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Submission to the Standing Committee on Education and Employment - Parliamentary Inquiry into Innovation and Creativity: Workforce for the New Economy

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Summary of Recommendations

1. The extent to which students are graduating with the skills needed for the jobs of today and of the future

Technological Progress and the Pace of Change
- **Recommendation:** ensure students develop adaptability as a skill set

Automation
- **Recommendation:** focus on transition planning for industries most at risk of disruption, drawing on the research that already exists in this space

The Nature of Work
- **Recommendation:** ensure that the education system, and workplace regulation, is relevant to the future nature of work. Encourage a focus on developing multiple skill sets, as opposed to a fixed career path

Implications for Learning
- **Recommendation:** focus on developing communication, creativity, critical thinking, and collaboration skills

3. Factors that discourage closer partnerships between industry; in particular small and medium enterprises, the research sector and education providers; including but not limited to: intellectual property; technology transfer; and rapid commercialisation

Incentive Structures
- **Recommendation:** adopt the ATSE Research Engagement metrics as appropriate

Informal Networks & Cross-sector Professionals
- **Recommendation:** encourage opportunities for broad experience across multiple sectors and industries, such as; entrepreneurial leave for academics, professors of practice, internships and PhDs that are aligned to the research interests of industry and/or government

5. Other related matters that the Committee considers relevant

Driving Innovation and Commercialisation with Small Business Innovation Research (SBIR) Awards
- **Recommendation:** provide substantial funding for the SBIR Pilot Program, ideally well in excess of $20m per year, to enable a range of investments
- **Recommendation:** consult closely with the US experts (Charles W. Wessner, Ph.D) and learn from the US and European experience
- **Recommendation:** implement the Pilot Program in an agile manner and encourage state based programs
- **Recommendation:** work closely with relevant organisations such as the Australian Chamber of Commerce and Industry (ACCI) to maximise the uptake within industry
- **Recommendation:** provide modest incentive awards for university faculty to prepare applications to the SBIR program
- **Recommendation:** engage resources (ideally with experience across industry, government and the research sector) to drive engagement with the Pilot Program

Inquiry into innovation and creativity: workforce for the new economy

This submission sets out a longer term view regarding skill requirements into the future (with recommendations to maximise adaptability and responsiveness to future changes), and a shorter term perspective on actions that can be taken now to boost Australia's innovation and commercialisation outcomes (namely through the planned SBIR program).

1. The extent to which students are graduating with the skills needed for the jobs of today and of the future

Technological Progress and the Pace of Change

Technology has a long history of eliminating selected jobs whilst creating others, however the rate at which this is happening is now much faster. We are also seeing a blurring of boundaries between different industries and sectors. In times of rapid change, generalist skills and an ability to quickly adapt become increasingly valuable.

System thinking, as promoted by Senge (1994) in the Fifth Discipline is dependent upon an ability to see the whole, rather than just component pieces. Despite these findings being published in the 1990's, recruitment processes for senior positions still typically focus on extensive experience in particular specialisations. While specific experience is valuable, it shouldn't come at the expense of being able to see the bigger system. This can be particularly dangerous when executives fail to see major structural shifts that will impact on their industry (often resulting in large scale bailouts). In retrospect, or to selected outsiders, many changes can seem obvious. But a failure to identify and respond to these challenges in an appropriate way can often occur because of a focus that is simply too narrow, and a failure to perceive the broader context. Generalist skills applied to various potential scenarios are therefore an important inclusion in the education process.

Continually adapting and repositioning for the future is essential. This is true for individuals, organisations, sectors and nations more broadly. Therefore a key challenge facing the education system is preparing students to rapidly move between a range of jobs that potentially don't yet exist. While it may be difficult to predict future demand for specific jobs, adaptability is a skill that can be enhanced through education and will serve students well regardless of how the future unfolds.

- **Recommendation:** ensure students develop adaptability as a skill set

Automation

While automation had previously been primarily disrupting blue collar jobs, the capabilities of artificial intelligence (AI) are growing exponentially: "Recently a computer program passed the entrance exam to a university. Robots can cook and work in retail. Robots can learn, and we're learning to make them learn faster. There are even computer programs that can rewrite themselves to be more efficient." (Vanstone, 14th Jan 2016). IBM's "Watson" now has the ability to diagnose patients faster and more accurately than doctors (though some human intervention is still required to administer the recommended tests and enter the results). Software to automatically handle legal matters is also well progressed, as is software to replace many of the top paid employees in the finance sector (Baer, 2016).

In 2013, research undertaken by Oxford University found that 47% of US jobs were at risk of automation over the next two decades (Frey & Osborne, 2016), with Australia likely facing a similar scenario. Some commentators go as far as saying a reduction in working hours may be required to offset the shrinking requirement for human labour (Wadhwa, 2014). The level of disruption that automation will generate is potentially far broader than technology's historical impact. As with all exponential technology, progress will seem slow at first, then hit a tipping point where rapid uptake occurs. Effectively managing this transition will be critical for government. The work of Frey & Osborne also includes several policy recommendations for government on how to best prepare.

- **Recommendation:** focus on transition planning for industries most at risk of disruption, drawing on the research that already exists in this space

The Nature of Work

In the modern economy, companies come and go continuously, sometimes entire industries disappear as new technology is developed or it becomes advantageous to shift offshore. Just because a company has been around for 100 years doesn't mean there's any guarantee that it will make it to the end of the month. The idea of one permanent job with one company is becoming outdated in the modern economy. Building a varied, dynamic and agile career increasingly represents the best possible strategy for ensuring steady income over the long term (Piper, 2015).

The popularity of "gig based" or "portfolio careers" is on the rise: "Freelancers now comprise 34% of the US workforce. Most interestingly, 50% of freelancers surveyed indicated they would not go back to a traditional job no matter how much it paid. Research has shown that crafting multiple job roles and identities is on the rise." (Sander, 12th Jan 2016). This highlights that greater flexibility and variety is perceived as a positive, as opposed to a negative situation.

- **Recommendation:** ensure that the education system, and workplace regulation, is relevant to the future nature of work. Encourage a focus on developing multiple skill sets, as opposed to a fixed career path

Implications for Learning

As the rate at which information becomes outdated increases, and access to information becomes easier than ever before, the education system needs to shift. As Berman notes:

> "Finland recently shifted its national curriculum to a new model called the "phenomenon-based" approach. By 2020, the country will replace traditional classroom subjects with a topical approach highlighting the four Cs—communication, creativity, critical thinking, and collaboration. These four skills "are central to working in teams, and a reflection of the 'hyperconnected' world we live in today," Singularity Hub Editor-in-Chief David Hill recently wrote.
>
> Hill notes the four Cs directly correspond to the skills needed to be a successful 21st century entrepreneur—when accelerating change means the jobs we're educating for today may not exist tomorrow. Finland's approach reflects an important transition away from the antiquated model used in most US institutions—a model created for a slower, more stable labor market and economy that no longer exists.
>
> In addition to the four Cs, successful entrepreneurs across the globe are demonstrating three additional soft skills that can be integrated into the classroom—adaptability, resiliency and grit, and a mindset of continuous learning.

These skills can equip students to be problem-solvers, inventive thinkers, and adaptive to the fast-paced change they are bound to encounter. In a world of uncertainty, the only constant is the ability to adapt, pivot, and get back on your feet."

This approach is consistent with recent research from the World Economic Forum and Boston Consulting Group regarding the foundational literacies, competencies and character qualities to focus on imparting, as shown below:
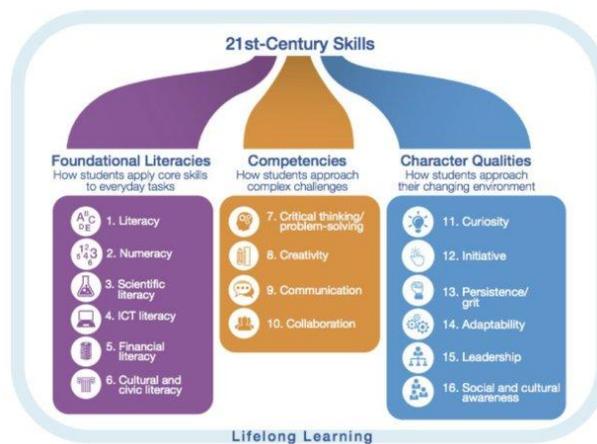
(Source: World Economic Forum & Boston Consulting Group report: _New Vision for Education: Unlocking the Potential of Technology._)

- ▪ **Recommendation:** focus on developing communication, creativity, critical thinking, and collaboration skills

3. Factors that discourage closer partnerships between industry; in particular small and medium enterprises, the research sector and education providers; including but not limited to: intellectual property; technology transfer; and rapid commercialisation

Incentive Structures

Institutions and the incentive structures they implement play a role in encouraging or impeding cross-sector collaboration. The focus on journal publications within academia has significantly skewed the focus away from industry engagement. ATSE have been undertaking important work

looking at how the assessment of academics can help drive research engagement. This work should now be implemented to help encourage greater collaboration.

- **Recommendation:** adopt the ATSE Research Engagement metrics as appropriate

Informal Networks & Cross-sector Professionals

Informal practices and culture can be just as important as official policy. In particular, two possible means of fostering increased collaboration are:
- Informal networks
- Cross-sector professionals

Informal networks exist through both personal and professional connections. They are particularly helpful where the nature of the relationship is such that it is possible to pick up the phone and get a timely, relevant, and accurate answer to a question. These relationships are ideally seen as mutually beneficial, with both parties utilising them as a means of securing input/engagement from another sector as and when required. Communication may be sporadic, but the key is that it is available at the times it is needed.

Cross-sector professionals seek to operate across industry, government and the research sector, often simultaneously (or frequent cycling between). This takes cross-sector interaction a step further as these professionals are able to bring their knowledge of the three sectors to each organisation they engage with. This provides a more comprehensive, internal source of knowledge beyond a reliance on informal networks. Each time a professional cycles through different sectoral engagements, they spread knowledge and bring the value inherent in a very broad, cross-sector network of connections. These relationship can also be drawn on in forming productive, cross-sector collaborations.

Compared to other developed countries, Australia has limited movement of people between industry, government and the research sector; it isn't uncommon for an individual to spend their entire career in the one sector. By contrast, in the US it is more common for a university professor to set up and spin out a company based on technology they have developed, and then return to academia after exiting the business. This generates benefits on a number of fronts:
- The professor gains first hand experience in running a commercial venture (leaving them in a stronger position to effectively engage with industry in future)
- Employees of the business experience a working model of close engagement with a research institution
- New networks are formed across the two sectors, which can be drawn on as participants in the venture move on to different roles

Initiatives such as secondments, entrepreneurial leave, industry based PhDs and more holistic recruitment considerations can all assist with greater movement of people across sectors and the establishment of informal networks.

- **Recommendation:** encourage opportunities for broad experience across multiple sectors and industries, such as; entrepreneurial leave for academics, professors of practice, internships and PhDs that are aligned to the research interests of industry and/or government

5. Other related matters that the Committee considers relevant

Driving Innovation and Commercialisation with Small Business Innovation Research (SBIR) Awards

Following on from initial meetings with several members of the Education and Employment Committee on 16th March 2016, Charles W. Wessner, Ph.D. has prepared the input below:

Driving Innovation and Small Firm Creation: An SBIR System for Australia

The SBIR Program is the world's premiere program providing early-stage finance for small firms. It was created in the United States in 1982 and has operated successfully since then, and is now considered a key element in the U.S. innovation system. The program has many advantages. It has grown over the years and now is approximately $2.8 billion per year. It has no budget line. It is funded through an allocation of funds on the R&D budgets of leading U.S. departments and agencies. This feature has helped ensure its continuity, now over 30 years. And the percentage allocation has grown as well and is now at 3.1%, although because it is a fixed percentage of agency R&D budgets, the program grows (or declines) with that budget. This mechanism has proved highly successful in generating a large and stable program.

Other key characteristics of the program are as follows:

- ▪ ***The program is focused on Early-stage/relatively High Risk technologies.*** *SBIR provides funding for some of the best early-stage innovation ideas - ideas that, however promising, are still too high risk for private investors, including venture capital firms.*

- ▪ ***The program is highly competitive.*** *The first phase success rate is approximately 15-20%, depending on the agency and the year. The second phase is roughly 50% or less of the successful phase ones.*

- ▪ ***Focus on Valley of Death.*** *The program funds proof of concept and prototypes. It addresses the gap in funding for promising, but unproven, ideas. As the investment community realizes, often the first money is the hardest to obtain for new companies, however promising the idea.*

- ▪ ***Phasing.*** *This is a key element in de-risking technologies. The program employs up to three-phased awards from federal research funds to address government mission needs. The effect of the phasing is to de-risk technologies. The selection process acts as a due diligence assessment, with the result that private capital is often attracted to support successful SBIR awardees.*

- ▪ ***Scale.*** *The program has significant scale, providing support for technological innovation with over 6000 awards and $2.5 billion a year to small businesses.*

- ▪ ***Portfolio Effect.*** *The substantial sums invested by the program in new and existing companies over a long period act to increase the success of the program overall. A key point to keep in mind is that project failure does not equate to program failure. In fact, all projects should not succeed. Excessively high rates of success would suggest low risk taking and therefore low value added.*

- ▪ ***Decentralized & Adaptive.*** *Each Ministry uses its funds to support research by small companies to meet its unique mission needs.*

The effects of the program are very positive. The program was reviewed by a major National Academies of Sciences study, in itself costing $5 million USD. The conclusion of this rigorous evaluation is that the program was "sound in concept and effective in operation".

Would an SBIR program work in Australia?

The Australian innovation system could benefit from this program in important ways. Australia has seen a decline in firm formation and ranks last in the OECD in industry-university cooperation. Early

stage funding is difficult to obtain in the Australian innovation system, and it is particularly difficult to obtain for high-tech companies. This is especially true in the biomedical space where Australia has made substantial and sustained investments. On the positive side, Australia's scientific position is well-established. Indeed, the country publishes "well above its weight" in internationally competitive journals. The question is how to convert this scientific accomplishment into productive firms that address social needs while generating growth and employment.

Given the challenges facing the Australian innovation system, a key policy question is "what actions can be taken in the innovation ecosystem to improve performance?" Instituting a well-funded, broadly based SBIR-type program would be a logical choice. While not a panacea, the SBIR program addresses many of the challenges faced by the Australian innovation system. For example, SBIR awards result in:

- *The creation of new firms. 20% of the companies responding to the National Academies of Sciences surveys indicated that they were founded as a result of a prospective SBIR award (25% at Defense). This means that the program acts as a conduit for new ideas from the university to the market.*
- *The initiation of new project research. The Academy surveys also showed that SBIR awards played a key role in the decision to pursue a research project, with some 70% claiming it motivated their decision to undertake the research. And the research itself often results in peer-reviewed publications, patent applications, and patent awards, reflecting the quality of the activity.*
- *Enhanced partnering with universities. Interestingly, the NAS research found that SBIR funding is often used by awarded companies to reach out to universities for expertise. Frequently awardees bring in academic consultants and to partner with other firms, thus strengthening university-industry connections and cooperation in the innovation system as a whole.*
- *Company growth. In many cases, company management indicated that a significant part of subsequent firm growth resulted from award.*
- *Improved government procurement. By providing for more innovative public procurement, SBIR awardees reduce the influence of hold of oligopoly suppliers in procurement systems, providing for more competition in terms of price, quality, and range of choice.*

In short, the SBIR program addresses key challenges in the Australian innovation system. It is important to keep in mind that it is a proven component of the market-oriented U.S. innovation system, having been in place over 30 years and regularly expanded under Democratic and Republican administrations alike. It has also been adopted – and adapted – into the innovation systems of a variety of different countries. In closing, the key question to ask is "Given the needs of the Australian innovation system, why would this proven program not be adopted?"

SBIR Observations
It is noted that the government intends on introducing an SBIR Pilot Program at a federal level (as well as several state-based SBIR programs being planned). While this is strongly encouraged, it is important that the Pilot Program be given the best chance of success to ensure its merits can be fairly assessed. Key areas in this regard are as follows:

1. Sufficient Funding - in the venture capital industry, the expectation is that for every ten investments, only one will show a strong positive return, a couple more will do ok, and the rest will just return capital and a number will lose the funds invested. Given this, it should be expected that the Pilot Program will need to make multiple investments in different ventures, in different sectors, over multiple rounds, to maximise the chance of generating successful companies. To do so,

additional funding should be put towards the Pilot Program. This could be achieved through a reallocation of a portion of the procurement budgets of relevant Departments.

- **Recommendation:** provide substantial funding for the SBIR Pilot Program, ideally well in excess of $20m per year, to enable a range of investments

2. World's Best Practice - while some adjustment may be required for the Australian marketplace, the Pilot Program should look to world's best practice as a starting point. With the SBIR successfully operating in the US for over 30 years, Australia has the opportunity to learn from its experience by consulting with relevant experts. It is also prudent to keep in mind the experience of the Europeans and the results they have achieved following the changes they have made in their own SBIR implementation. Key features in the US program such as simple applications, phasing and no recoupment should be retained.

- **Recommendation:** consult closely with the US experts (Charles W. Wessner, Ph.D) and learn from the US and European experience

3. Agile Implementation - in addition to learning from world's best practice, the Pilot Program should be implemented in an agile manner, with differences accepted across agencies and sectors and with adjustments made as required to maximise impact. It is important that this is done with guidance from relevant experts who can advise on how best to address any issues that arise.

- **Recommendation:** implement the Pilot Program in an agile manner and encourage state based programs

4. Industry Engagement - ensuring appropriate industry awareness and take up of the Pilot Program will be critical to its success. In the current environment, many small business people already feel overwhelmed regarding the number of grant and assistance programs that are available and the rate at which they are created, ceased or renamed. Therefore additional effort may be required to ensure that industry actively engage with the Pilot Program. As a starting point, engagement should occur with the Australian Chamber of Commerce and Industry Productivity Unit, who have a mandate from the Department of Employment to deliver initiatives aimed at improving workplace productivity, a key component of which is empowering entrepreneurs.

- **Recommendation:** work closely with relevant organisations such as the Australian Chamber of Commerce and Industry to maximise the uptake within industry

5. University Engagement - university based firms are a major source of innovation in the US and elsewhere. Providing a positive innovation oriented environment within the university through prizes and small awards , backed by positive career incentives can encourage university based entrepreneurship and underscore the benefits of R&D investments. Universities should be incentivised to participate in the Pilot Program.

- **Recommendation:** provide modest incentive awards for university faculty to prepare applications to the SBIR program

6. Active Management - in the early stages of the Pilot Program implementation, it may be beneficial to take a more proactive approach to encouraging both Departmental and industry participation. This could include looking at SBIR solicitations put forward overseas to help with generating local requirements, and exploring the extensive dataset of registered IP that may not yet have been fully commercialised (as captured in Source IP: https://sourceip.ipaustralia.gov.au). Program advocates with large networks across industry, government, and the research sector could help to generate engagement in the Pilot Program, facilitate beneficial collaborations, and provide valuable input when assessing which proposals to fund.

- **Recommendation:** engage resources (ideally with experience across industry, government and the research sector) to drive engagement with the Pilot Program

Closing Remarks

In addition to the commentary provided above, both authors (Zoe Piper & Dr Charles Wessner) are committed to continuing the dialogue. We are well placed to provide advice from a cross-sectoral perspective, and to draw together relevant stakeholders to help drive program success. We look forward to further opportunities to continue the discussion.

About the Authors

Zoe Piper - Allaran, Founder/Director

Zoe Piper has over 17 years experience across management consulting, technology, manufacturing and investment. She has a strong interest in cross-sector interaction and is actively engaged in a range of roles and appointments.

Highly experienced in assisting organisations (both public and private) to analyse and enhance performance, Zoe regularly facilitates professional connections and collaborations. She currently manages the Australian Chamber of Commerce and Industry (ACCI) Productivity Unit, designing and delivering initiatives to boost firm level productivity (focusing on management and leadership, human capital, innovation & technology, sustainability and trade). In this role Zoe has engaged stakeholders from business, academia and government to jointly address Australia's productivity challenge.

An active investor, Zoe draws on her previous private equity experience to identify investment and joint venture opportunities where she can add value. In 2009 she co-founded Ecolour, an Australian based manufacturer of premium quality, non-toxic paint that is now distributed across the country. In 2015 Zoe was named as a finalist in the Emerging Entrepreneur category of NAB Women's Agenda Leadership Awards.

Zoe is a Fellow of the Australian Institute of Management (chairing the AIM ACT Regional Advisory Committee) and a member of the Australian Institute of Company Directors. She has studied in the USA, Europe and China, and her qualifications include an MBA, Bachelor of Economics and Bachelor of Communication. Zoe is currently undertaking a PhD (Public Policy) at the Australian National University focusing on cross-sector collaboration.

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Charles W. Wessner - Professor, Global Innovation Policy, Georgetown University

Dr. Charles Wessner currently teaches Global Innovation Policy at Georgetown University and is a powerful advocate of effective innovation policies. Previously, he served for two decades as a National Academies scholar where he founded and directed the National Academy of Sciences Technology, Innovation, and Entrepreneurship Program. He is recognized nationally and internationally for his expertise on innovation policy, including public-private partnerships, entrepreneurship, early-stage financing for new firms, 21st century manufacturing, cybersecurity, and the special needs and benefits of high-technology industry. As an outgrowth of his work with the U.S. government, he advises technology agencies, universities, and government ministries, including the Prime Ministers of countries in Europe and Asia. In addition, he cooperates closely with

international organizations and lectures at major universities in the U.S. and abroad. The overarching goal of his work is to develop a better understanding of how we can bring new technologies forward to address global challenges in health, climate, energy, water, infrastructure, and security. Reflecting his commitment to international cooperation, he was recently named an Officer of the Order of Merit by the President of France.

Recent Policy Briefings

Reflecting the strong global interest in innovation and Dr. Wessner's policy expertise, he is frequently asked to address issues of shared policy interest with foreign governments, universities, and research institutes, often briefing government ministers and senior officials. He frequently gives keynote addresses and presentations to international organizations, such as UNCTAD, the U.N. Economic Commissions for Europe and for Latin America, the World Bank, the Inter-American Development Bank, the OECD, and the European Investment Bank, as well as the European Commission. In Washington, he works closely with Congressional staff, the White House, and major departments and agencies in the Executive Branch on the formulation of effective innovation policy. Recent policy speeches include addressing the governing parties in the German Bundestag and the Annual Meeting of the Australian Cooperative Research Centers in Brisbane.

Advisory Roles

Dr. Wessner has served as an advisor to the 30-nation OECD Committee on Science and Technology Policy, as a member of the Canadian Council of Academies' Expert Committee on Science and Technology in Canada, as an advisor to the National Technology agencies of Finland (TEKES) and of Sweden (VINNOVA), and as a member of the Norwegian Technology Forum. He was nominated by the U.S. Government as an Innovation Expert for UNCTAD and advises WIPO on its new innovation initiative. He was also recently named Deputy Chairman of the Innovation Advisors to the UNECE. He has participated in the Prime Minister of Taiwan's Science and Technology Advisory Group and served as a member of the Board of the National Association of Seed and Venture Funds.

The overarching goal of his work is to develop a better understanding of how we can bring new technologies forward to address global challenges in health, climate, energy, water, infrastructure, and security.

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