ATSE

SUBMISSION TO THE

House of Representatives Standing Committee on Education and Employment Inquiry into Innovation and Creativity: Workforce for the New Economy

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AUSTRALIAN ACADEMY OF
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SUBMISSION TO THE HOUSE OF REPRESENTATIVES STANDING COMMITTEE ON EDUCATION AND EMPLOYMENT

INQUIRY INTO INNOVATION AND CREATIVITY: WORKFORCE FOR THE NEW ECONOMY

The Australian Academy of Technology and Engineering (ATSE)[1] welcomes the opportunity to provide input into the Committee's inquiry into Innovation and Creativity. ATSE has long argued that a successful innovation economy requires development of Australia's Science, Technology, Engineering and Mathematics (STEM) capabilities. It is widely accepted that STEM skills are not only required in STEM based occupations but prepare graduates for a broad range of occupations, including management. STEM graduates typically excel in a range of highly desirable capabilities including active learning, critical thinking, and complex and creative problem solving[2]. ATSE's responses to the Committee's terms of reference are outlined below.

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

Engagement in STEM related studies at a primary and high school level allows for the creation of a scientifically literate community and ensures that there is a large pool of high school graduates with the requisite skills for further studies in STEM related fields. Unfortunately, at the secondary school level, participation in STEM related studies has declined significantly over the past two decades[3]. A 2015 report by PricewaterhouseCoopers[4] reported that 44% of current jobs in Australia will be obsolete within 15 years and predicted that 75% of the replacement jobs will require STEM skills. As such, the trend of decreasing STEM participation in secondary school urgently needs to be reversed. ATSE recently released an action statement[5] outlining this issue and arguing that the development of world-leading, inspirational teachers is essential to increase participation in STEM studies. To drive this change, the statement recommended that:

- Initial teacher education and training for STEM teachers should require a bachelor's degree with an appropriate major, along with either undergraduate or postgraduate qualifications in teaching;
- An independent national professional body for teachers, similar to those for other professions, should be established; and
- All out-of-field teaching in STEM disciplines needs to be eliminated as soon as practicable.

In order to actively address the problem of low STEM participation rates at the upper secondary school level, ATSE developed the STELR (Science Technology Education Leveraging Relevance) initiative[6]. ATSE recognised that one major reason for low participation rates in STEM subjects is that students do not perceive and appreciate the relevance of science in their lives. STELR addresses this

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1 ATSE advocates for a future in which technological sciences, engineering and innovation contribute significantly to Australia's social, economic and environmental wellbeing. The Academy is empowered in its mission by some 800 Fellows drawn from industry, academia, research institutes and government, who represent the brightest and the best in technological sciences and engineering in Australia. The Academy provides robust, independent and trusted evidence-based advice on technological issues of national importance. ATSE fosters national and international collaboration and encourages technology transfer for economic, social and environmental benefit.

2 http://www.chiefscientist.gov.au/wp-content/uploads/DAE_OCS-Australias-STEM-Workforce_FINAL-REPORT.pdf

3 http://www.chiefscientist.gov.au/wp-content/uploads/BenchmarkingAustralianSTEM_Web_Nov2014.pdf

4 PricewaterhouseCoopers Australia 2015, *A smart move*.

5 http://www.atse.org.au/Documents/policy/world-leading-stem-teachers-australia.pdf

6 https://www.atse.org.au/content/education/stelr-project.aspx

by relating STEM subjects to highly relevant issues affecting all students. PwC recently recognised the STELR Program as one of the best STEM Education programs in Australia, awarding it a place in their $2.5 million 21st Century Minds Accelerator Program. The STELR program:

- Is hands-on, inquiry-based, and is taught as a part of the regular school curriculum;
- Uses relevant contemporary issues such as Climate Change, Sustainability, Car Safety, Technology in Health and Water and Food Security;
- Shows students that science and maths are relevant to their lives;
- Increases student enthusiasm for and engagement with STEM subjects;
- Supports teachers 'teaching out of field'; and
- Provides students with career profiles, which highlight the study pathways necessary for jobs in STEM-related industries.

Government support for widespread implementation of innovative, relevant, in-curriculum programs such as STELR would help to address problems with student engagement at the secondary school level.

Gender imbalance in STEM is a major problem. Despite girls outperforming boys in maths and science at secondary school, girls are far less likely to pursue careers in the engineering or IT industries. Boys are also five times more likely to study physics and nine times more likely to study information technology compared with girls. In addition, women comprised only 3% of university applications to study IT[7]. Without encouraging and supporting girls and women to pursue careers in STEM, Australia is missing out on an extremely large talent pool.

Tertiary qualifications in STEM must equip Australian graduates' with contemporary discipline knowledge and employability skills for a wide range of possible careers and further study. It is widely accepted that STEM skills are not only required in STEM based occupations, but also prepare graduates for a broad range of occupations, including management. STEM graduates typically excel in a range of highly desirable capabilities including active learning, critical thinking, complex problem solving and creative problem solving. However, industry often questions whether STEM graduates possess satisfactory interpersonal and time management skills, and knowledge of business practices. To address this, all formative STEM degrees should feature relevant interdisciplinary and non-STEM content (e.g. ethics, entrepreneurship, project and IP management). Any such changes will require detailed assessments of existing course deficiencies and the needs of the future workforce. Given the changing nature of employment, there is also a strong case for the inclusion of STEM skills, such as data analysis, in non-STEM degrees.

Australia's future prosperity and wellbeing will depend on employing more creative and innovative graduates. Graduates will need to possess postgraduate coursework qualifications and research degrees in the STEM disciplines. Many will be at the forefront of Australia's new and emerging enterprises.

In 2013, the Australian Council of Learned Academics (ACOLA)'s Securing Australia's Future (SAF) Program[8] released a report comparing international STEM education policy and capabilities[9]. The report highlighted a number of potential issues, including low rates of tertiary entrants into mathematics (0.4% in Australia compared with an OECD average of 2.5%), low proportions of Doctor of Philosophy (PhD) degrees awarded in engineering, and a large proportion of growth in STEM PhDs

7 http://melbourneinstitute.com/downloads/working_paper_series/wp2016n10.pdf

8 ACOLA combines the strengths of the four Australian Learned Academies (Science, Technology & Engineering, Humanities, and Social Sciences) to provide a nexus for interdisciplinary cooperation and develop integrated problem solving and cutting edge thinking on key issues for the benefit of Australia. Funded by the Australian Research Council and conducted by ACOLA for the Australian Chief Scientist and the Commonwealth Science Council, *Securing Australia's Future* delivers evidence-based research and interdisciplinary findings to support policy development in areas of importance to Australia's future. www.acola.org.au

9 http://acola.org.au/index.php/projects/securing-australia-s-future/project-2

due to international students. Australian students' participation in computing and IT degrees is also relatively low compared with other OECD countries.

ATSE is currently participating in two ACOLA research projects under the SAF Program. *Project 10: Capabilities for Australian enterprise innovation*[10] seeks to examine the way that Australia's high-performing enterprises identify, manage, build and mix the capabilities to succeed, and Project 13 is a comprehensive review of Australia's research training system[11]. Both of these reports are set to be released within the coming months and bear direct relevance to this Inquiry. ATSE strongly recommends them both to the Committee.

Any changes to regulations in the education sector area should be supported by a strong evidence base. A preliminary finding in the ACOLA review of research training relates to the lack of longitudinal data on Higher Degree by Research (HDR) course satisfaction, course completions, and career outcomes. Data on career outcomes for HDR graduates is currently very poor, both in Australia and overseas. As such, it is difficult to form sound evidence-based policy in this area. Comprehensive mapping of Australia's future skills needs and the changing nature of employment will be very important to ensure that Australia remains competitive and prosperous in years to come. It is also essential to recognise that there is likely to be a long lead time before the benefits of improved STEM skill training in schools and universities are apparent.

Matters relating to laws and regulations that may act as a barrier to education providers being able to offer qualifications that meet the needs of the new economy and fastest growing sectors

Due to the funding and regulatory frameworks imposed by government, entry pathways to HDR training are inflexible, which restricts the choice and background of prospective students. The ACOLA research training review has examined this issue in some depth and will soon issue findings on how this situation could be improved. The *Review of Research Policies and Funding* (the Watt Review)[12] recommended that the three schemes which support research training – the Research Training Scheme (RTS), Australian Postgraduate Awards (APA) and the International Postgraduate Research Scholarships (IPRS) – be combined and simplified. It noted that "in particular, current arrangements create impediments to greater use of industry placements during PhD courses — a key strategy for generating greater commercial interests among PhD students". According to the Watt Review, simplification of the research training schemes would give universities the flexibility to:

- Offer both stipends and tuition fee scholarships to the best applicants in priority areas of research, regardless of nationality;
- Offer stipends and tuition fee scholarships for longer periods of time, where justified by innovation in course structures or personal circumstances; and
- Introduce innovative structures and arrangements which increase the skills and employability of research graduates, such as business placements and relevant coursework in appropriate research fields.

ATSE supports these measures, which are consistent with the research conducted for the ACOLA research training review.

Another possible consideration could include funding models for higher education, based around professional certification levels. This would allow for a greater mix of Commonwealth Supported Places (CSPs) for Masters level professional accredited programs. Attention should be given to the barriers, availability, accessibility and incentives relating to education opportunities that can provide employment relevant qualifications and skills development for those already in the workforce.

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10 http://acola.org.au/index.php/projects/securing-australia-s-future/saf10

11 http://acola.org.au/index.php/projects/securing-australia-s-future/saf13-rts-review

12 https://docs.education.gov.au/system/files/doc/other/main_report_final_20160112.pdf

Similarly, there exists a need to examine how education providers could deliver intensive re-skilling of the workforce in transition industries.

Care needs to be taken to ensure that any changes made promote (or at least do not negatively affect) diversity in graduates and make higher education more accessible to underrepresented groups. In addition to the moral argument for improving equity, it is widely acknowledged that increased diversity is an important driver of innovation[13]. There are currently severe gender imbalances in Australian tertiary enrolments and career progression in STEM disciplines. ATSE has partnered with the Australian Academy of Science to establish *Science in Australia Gender Equity* (SAGE), which is based on the Athena SWAN program in the United Kingdom) and aims to improve the environment and prospects of female STEM professionals in higher education institutions. Indigenous students are also severely underrepresented in the physical sciences, engineering and information technology.

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.

Unlike other OECD countries, Australia offers almost no incentives for business to collaborate with public sector researchers. ATSE's recent submission to the R&D Tax Incentive Review recommended that the incentive be used to encourage greater collaboration between industry and public sector researchers[14]. This would better align the Incentive with its primary goals of encouraging additional R&D with spill-over benefits. ATSE also encourages the Australian Government to provide direct targeted incentives for collaborative R&D projects. The introduction of targeted schemes (such as Third Stream funding and/or Knowledge Transfer Partnerships in the UK) would drive positive behaviour in universities and industry (the ACOLA SAF Project 9, *Translating research for economic and social benefit* provides a number of other examples).

Research has suggested that the innovative potential of a nation is not directly proportional to its spending on R&D. The absorptive capacity of industry is a key determining factor in adequately capturing the outcomes of public sector R&D. Direct collaboration between staff in businesses and Public Funded Research Organisations (PFROs) is recognised to be the most effective way to facilitate this knowledge transfer[15]. OECD data shows that Australian universities and publicly funded research institutes and industry in Australia are less engaged in collaboration than their counterparts in other countries. At present, PFROs are not provided with an appropriate incentive for collaboration. To address this, ATSE has developed and trialled a set of metrics, titled *Research Engagement for Australia* (REA), which use existing data already submitted to the Australian Research Council[16]. ATSE has conducted a pilot of the REA metrics with universities and state governments in South Australia and Queensland. This pilot demonstrated the feasibility of using the metrics as a measure of engagement between university researchers and industry. The Federal Government has acknowledged the work done by ATSE and has committed to introducing a systematic national assessment to measure the impact and engagement of university research in the National Innovation and Science Agenda (NISA). The evaluation measures will be determined through an extensive consultation with universities, industry and community stakeholders and the assessment will be conducted by the Australian Research Council (ARC) as a companion exercise to the Excellence in Research for Australia assessment[17].

Other important barriers to partnerships between industry and university include fundamental cultural differences, the slow turn-around time of PFROs compared with industry and the high transaction costs associated with collaboration. Legal arrangements between industry and PFROs are often

13 http://www.forbes.com/forbesinsights/innovation_diversity/

14 https://www.atse.org.au/content/publications/submissions/industry-innovation/r-and-d-tax-incentive-review.aspx

15 https://www.atse.org.au/Documents/reports/strengthening-links-between-industry-public-research-report.pdf

16 http://www.atse.org.au/content/publications/reports/industry-innovation/research-engagement-for-australia.aspx

17 http://www.innovation.gov.au/page/measuring-impact-and-engagement-university-research

complex and dominated by risk avoidance. The development of simplified, streamlined and flexible standardised legal frameworks (e.g. Easy Access IP[18]) for industry-PFRO partnerships can help to reduce complexity and costs, but there are still significant cultural challenges that need to be overcome.

ACOLA's SAF Project 13: *Review of Australia's Research Training System* has examined a number of issues related to improving the linkages between HDR students and industry. The Review's findings will include a focus on issues such as:

- improving incentives for universities to collaborate with industry, including by supporting candidates to undertake placements, internships and research on industry-relevant research projects;
- introducing more flexibility in research training scholarships and funding models to encourage more partnerships with industry;
- examining the regulatory and taxation barriers that prevent or discourage HDR students from working with or in industry; and
- supporting schemes that facilitate industrial placements for HDR students

The Academy urges that greater weighting is given to industry experience in university STEM academic appointment, reward and promotion considerations. There is also a need to examine structural issues within STEM that discourage researchers from easily interchanging between academia and industry during their careers. Increasing the opportunities for undergraduates to gain industry-relevant skills, such as through work experience and co-operative education placements would further help promote collaboration between industry and universities.

Consideration should be given to the role that government procurement processes can play in empowering investment from industry and encouraging more corporate responsibility for investment in internships, training and local innovation teams. Significant government investments in areas of national importance have the potential to activate skills and innovation capacity in Australia.

Relationships between tertiary education entrepreneurship programs and private incubator and accelerators.

A finding of ACOLA's SAF Project 9[19] was that the development of entrepreneurial skills in Australia's public sector research institutions is essential to improve their performance in research translation. Several of the countries that were reviewed for the project provided targeted assistance to develop research translation skills in public sector research institutions. Such skills development should not be limited to university technology transfer office staff. Providing university students with opportunities to develop entrepreneurial skills as part of their studies is a means of increasing interest in start-up company formation. Government can assist public sector research institutions by providing support for programs such as innovation contests, start-up programs (including incubators and accelerators), internships and placements, and innovative workspaces. It is also important that universities encourage and provide opportunities for their staff to develop entrepreneurial skills.

ATSE will lead a 'Young Entrepreneurs' program in China in May 2016, funded through the Department of Education and Training. The purpose of the program is to develop entrepreneurship skills in the higher education sector through interaction with some of the leading proponents in the field in China. It is also hoped that the links forged between the Australian and Chinese participants will lead to productive initiatives in the future. An educator and two outstanding postgraduate students from four of Australia's major incubator and entrepreneurship education programs have been invited to participate. The program will run over two days and include site visits in the Shanghai area followed by a one day workshop hosted at the Monash University campus at Suzhou. Chinese students and

18 http://easyaccessip.com/

19 http://acola.org.au/index.php/projects/securing-australia-s-future/saf09

educators involved in entrepreneurship and incubator programs will also be invited to join the workshop. Workshop discussions will be focused on advanced manufacturing, encompassing aspects of biotech and renewable energy.

Other related matters that the Committee considers relevant.

ACOLA's SAF Project 4, *The role of science, research and technology in lifting Australian productivity*[20] deals with a number of issues related to this Inquiry, including the importance of local and international collaboration; the role of an innovative workforce in improving productivity; the importance of advanced manufacturing and support for innovation; and the links between innovation, collaboration, management skills, and productivity in Australian businesses. The Report contains three major findings:

- Building Australia's future industries will depend on adopting technological innovation to develop high-value products and services for a global market.
- Improving collaboration in Australia, between businesses and between business and publicly funded researchers, will significantly enhance innovation. International collaboration is also critically important. Both domestic and international collaboration improves the productivity and competitiveness of Australian technology-based firms.
- An innovative workforce that combines technical and non-technical disciplines, and enables good business management, is essential to underpin the competitive advantage of Australian industries and realise opportunities to lift productivity.

As an example sector, there are significant lessons to be learnt from the agricultural sector, particularly in the way R&D is funded. ACOLA's SAF Project 7 - *Australia's Agricultural Future*[21] found that the Rural R&D Corporation (RDC) model, which supports investment in collaborative R&D from government and industry, has been particularly successful. The research also noted that there was a long lead time between research investment and achieving productivity gains. This outlines the necessity of providing stable funding and appropriate review timeframes for any programs aiming to improve the innovation and creativity skills of Australia's workforce.

ATSE would be pleased to further assist the Inquiry in its work, and the expertise of the Academy and its Fellows remain available to the Committee. Should you require any further assistance, the contact at ATSE is Dr Matt Wenham, Executive Manager, Policy & Projects (matt.wenham@atse.org.au or 03 9864 0926).

Recommended Reading

ACOLA's Securing Australia's Future Projects 2, 4, 7 and 9 (currently available), and Projects 10 and 13 (to be released shortly), available at http://www.acola.org.au/index.php/projects/securing-australia-s-future

ATSE 2016, *Submission to the R&D Tax Incentive Review*, available at https://www.atse.org.au/content/publications/submissions/industry-innovation/r-and-d-tax-incentive-review.aspx

ATSE 2016, *Research Engagement for Australia: Measuring Research Engagement between Universities and End Users,* available at http://www.atse.org.au/content/reports.aspx?policy-reports-collection=5#

20 www.acola.org.au/index.php/projects/securing-australia-s-future/project-4

21 http://www.acola.org.au/index.php/projects/securing-australia-s-future/7-australia-s-agricultural-future