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29 July 2015

Department of Industry
Department of Education and Training
Australian Government, Canberra

Dear Minister Macfarlane and Minister Pyne

Response to Consultation: Vision for a Science Nation

I write on behalf of the Australian Council of Engineering Deans (ACED) to provide responses to the questions in the consultation paper (the 'Vision Paper').

ACED is an association of the 35 Australian universities providing engineering degree programs, and research in engineering science, engineering practice and engineering education. ACED's mission is to support engineering education and research in its members' and the national interests.

The ACED member universities produce about 17,000 engineering graduates per year, and much of the nation's basic and applied engineering research. ACED views engineering capability as central to the realisation of Australia as a nation that creates, uses and values science, technology, engineering and mathematics (STEM), as envisioned in the Chief Scientist's Government's papers.

Do these proposals adequately respond to the Chief Scientist's recommendations – both now and over the longer term?

The complexity of the issues involved with positioning STEM (and therefore covering much more than "science") at the centre of the vision demands a wide range of initiatives and proposals. The proposals and initiatives align positively with most of the Chief Scientist's recommendations. .

A fundamental understanding that could be much clearer in both documents is the explicit recognition that ***engineers are the leading professionals who add economic value to scientific and mathematical knowledge*** through the products, systems and infrastructure that they conceptualise, design, produce and maintain. Innovation is at the heart of engineering. Similarly it is ***technology*** (as encapsulation of knowledge in hardware and software) that has monetary value, rather than its underlying science and mathematics.

The Vision Paper should therefore express more accurately the ***complementary roles*** of scientists and engineers[1], and the ***intersections*** between STEM-based work and business and enterprise. ACED would see value in further emphasising the more inclusive concept of ***STEM-based innovation*** at the heart of the vision, rather than 'science'. A further point is that much STEM-based expertise – particularly in engineering – resides in industry and business. The identification of being an 'expert' with formal 'research' undervalues the innovative roles of engineers and technologists who practice in industry. As existing and new business ventures will ultimately transform the vision into reality, a stronger sense of partnership of expertise and knowledge between industry and the research sector could be more strongly expressed.

The Chief Scientist's paper provided a clear set of recommendations against distinct headings. ***The Vision Paper needs to support its implementation proposals with a set of robust metrics against which performance can be tracked.***

[1] Albert Einstein is reported to have said that "*Scientists investigate that which already is; Engineers create that which has never been*".

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Do you consider there are any areas that require more urgent action? Have we missed anything?

As most of the Australia's current economic performance indicators are trending negatively in line with reducing resources and energy export values, urgent action on most of the proposals is desirable.

ACED sees the need for urgent action on the Industry Growth Centres and the CRC program, and indeed argued for expansion of the latter in its submission to the Miles Review in 2014. Similarly, ACED urges action on the initiatives and incentives to increase collaborative research training with leading-edge engineering businesses.

ACED considers that taking action on the following are particularly critical:

- implementing the Innovation Board;
- implementing 'strategies to improve translation of research into commercial outcomes', including the R & D Taxation incentive; and support for STEM-based start-up companies[2];
- urging the States and other educational authorities to implement the revised ACARA curriculum, including inquiry-based and ***project-based*** learning, the Digital Technologies and Design and Technology subject areas, including coding, ensuring that the latter is done rigorously and in contexts that encourage creative thinking and stimulate school students' interests. Emphasis on project-based learning increases students focus on deliverable outcomes.
- recruitment of science, mathematics, technology and engineering teachers, and reducing impediments to engineers and ICT professionals from making career changes into school teaching and allowing them to teach in area of science and mathematics in which they are competent and knowledgeable;
- dissemination of the outcomes of the Enhancing the Training of Mathematics and Science Teachers Programme, and expanding their outcomes into new teacher education programs;
- development of multi-disciplinary course units in innovation and innovation management that are suitable for undergraduate and postgraduates in STEM, business and other disciplines;
- development of strategies to routinely support employers to incorporate work integrated learning and industry placements for ***all*** STEM undergraduates[3].

A further specific additional suggestion is that National Science Week be refocussed into 'National STEM Week', if suitable accommodation can be made with Engineers Australia that runs National Engineering Week.

Which of these proposals will have the greatest impact on Australia's STEM performance?

The initiatives and proposals referred to as urgent (above) are all necessary to contribute to the transformation of Australian business envisaged. All proposals will have some impact, but this will be maximised by bi-partisan, whole of government (Commonwealth, states and territories) and support, and commitment by relevant industry peak bodies.

There are, however, the following linked drivers will have the greatest impact.

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[2] Crossroads 2015, published by AusStartUp. See https://startupaus.org/resources/crossroads-report/ outlins the difficult environment for start-up companies in the ICT sector.

[3] The Vision Paper refers to increasing the employability skills of STEM graduates, and the national initiative on work integrated learning in first and formative degrees. The Australian Engineering faculties and schools have traditionally required graduates of formative engineering degrees (i.e. those accredited by Engineers Australia as meeting the internationally benchmarked standards for commencing supervised practice) to have undertaken "exposure to engineering practice", normally including at least 12 weeks of workplace experience. With some 11,000 such graduates per year, this is a very difficult requirement for engineering employers. Surveys conducted by Office of the Chief Scientist and others also have shown that, in general, engineering graduates meet key employability requirements (in areas such as problem solving and teamwork) quite well.

Industry and business pull: our existing businesses must come to believe more strongly than they appear to, that their future relies on adopting STEM-based innovation, and that a significant proportion of this can come from partnerships with the higher education and research sectors. Such innovation thinking must begin in schools, and effective partnerships with Industry and Business need to be strengthened and supported. This needs to be incentivised by several of the initiatives and proposals in the paper. ***STEM-based careers need to be seen to be attractive, desirable and attainable***.

STEM-based start-ups need to be better supported and nurtured. Australia's reported '*have a go*' culture that underpins many small businesses needs to be developed more strongly into the professional STEM-based areas that have the potential to become world-leading businesses. The community must be made more aware of the successes and the role models we have. ***These will act as inspiration for the education sectors.***

Higher education improvements: Australia has many well-ranked universities in STEM-based research (including medical sciences). Their performance in collaborative research training and in STEM undergraduate and coursework masters degrees with a stronger emphasis on innovation could be greatly improved, by collaborative and multi-disciplinary new coursework initiatives. ***These could be underpinned by specific programmes within the proposed successor to the Office of Learning & Teaching.***

School education: ultimately the community at large, and especially parents, will have to believe in the vision sufficiently strongly to push the proposed radical changes envisioned in the refocus of Australian school education on STEM, and on STEM careers. ***STEM subjects will need to be interesting and enjoyable, and to lead to good employment.***

Which of these proposals will enable you and your organisation to contribute to Australia's STEM performance?

ACED and its member faculties and schools have roles to play in many of the proposals, and are keen to play their part in realising the vision.

Over the past seven years, ACED itself has managed several projects that have improved the quality of engineering education, including such areas as work integrated learning. Many of these projects have been funded by the Office of Teaching and Learning, and its predecessors, with outcomes that have improved engineering graduates' employability skills.

ACED could envision undertaking, with its members, further system-wide project work in areas such as:

- projects related to improving industry-linked research training;
- education for engineering innovation;
- support to school education and teacher educators in STEM;

ACED would be pleased to provide further information as required.

Yours sincerely

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