particularly impressed by Finisar's "...ground-breaking work to harness new technology in developing a key product for the emerging world market in optical fibre communications...".

According to Dr Simon Poole, co-founder of the company and currently Director of New Business Ventures in Finisar Australia, while the early stages of R&D and product development relied on venture capital funding and investment from the founding management team, government support was also vital. In particular, funding received through the AusIndustry START program was critical to supporting the development of the DWP family.

Dr Poole considers that if the START grant or similar was still available, Finisar would significantly increase its long-term product development activities. Dr Poole also advocates for the reintroduction of the deferral of option taxation for executives and would like to see Australian companies provided with royalty-free access to the outcomes of Australian Research Council-funded research as ways that government can foster and support innovation in Australia.

In a final word on innovation, Dr Poole says,

> *Innovation is, in and of itself, necessary but, as the mathematicians say, insufficient. It is the linking of innovation with the ability to profitably implement the outcomes of that innovation, in a way that satisfies a market need that is the critical second step of innovation that is so often overlooked. Without this second step, Australia is doomed to forever be a place of great research but which does not benefit from the outcomes which the research is capable of delivery.*

See: **www.finisar.com**

AUSTRALIAN CENTRE FOR FIELD ROBOTICS – AUTOMATED STRADDLE CARRIER

Dr Hugh Durrant-Whyte is a scientist, engineer and innovator who has been at the forefront of robotics in Australia since migrating here in 1995. In his role as the head of the Australian Centre for Field Robotics (ACFR) and the ARC Centre for Excellence for Autonomous Systems at the University of Sydney, Dr Durrant-Whyte led many research and development projects that utilised government funding and support programs on the path to transforming an idea from the discovery stage through to commercialisation.

Dr Durrant-Whyte's experiences with the Australian Research Council (ARC) highlight an important role that governments play in funding and supporting innovation. ARC funding was instrumental in the development stages of outdoor sensors required for autonomous straddle carriers used for stacking and moving containers. This technology enabled the ACFR to develop an automated container terminal for Patrick Ports and Stevedoring in Brisbane. According to Dr Durrant-Whyte, the ARC Linkage Project bridged a gap between research and industry, and gave the University of Sydney the visibility and credibility to partner with Patrick to create the AutoStrad Terminal.

Source: Patrick (2010)

As a result, Patrick is a world leader in the technologically advanced management of containers within terminals. Differential Global Positioning System (DGPS) provides instant container tracking and pinpoint accuracy of location. The innovative Operational Management System (OMS) integrates graphical planning equipment control, container movements and client information access in a single computer framework. In Brisbane, Patrick's ground-breaking project, the world's first automated straddle carrier (AutoStrad) terminal, is now servicing all Patrick container volume. The automated 10 metre high, 65 tonne straddle carriers are fitted with sophisticated motion control and navigation systems which allow them to operate unmanned – moving and stacking containers from the quay into holding yards and onto vehicles and back to quay cranes with pinpoint accuracy. Unlike other automated systems, the revolutionary AutoStrad moves freely on a virtual computer-generated grid, which can be applied to most existing terminal facilities. A key benefit of this system is that it does not require extensive capital works to install in ground nodes or wires.

The AutoStrad carriers can operate 24 hours a day in virtually any conditions and have an inbuilt capacity to optimise container movements and storage requirements thereby maximising productive use of port infrastructure. The system can be controlled by one operator at a control centre on site. All of Patrick's systems and software are developed and maintained by the Patrick Technology and Systems team." (**www.patrick.com.au**)

According to Dr Durrant-Whyte, Australia's innovation efforts can be maximised by focusing on specific areas of need such as the transport and logistics industry, which contributes around 14 percent of Australia's GDP. The use of technology can have a significant effect on cost efficiency.

Dr Durrant-Whyte considers that the most important role of governments is to provide the right mechanisms and environment for innovation. He strongly believes that ARC grants, for example, should be competitive and awarded to the best projects.

IOMNISCIENT – TECHNOLOGY LEADER IN VIDEO ANALYTICS

iOmniscient, a Sydney based company, is recognised as the provider of the world's leading Video Analytics Products. The company's patented technologies position it as having the most advanced Artificial Intelligence based Video Analysis systems. The company has won awards on every continent and was winner of the 2010 Engineers Australia National Engineering Excellence Award as well the 2010 Global Security Challenge for the best security software system by the UK Home Office. Its customers range from City Surveillance in Kazakhstan to pipeline protection in Mexico; from Airports in Abu Dhabi to Museums in Sydney. Major customers include the safety system on the Fast Trains in China and queue management at Disneyworld (see: **www.iOmniscient.com**).

iOmniscient has developed Artificial Intelligence surveillance technology that analyses CCTV images to provide real-time alerts and enable preventive action when an unusual event occurs, rather than post-event, as in conventional systems. The application of this software goes beyond security and includes the protection of art works, the prevention of graffiti, crowd control and the management of queues in theme parks. iOmniscient's system has gained acclaim in the market as it is the only system proven to work in crowded and complex environments with a minimum of false alarms. It also has the most comprehensive portfolio of applications in the industry from facial recognition and license plate recognition to the ability to detect bags and other objects that may be virtually invisible to the human eye.

The initial research for the technology was performed by CSSIP, a CRC from Adelaide. iOmniscient acquired the IP ten years ago and patented and commercialised it. The current products extend far beyond that initial research and the company has several patents on its newer innovations. Most of the development work has been done by engineers in Australia and the company has used the R&D tax concession to support its research efforts. Its continuous innovation program has enabled it to release several new products every year. In 2011 it released the world's first CCTV analytics system capable of Face Recognition in a Crowded Scene and won a global security industry award.

More than 95% of sales are outside Australia and the company has sales offices in more than ten countries. The company has made use of Austrade's Export Market Development Grant (EMDG) to support its marketing efforts overseas. Today 12 of 20 of the world's largest Systems Integrators for CCTV systems use iOmniscient software exclusively for their video based security projects. iOmniscient is also rapidly implementing face recognition applications in video based security projects in the USA, Middle East and Asia.

The company has previously funded several ARC linkage grant projects at universities in Melbourne, Sydney and Perth. It has also licensed technology from research organisations like NICTA, Australia's National Information and Communication Technology Research Centre.

Despite its international success, the company has found it difficult to access markets in Australia especially where government procurement tends to be conservative and risk averse to implement new technologies. Incentives to encourage government agencies to purchase Australian innovative technologies would support Australian companies in bringing new technologies to the world market.

GHD - INNOVATION IN INFRASTRUCTURE – A CASE STUDY OF AN INNOVATION PROGRAM

$(innovations)^n$ *To identify and deliver game changing innovations to the global infrastructure industry.*

GHD is one of the world's leading engineering, architecture and environmental consulting firms. Established in 1928, GHD employs more than 6,000 people across five continents. Wholly-owned by its people, our network of professionals collaborate to deliver sustainable outcomes to communities and clients in the global markets of water, energy and resources, environment, property and buildings, and transportation. (**www.ghd.com/innovation**)

Recognising the growing need for the infrastructure industry to deliver more with less, GHD identified that innovation – delivering new ideas that create value – was one solution.

In March 2008, GHD launched a formal and focused innovation program with the key aim to identify and deliver game changing innovations to the global infrastructure industry.

The value of the program was to be measured using GHD's three key platforms -

- Clients – greater understanding of their client's needs and better solutions for their clients.
- People – number of GHD people engaged and internally/externally recognised.
- Performance – value of both commercialised ideas and internal process improvement ideas

The program has been delivered through a three-stage approach:

Stage 1 Within GHD – engaging with their people.

Stage 2 On Projects – adopting an innovation framework in project delivery.

Stage 3 In Industry – establishing and managing the "Innovation Interchange".

GHD designed and built a customised idea management portal called the Zone to connect all 6,000 GHD people throughout the five continents in an open and transparent manner. It is a voluntary program and through the Zone, everyone is free to participate by submitting challenges, respond with ideas, or collaborate and vote on the ideas of others. To date, almost 1,750 ideas have been submitted, with over 6,000 collaborations, and 38 ideas delivered. There have been nine patents filed and several commercialisation agreements. It was awarded the 2009 Engineering Excellence Award for Workplace Innovation by Engineers Australia (Victorian Division) for its contribution to the personal development of its people.

The delivery process for a number of major infrastructure projects has incorporated a formal innovation framework, including GHD's "Dual Pipeline". This has resulted in even more great ideas being generated and delivered for project and client value. A number of 'game changing' innovations have been captured and are now managed through GHD's innovation team.

Currently in the third stage, GHD developed (and now manages) the Innovation Interchange, a business-to-business global community to connect, collaborate and solve infrastructure industry challenges. This initiative is also supported through a Victorian State Government grant, through the Department of Business and Innovation.

In this ecosystem, 'Infrastructure Managers' submit their challenges, 'Technology Providers' respond with innovative solutions and 'Associates', specialist service providers involved in research, raising of funds, law, construction, commercial/accounting and manufacturing, support the commercialisation process.

(Visit: **www.innovationinterchange.com**)

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