

Inquiry into innovation and creativity: Workforce for the new economy

House of Representatives, Education and Employment Committee
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Education, The Warren Centre and the Australian Centre for Innovation

The Warren Centre brings industry, government and academia together to create thought leadership in engineering, technology, and innovation. We constantly challenge economic, legal, environmental, social and political paradigms to open possibilities for innovation and technology and to build a better future. The Warren Centre advocates for the importance of science, technology and innovation. Our 30 years' experience of leading the conversation through projects, promotion, and independent advice drives Australian entrepreneurship and economic growth.

The Warren Centre collaborated with Professor Ron Johnston and the Australian Centre for Innovation on this paper. Prof Johnston is on the forefront of educating Australia's next generation of innovators and research on innovation, technology and policy.

This submission forms our joint response to the Education and Employment Committee inquiry on adjustments to the tertiary system to meet the needs of a future labour force focused on creativity and innovation. The specific terms of reference addressed are:

- Factors that discourage closer partnerships between industries; in particular small and medium enterprises, the research sector and education providers; including but not limited to: intellectual property; technology transfer; and rapid commercialisation.
- Relationships between tertiary education entrepreneurship programs and private incubators and accelerators



Executive Summary

Making the transition from a resources-based economy to a knowledge and ideas-focused economy requires changes in collaboration, better recognition of intellectual property and changes in culture. The economic prosperity that accompanied Australia's resources boom is cause for celebration, but significant changes are required in the way the public, business and universities view future opportunities to maximise productivity in the global knowledge economy.

To ensure that the Australian tertiary sector evolves to meet the challenges of the new economy, we make the following recommendations:

1. Greater collaboration is needed between industry and universities. Incentives can drive changes in behaviour.
2. Intellectual property policies and strategies should be set at the national level and disseminated through the National Innovation System. Australian innovators should be as skilled and fluent as their US/EU counterparts and be aware of unique risks in the Asia environment. Sophistication and appropriate strategic selection is needed for different sectors.
3. Cultural changes are necessary beyond just increased collaboration. Economic growth and productivity gains are possible throughout the economy thanks to technology, digitisation and social acceptance of new business models.

What is the future economy?

The future economy will erase lines that presently separate man and technology (Kenney & Rouvinen, 2015). Globally societies are entering uncharted waters where government, business leaders, the scientific community and citizens must collaborate to define paths that direct technologies towards improving human lives. Innovation, uncertainty and risk will exist side-by-side in this process. Hybrid economic models characterised by the sharing economy and peer-to-peer platforms will be increasingly common. In the services sector, widespread adoption of the instantaneous 5-star rating system combined with the ubiquity of social media will create rapidly adaptive practices for dynamic and informed pricing and marketing. In the manufacturing sector, robotics, 3D printing and artificial intelligence are creating rapid changes in global supply chains.

Previous technological innovation delivered more jobs, not fewer. However recently, driven by reports such as *The Future of Jobs* by the World Economic Forum, there is

concern and uncertainty about future workforce requirements. A wave of digitisation is forever changing business. From driverless cars in the streets of San Francisco, to robots detecting light and colour patterns and performing tasks with dexterity and precision, to deep learning and artificial intelligence analysing stock markets and reassessing financial transactions, automation is an unstoppable force, with resultant disruption (Brynjolfsson & McAfee, 2014). Creativity and skill underpin technological change, and an innovative society fosters the appropriate knowledge and imagination to develop the ability to design, engineer, manufacture, diffuse, adapt, choose and use technologies (Dutta, et al., 2015).

The role of the tertiary sector therefore becomes integral in technology creation and value capture in the future economy. Universities will be seen as incubators and demonstrators of highly advanced technologies (World Economic Forum, 2016). The processes along the line from technology creation to adoption to value capture will be focused on how well an economy's universities can transfer technology and improve innovation and business sophistication. According to the Global Innovation Index 2015, the evidence suggests that Australia is less efficient than similarly developed countries in transforming innovation inputs to outputs (Office of the Chief Economist, 2015). To maximise productivity, citizens must be well prepared for the future economy and the unique challenges foreseen. The tertiary sector must evolve to include broader technological leadership as a part of its agenda.

What does it mean for Australia?

Preparing Australia to meet the unique challenges of the new economy is imperative for continued prosperity. Adapting practices and adopting new approaches for the present labour force are only part of the solution. We addressed other key elements in our Disruption Inquiry paper submitted to the Productivity Commission in February 2016. The more significant challenge is in education and preparing the workforce for the future challenge. The present Commonwealth Government initiatives for innovation set an excellent direction for innovation and revived entrepreneurship. As the resources boom slows and the 'ideas boom' commences, it is important that the tertiary sector responds to the government narrative around innovation, commercialisation and value capture with university-specific language around technology creation and leadership.

Australia contributes significantly to the global advancement of digital technologies and innovation. Across areas of automation, there are several leading research universities and facilities. Research at the Australian Centre for Field Robotics, at the University of Sydney is at the cutting edge of algorithm development, artificial intelligence and



systems automation. Examples of successful application to industry include the AutoStrads, a fully autonomous straddle carrier currently operating at the Port of Brisbane and in Sydney's Patrick Terminal. Substantial productivity benefits have been realised. Integrated decision making and systems-of-systems engineering are Australian research specialisations. These capabilities improve productivity and generate significant economic value. Research organisations such as CSIRO and Data61 (formerly NICTA) bridge the divide between universities and industry and have created numerous technology spin-offs around 3D mapping, data visualisation, intelligent transportation, internet of things and social media. Incubators and accelerators such as Stone and Chalk, Fishburners, Incubate and ATP Innovations in Sydney host start-ups aiming to crack the automation, decision-making and connectivity opportunities. According to the World Economic Forum report, *'The Future of Jobs'*, the industries that will lead to the greatest drivers of change include mobile internet, cloud technology, processing power, new energy supplies, internet of things, sharing economy, artificial intelligence and robotics (World Economic Forum, 2016). Australia plays a significant role in each of these emerging technologies.

Australia and tertiary education

Tertiary education is Australia's largest service export and fourth largest export overall behind iron ore, coal and gold (Hon. Christopher Pyne MP, 2015). The economic footprint is valued at \$17 billion per annum with roughly 600,000 full fee-paying international students enrolled in 2014 (Dodd, 2015). Australia's value capture as an educational provider is already a vital contribution to our national economy. Translating the research and productivity benefits realised through student populations and ensuring that educational programs are constantly updated to match future needs are necessary to continue holding and to extend our comparative advantages.

We recognise limitations in current university agenda across three broad but important areas that will govern Australia's future innovation capability:

- collaboration and cooperation;
- intellectual property and value capture; and,
- broader cultural connection with innovation.

How should tertiary education better serve national innovation needs?

1. Collaboration and cooperation

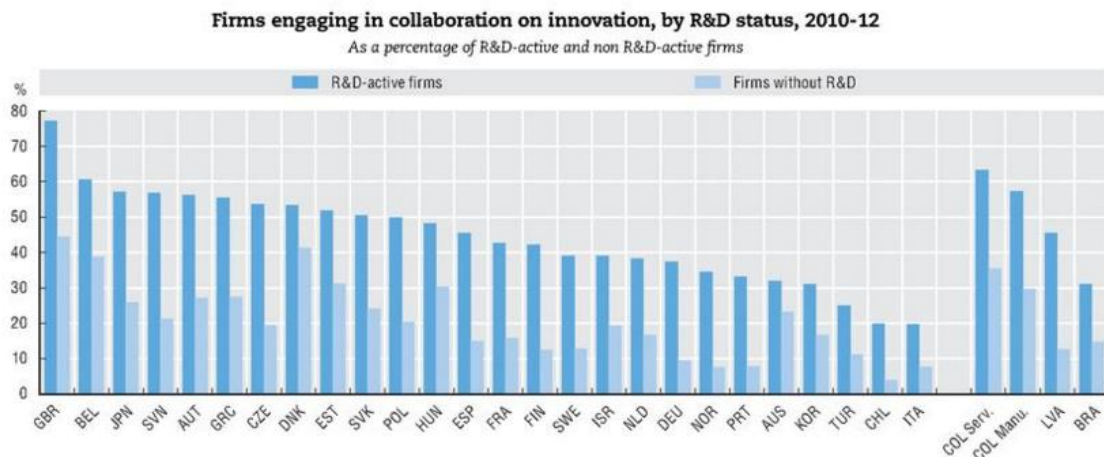


Figure 1: Firms engaging in collaboration in innovation (published in 2015 OECD Scorecard)

Collaboration and cooperation are frequently cited as a limitation in the Australian national innovation system. Figure 1 shows that Australia consistently ranks amongst the lowest in firms collaborating as reported by the OECD 2015 scorecard. This is despite Australia's total research output ranking amongst the top ten countries worldwide. Collaboration and cooperation have a multiplying effect on innovation, technology commercialisation and value capture abroad. For Australia to gain these benefits and for Australian students to be well prepared for future challenges, it is important that working with industry becomes a part of initial training. Overseas, a variety of methods that increase university/industry collaboration and cooperation are documented in the ACOLA 'Securing Australia's Future 09' report (Bell, et al., 2015). Australia can assess the lessons learned from programs such as Finland's 'Creating business from research ideas' or Canada's 'idea to innovation grants'. However the solution for Australia will uniquely reflect domestic technology strengths and workforce capabilities (Bell, et al., 2015).

One approach to drive industry cooperation behaviours is to change the methods by which universities and academics are rated and evaluated, to evolve from a focus on publications to include innovation activities (patents, business collaborations, commercialisations, royalties, spin-off companies) (Australian Science and Innovation Forum (2014), Warren Centre (2014, 2015)). At a university level, a voluntary innovation rating could be developed to rank universities based on their innovation

output, rather than the publication based ranking that is used in the Higher Education World Reputation rankings (Australian Science and Innovation Forum). On the individual level, innovation-centric activities should be recognised and valued in the promotion of academics and in application for research grants (GO8 (2014), Australian Science and Innovation Forum (2014)).

The allocation of university funding should include a component that recognises and assesses commercialisation output. A portion of funding could be allocated based on how a university meets an *Australian Commercialisation Outcome Target* over a three year rolling average. Another approach is to link academic income as a multiple of income from external sources such as royalties, partnerships with industry and private funding (Australian Science and Innovation Forum, 2014).

Industry innovation leave could be enabled and encouraged for researchers to spend time working with companies, and PhD candidates could have six month extensions on their APA scholarships by participating in an industry placement (GO8 (2014), Australian Science and Innovation Forum (2014)). The Australian Industry Group notes that the *Researcher in Business Program* was a successful example that brought researchers into businesses to assist at a detailed and practical level. Of the 130 businesses that were involved, 90% subsequently established ongoing collaborations (Australian Industry Group).

Further, clusters and innovation ecosystems are very valuable in supporting fundamental research and identifying the value that can be captured from fundamental research. Development of knowledge clusters (through CRC programs, industrial centres for excellence and industry precincts) are supremely valuable. CRC programs rank amongst Australia's most successful cross-industry programs. The CRC of Advanced Composite Structures has produced over 100 industry-ready PhD graduates, facilitated hundreds of millions of dollars of commercialisation outcomes and brought dozens of SMEs into the local and international industrial value chain through collaborative research engagement (CRC-ACS). The Allen Consulting Group in a 2012 study found that the program is highly beneficial in engaging researchers with domestic and international end users and has shown a 3:1 return on investment. Agencies like CSIRO and Data61 bridge the divide between universities and industry and have also reported significant innovation capability and value capture.

According to the Engineers Australia article '*Engineering a collaborative future*', Professor Archie Johnston from the University of Sydney stated that industry projects are



sought by students specifically because of their relevance and applicability to workforce capability (Young Engineers Australia; The Warren Centre for Advanced Engineering, 2016). In particular, allowing and incentivising industry access to student talent through increased internship programs, mentoring, summer projects and honours theses ensures that research output is targeted to practical challenges of the future economy and that students are gaining experience and expertise instantly relevant to evolving market needs.

Collaboration and cooperation form an asset to the tertiary education sector for preparing the future work force. Measures to improve Australia's global standing in collaboration and cooperation must be undertaken.

2. Intellectual Property and technology transfer

The terms of reference ask for specific input on factors that discourage closer partnerships between industry and university including intellectual property and technology transfer. There is limited strategic discourse in Australia about patenting and intellectual property compared to overseas environments where it is well understood that diligent and resourceful protection of intellectual property is necessary to ensure commercialised technology returns value to the innovator and the society investing in research. Failure to capture Australian IP value at home is effectively giving it away to the rest of the world to exploit. American, German and Japanese environments are much more sophisticated in their application of IP strategies and adaptation to different roles and collaboration forms that enable innovation. IP strategies are not a one-size-fits-all answer. In many innovation settings, speed and control of technology platform have much greater commercial value than patents or IP contracts. Part of the sophistication is choosing the correct strategy for a particular innovation situation.

The National Innovation and Science Agenda fails to address significant shortcomings in Australian intellectual property sophistication and value capture. Australia holds a disproportionately low number of patents worldwide despite being a significant contributor to the global research landscape. As Australian innovators aim their creative efforts towards larger international markets, their IP awareness must also be attuned to business and legal environments beyond the Australian national boundary. Unnecessary differences in Australian IP practices compared to larger markets and prevailing global practice represent a 'friction' cost in doing business aimed at foreign markets. Globally efforts underway are harmonising international patent laws as described by the US National Academies in *A Patent System for the 21st century*. The final recommendation of that report was to align the patent examination systems among the US, Europe and

Japan. As the largest jurisdictions with patents, the US and European systems should be understood by Australian innovators. The largest export market opportunities in Asia currently have relatively weak IP systems. This demands further sophistication and adaptation. Cybersecurity risks are key, but poorly understood, and solutions may lack necessary business sophistication. As international IP regimes harmonise, Australian should adopt a national IP policy adapted to Australia's position in the globalised knowledge economy.

We recommend these four innovation policy guidelines which will develop Australian intellectual property protection and ensure our place in the future economy.

- a. A national intellectual property strategy is needed to support the National Innovation and Science Agenda with dedicated funding for researcher education programs and university business units which function to assist researchers in protecting valuable technology creation.
- b. The national intellectual property strategy should specifically evolve to increase Australia's global share in patents productivity.
- c. Future innovators contributing to global knowledge export should be equipped with an awareness of and appropriate skills in technology adoption, value capture, and basic intellectual property.
- d. Strategies should be available to innovators for the Asian versus EU/US market, for cybersecurity threats and for different innovation sectors with different needs of speed and flexibility versus 'hard' IP protection.

3. Culture

Collaboration and cooperation are key to culture, but more is needed.

There is a broad cultural disconnection between the current government narrative and academia's understanding of their role in national innovation. Recognising the intrinsic long-term productivity potential of early-stage research as well as the importance of enterprise linkages with maturing technology creation is imperative. Lundvall in his paper published in 2007 in the Journal for Industry and Innovation cites that for innovation to remain relevant it requires a wide system policy approach, where the national innovation system (NIS) is seen as a system that involves interactive learning and where science is a part of a larger national narrative.

All relevant industries should be engaged in the national innovation system: creative arts, digital media and advertising. Areas not traditionally associated with 'innovation' are increasingly relevant to the broader narrative. User-driven research

and development will be vital to the future, and the nation must engage social capital to ensure that Australia meets demand. Developing new processes, building different business models and engaging in unique supply chains are also part of the innovation narrative. Further, developing new technologies and then bringing them to market is as much 'traditional' (science, technology) innovation as it is creative industries innovation. Thus, according to Innovation Australia, "*[the] opportunity lies in unlocking innovation value in three key public goods: open data, public-private partnerships and social capital*". Recognising the productivity potential of diverse university streams like Marketing, Political Economics and Media and Communications alongside traditional STEM is an innovation accelerator. Increasing degree options, opening more electives and allowing students to broaden undergraduate training has the potential to assist the national innovation system.

To this end we support two distinct conclusions reached by Australian government business units, the Office of the Chief Economist and Universities Australia. The Office of the Chief Economist in the Australian Innovation System Report 2015, quoted the World Economic Forum and derided Australia's business sophistication. Australia ranked 27th in the world in a metric that examined factors including: cluster development, value chain breadth, control of international distribution and production process sophistication (Office of the Chief Economist, 2015). Similarly, the Global Innovation Index ranked Australia 23rd for business sophistication. In the future economy, a key area for business sophistication will come from universities as technology incubators. Picking 'winners' in the technology market will increase Australian competitive advantage and value capture. Universities Australia in their 2013 report Australia's Higher Education Agenda 2013-2016, states that for Australia to capture the benefits of the upcoming decade, broad university reform in the areas of research commercialisation and university culture is required, specifically with reference to where it sits in a broader innovation space (Universities Australia, 2013).

By recognising both the value of research commercialisation as well as the broader innovation value of the skills to market a product and communicate the benefits of it to the broader public, graduates of university education will be armed to compete effectively in the future economy.

Conclusions

By increasing collaboration, creating valuable intellectual property and expanding innovation throughout business culture, the Warren Centre believes that Australia will be well prepared to capture economic and social benefits in the current transformation.

The Warren Centre looks forward to discuss this submission or provide further analysis to support and amplify any aspect of this submission.

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About the Warren Centre for Advanced Engineering

The Warren Centre constantly challenges the economic, legal, environmental, social and political issues raised by innovation. We collaborate with industry, government and academia to achieve globally significant outcomes.

<http://thewarrencentre.org.au/>

About the Australian Centre for Innovation

The Australian Centre for Innovation was established in 1992, in the form of Australian Centre for Innovation and International Competitiveness (ACIIC Ltd) as an independent non-profit company. Its articles of association included contributing to the objectives of the University of Sydney and the Warren Centre for Advanced Engineering. It has also been deeply involved in developing a better understanding of the changing nature of the global knowledge economy and the means to prosper within it. At the same time, the Centre has continued its research and consulting in the areas of innovation, research and technology policy.

<http://www.aciic.org.au/>

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