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Online at: consult.industry.gov.au/science-and-commercialisation-policy-division/vision-for-a-science-nation

Vision for a Science Nation

The University of Sydney welcomes the development of a comprehensive science policy by the Australian Government, and the STEM strategy as part of that policy.

STEM education is a critical part of maintaining and growing Australia's innovation capacity, as is support for STEM research and researchers. Encouraging entrepreneurship is key to unlocking this capacity to drive innovation, and we applaud the government's appropriate focus on the need to develop entrepreneurial and communication skills in STEM graduates. We would go further, however, and suggest that the Arts, broadly defined, should be given attention as part of STEM education – indeed, our international colleagues are already moving to discussing STEAM, in place of STEM, as part of recognising the importance of the creative side of problem solving.

The Humanities, Arts and Social Sciences, are important not only as part of education, but also valued in addressing the research challenges that are identified as Australia's research and science priorities. Facilitating multi-disciplinary collaborations to unlock creative solutions to the nation's most pressing challenges is a key feature of our current research strategy. It would be a setback if the proposed STEM strategy had the effect of discouraging such approaches.

Some more detailed responses to the consultation questions posed are attached. The University's Warren Centre for Advanced Engineering will also make a submission in its own right. The Warren Centre's mission is to foster excellence and innovation in advanced engineering throughout Australia, including through the provision of independent comment and advice to government and industry on technology and innovation.

Should any further information be required from the University in regards to its response to the STEM strategy, in the first instance please do not hesitate to contact Mr Tim Payne, Director Higher Education Policy and Projects in my office, 02 9351 4750, tim.payne@sydney.edu.au.

Yours sincerely,

Dr Michael Spence

Vice-Chancellor and Principal

Attachment University of Sydney specific comments on the paper

University of Sydney Detailed Responses

Innovation

The University of Sydney welcomes the addition of science expertise to the Innovation Australia Board. The intention to use the Board to oversee important industry-research collaborations such as the Cooperative Research Centre program makes it critical to have such expertise available. The identification of innovation priorities that will complement the science and research priorities is also very welcome, though we note that there is already a heavily 'applied' focus to the science and research priorities – it would therefore be appropriate for the proposed innovation priorities to directly address the research priorities.

By far the largest Government investment in research is through the R&D tax concession for industry, which cost the Budget approximately \$2.5 billion in 2012-13¹. We are very supportive of indications in this document that the Government will consider, as part of the Taxation White Paper process, how this investment could be refined to ensure it is achieving maximum impact for research and innovation in Australia.

The University's programs already embed entrepreneurial skills training in many areas, such as in the Faculty of Engineering and Information Technologies, where accelerator-innovation laboratories that encompass the latest 3d printers, innovative software and state-of-the-art data analytic tools have been established to serve the entrepreneurial interests of our engineering and IT leaders of the future. In addition, the Business School offers a graduate certificate that focuses on entrepreneurship and our University Union runs an award-winning startup accelerator and entrepreneur program. Incubate, led by one of our IT graduates, provides funding, co-working space and mentoring that is open to students, researchers and alumni of the University and is currently expanding Australia-wide. Engineering has also attracted external philanthropic funding that supports the Warren Centre Chair in Engineering Innovation.

Innovation very often relies on the novel integration of disciplines, however, and must focus not only on the traditional STEM disciplines but also include the humanities, social sciences, design, and others.

Enhancing engagement with industry is a key part of our educational strategy for students at all levels. All undergraduate engineering students undertake a mandatory industry internship. Our Faculty of Science has recently signed up to membership of the Australian Mathematical Sciences Institute intern program which places students with industry, business or government, and our Chemistry School offers a year in industry program for undergraduate students. We look forward to discussing, as part of the current Review of the Research Training System, how as a nation we can increase the numbers of research students who spend time embedded with industry during their studies. We have found that the enduring people-to-people links that are established when students spend time based in business and industry during their research studies, serves to increase linkages, understanding and overall levels of business/university collaboration.

Education and Training

The University of Sydney is committed to advancing STEM education and training. We offer a Bachelor of Primary Education that includes a mathematics specialisation and are in the process of recruiting a Professor of STEM Education. We are active in STEM Education research, with cross-faculty collaboration, as well as through offering in-service and pre-service education to teachers.

Our STEM Teacher Enrichment Academy provides teachers with professional development and training to improve the classroom teaching of STEM subjects. The first Academy was held in 2014/15 with 60 teachers from 13 schools participating in high-quality professional learning. The second will commence in November 2015. This unique Academy is supported by philanthropic sources and was opened by Minister McFarlane in 2014. It is a collaboration between the Faculties of Science, Education and Social Work, and Engineering and Information Technologies.

¹ Australian Government. *Re:think. Tax Discussion Paper*. March 2015

The focus in the paper on enhancing the training of mathematics and science teachers is an excellent initiative, however, it would be good to see the Government strengthen its commitment to other discipline specialist teaching in high schools. To that end, we would like to see a stronger focus on the teaching of technology, or of engineering at the primary and secondary school levels.

Noting the importance of practicum placements to effective teacher training, we welcome any moves to help create partnerships for work placements through the Universities Australia National Strategy for Work Integrated Learning, and to focus on graduate employability. It can be difficult to find high quality placements for our pre-service teachers and to identify exceptional STEM teachers for our students to work with. National and International shortages in secondary mathematics and physics teachers are crucial to address, and the proposed partnerships will assist in ensuring the supply of future STEM teachers.

We note the Government's intention to develop an employer satisfaction survey to measure satisfaction with higher education graduate skills. The University is currently consulting on its Education Strategy and is considering our Graduate Qualities in this context. We support a focus on outcomes-based evaluation of graduates, including teacher education graduates. While we note the Government's intention to introduce a literacy and numeracy test for pre-graduation teachers, we would suggest this is better applied as an entry standard, and should be an interim solution only while an outcomes-focused standard for teacher certification is developed.

The decreasing take-up of STEM subjects, particularly mathematics, at the secondary level and at HSC, is of particular concern if our aim is to grow the pool of STEM-qualified graduates. There is also significant gender imbalance, with young women increasingly opting out of mathematics and other STEM disciplines at HSC level, which has the effect of limiting women's future career options. We hope that some of this decline can be addressed through public programs and schools outreach such as that undertaken by our Faculty of Science, and we welcome the Government's support for public programs to raise the profile of STEM research. There are also disincentives within the current ATAR system that stream students away from challenging STEM subjects, and these should be addressed – along with considering the reintroduction of pre-requisites for further study.

In [our recent submission](#) to the Government's Draft International Strategy we also emphasised the critical importance of enhancing levels of second language acquisition amongst the Australian population, and raised concern about the continuing low numbers of students completing secondary schooling with proficiency in Asian languages such as Mandarin and Bahasa Indonesia. Encouraging second language acquisition is relevant to our performance in the STEM fields, as it is an enabler to international collaboration. The University of Sydney has recently introduced a Diploma of Language Studies which can be taken as an online intensive program alongside or after completing an undergraduate degree to help ensure our students have the opportunity to study a second language as part of any degree.

Developing high-value Australian Postgraduate Awards targeted to STEM fields as a way to ensure high potential STEM graduates are recruited to research careers should be considered as part of the Research Training System Review. Our initial view, however, is that such a program could continue to support the separation of disciplines across the curriculum, where an innovation-focused program might be expected to instead privilege interdisciplinary areas not limited to STEM.

Research

The University of Sydney is very supportive of any moves to take a longer-term view of support for STEM infrastructure and career development for both researcher and educators. Secure long-term funding for research infrastructure is vital, as is an established career path for both researchers and the highly skilled technical staff who support research. To that end, we welcome the proposed 10 year outlook for research and research infrastructure and the Government's commitment to continued support for early and mid-career research fellowship programs. We are also delighted to see the commitment to long term research infrastructure needs that will support and expand the strong relationships we have established with our industry partners, for example, our multi-million dollar research collaborations between the Australian Field Robotics Centre and Rio Tinto in supporting their 'Mine of the Future' in Western Australia as well as contracts with Qantas.

Longer timeframes are also very welcome for planning and supporting research career development and it would be good to see some more specific proposals in these areas. A secure, long-running postdoctoral support scheme, for example, along the lines of a permanent Future Fellowships Scheme or the old QEII Fellowship Scheme is imperative to provide a career pathway for STEM researchers. This will assist not only current STEM PhD students but will encourage the recruitment of high school students and others into such careers.

We are also pleased to see a focus on encouraging open access, but note that open access to scholarly journals may not achieve the goal of making research more accessible to governments, industry and others. There is a need, however, for translation products that make it easier for business to bridge the gap between researchers and industry.

International Engagement

Noting the Government's recently released draft National Strategy for International Education, we are concerned that the International Science Engagement Strategy proposed in this document may be too narrow in its focus, and could usefully be broadened to focus on engaging with partners across all areas of research. Most of the complex challenges that are currently facing Australia and our potential partner nations are multidisciplinary and broad in scope. This principle would apply also to any development of an Asian Area Research Zone, and the proposed global collaboration program and science diplomacy strategy.

We are delighted that the value of international engagement is prominent in the STEM strategy and believe this allows some of our key international alliances to grow and be more effective, for example, we have multi-million dollar alliances with two of China's top Universities – Tsinghua in the areas of smart grid technologies and economics and with the Shanghai Jiao Tong University in the area of Translational Medicine and Technology.

In addition, it will be important to consider how the Government's laudable intentions in this area to open up international collaboration on important STEM topics is limited by legislation such as the *Autonomous Sanctions Act 2011* and the *Defence Trade Controls Act 2012*, which significantly restrict international public good research collaboration. We are pleased that amendments were recently made to ensure that implementation of the *Defence Trade Controls Act 2012* continues to be overseen by an expert group, in order to identify further areas for improvement.