

originally submitted 11 March 2016
minor corrections: 26 April 2016

To the Standing Committee on Education and Employment
Australian Parliament

Re: Inquiry into innovation and creativity: workforce for the new economy

I write on behalf of the Australian Council of Engineering Deans (ACED) to provide input to this inquiry. ACED is an **incorporated** association of the 35 Australian universities providing accredited or provisionally accredited engineering degree programs. ACED's mission is to support and promote engineering education and research in the higher education sector.

Society implicitly expects engineers to be creative and innovative. Engineers have special responsibilities to design, build, operate and retire from service, physical and information-based products, systems and infrastructure. A further implicit expectation is that any new engineered product, system or infrastructure solution will be the best possible in terms of performance, given cost, environmental and other constraints. This requires engineers to be innovative in using new technologies and materials of cost, etc. Their ability to be innovative requires creativity, a skill that can be – and is – taught and encouraged within Australian engineering schools. Whilst carrying a key role in innovation, engineers invariably work in multi-disciplinary teams that include professionals from other disciplines within and outside the STEM (science, technology, engineering and mathematics) group.

This submission addresses the Terms of Reference as they apply to engineering education and research training in the universities.

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

The answer to this question has two parts: are we producing sufficient engineering graduates in number, and do those who are graduating possess the right skills.

On numbers, **in each** of the past two years, ACED member engineering faculties and schools have produced approximately:

- 11,200 graduates from Bachelor degrees (including Honours) (35% international)
- 4,800 graduates of postgraduate coursework awards (~55% international)
- .. 1,350 graduates of higher degrees by research (HDR), mostly PhDs (~ 53% international)

The Australian graduates, and some of the internationals, are likely to join Australia's workforce. Many bachelors degree graduates are employed in leading edge engineering companies and projects. Many of the postgraduates and all of the HDR graduates generate new engineering science and practice knowledge in the course of their studies; many will progress to leadership and management roles and will survive through their capacity to innovate.

Domestic Bachelor degree graduations have increased by about 23% over the past decade. Domestic PhD graduations have increased by only 18% in that period. Domestic masters graduations in engineering have more than doubled (from 645 to 1,426), but it should be noted that some of the latter are "first professional qualifications" from the new Melbourne University and University of Western Australia models. The majority of domestic Masters graduates are for employed engineers upgrading

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their technical skills. However, a higher number of practicing engineering professionals are likely to take MBA or Postgraduate qualifications in Project Management. The latter are of value in pursuing innovation and high quality engineering work.

Compared with other countries, Australian universities produce relatively few engineers, especially at the higher qualification levels. Graduate outcomes, in terms of employment rates and starting salaries are good. The need for local supply of graduates to be complemented by immigrant (qualified and experienced) engineers has been well documented. The much quoted PwC report* on the need for growth in STEM skills models 'engineering professionals' as the job of greatest need of supply growth. It may well be anticipated that Australian engineering industry will face stronger competition from the economies to the north, and fewer of the graduates we have educated will be available for work in Australia.

A corollary of these trends is that Australia must increase its efforts to increase the numbers of students motivated by and capable in school science, mathematics and technology subjects. A higher proportion of this larger population will need to progress to STEM degree – not least engineering – if Australia is to meet its future needs. This needs whole of government (federal and state) intervention on curriculum and high quality teaching, supported by the outreach programs of professional and employer bodies, the Academy Engineering and Technology (ATSE), and others. Ultimately, the community at large needs to see that careers in STEM are rewarding.

On the matter of quality and skills, all the Bachelor (Honours) degrees and "formative masters" degrees in engineering from Australian universities are professionally accredited by Engineers Australia (EA) to learning outcome standards consistent with global best practice. These are validated and reviewed by an international agreement, known as the Washington Accord. (Similar agreements operate for 3-year bachelor degrees and associate degrees/advanced diplomas.) The global and Australian graduate standards are informed and periodically reviewed by engineering practitioners and have an emphasis on the broad set of generic skills required for engineering practice, including in innovation and research practice, with a strong emphasis on design and problem solving. Graduates are also expected to know about the research directions of their specialisation.

Feedback from accreditation reviews and ACED members' industry advisory committees indicates broad satisfaction with the capabilities of graduates to tackle today's engineering problems with a suitable degree of creativity. Some graduates may lack high-level interpersonal skills, but most are competent in basic team work. Multinational companies report that Australian typical engineers are adaptable and versatile, surely the basic capabilities needed to tackle new challenges.

Most Australian engineering faculties and schools now have experts in engineering education practice and research. Over the years, they have won a large number of Office of Learning and Teaching grants, and network in the activities of the Australasian Association for Engineering Education, which is supported by ACED. These organisations and the faculties are strongly engaged in the international networks for education standards and education innovation.. Indeed, the immediate past chair of the Global Engineering Deans Council is Professor John Beynon, Executive Dean at the University of Adelaide, and is a former ACED president.

*<https://pwc.docalytics.com/v/a-smart-move-pwc-stem-report-april-2015>

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

ACED's principal concern in this area is the current restriction on coursework enrolments for higher degree by research candidates. An ideal PhD program should include coursework in the area of advanced specialisation (including via inter-institutional enrolment), and in such areas as entrepreneurship and innovation management. This may extend the duration of a PhD, but would reap great rewards for the candidate and his/her future career.

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

ACED cannot identify any particular inhibiting factors. Rather, we take this opportunity to state support for the outcomes of the recent CRC review, and the changes to the ARC Linkage grant scheme. Over the years, ACED has worked hard to develop close relationships with industry to provide good work experiences for students. Indeed, we have recently published an in-depth report on industry-academic collaborations**. Future opportunities for collaboration could lie with initiatives such as professional doctorates in engineering that have been successful elsewhere.

**Male, S. A., & King, R. W. (2014a). Best Practice Guidelines for Effective Industry Engagement in Australian Engineering Degrees. Retrieved from https://www.engineersaustralia.org.au/sites/default/files/shado/ACED/aced_industry_engagement_guidelines.pdf

**Male, S. A., & King, R. W. (2014b). *Improving Industry Engagement in Engineering Degrees*. Paper presented at the 25th Australasian Association for Engineering Education Conference, Wellington, New Zealand.

Relationships between tertiary education entrepreneurship programs and private incubator and accelerators

ACED has no comment to make on this; individual universities may provide comment relating to engineering.

Other related matters

None

Conclusion

ACED would be pleased to provide further information as required, or participate in a Senate Hearing.

Yours sincerely

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