
Response to Vision for a Science Nation Consultation Paper

The University of Melbourne is pleased to provide a submission to the consultation on the Vision for a Science Nation and welcomes the Government's response to the Chief Scientist's recommendations regarding Australia's future in Science, Technology, Engineering and Mathematics (STEM).

The University broadly supports the proposals in the Vision for a Science Nation consultation paper. In particular, the University supports the importance of a whole-of-government focus to coordinating and driving STEM priorities. The University's *Research@Melbourne Strategy*, reflected in the University-wide *Growing Esteem Strategy*¹ adopts similar themes to those identified in the Vision paper. Attached to this submission is a summary of the University's research priorities and recent achievements, which demonstrates the University's deep engagement in STEM and our work to remain at the forefront of best practice in teaching and research in STEM.

The University makes the following more detailed comments on the four priority themes adopted in the Vision.

1. Australian Competitiveness

Australia has a remarkable history of contributing to key inventions, including penicillin, wireless LAN, the bionic ear, IVF, CPAP machines, and interventions to reduce the likelihood of diseases including bronchitis and cervical cancer. World-class innovation in STEM-related disciplines relies on stable policy settings that ensure appropriate funding for researchers.

The University of Melbourne undertakes fundamental and applied research to enrich our understanding of the world, increase knowledge and respond to global challenges. In 2014 the University's expenditure on research was \$1.1 billion. Through such an investment, we recognise that we have an obligation to justify our efforts to society, to communicate our research and to ensure the conduct of our research is visionary, transformative and beneficial.

Under *Growing Esteem*, the University is deepening its commitment to industry and commercial engagement. From this year, our researchers are supported by a new Research, Innovation and Commercialisation team that will identify and support opportunities for researchers to engage more closely with industry and business partners. The model brings together the management of basic research application alongside commercial business development, led and resourced by staff with expertise in industry engagement, entrepreneurship, government relations, venture capital and commercialisation.

Major initiatives such as the Carlton Connect Initiative (home to a start-up incubator) and the development of a productive partnership with IBM, that has been instrumental in IBM establishing one of their Global R & D Labs near campus, are other important investments in working in this area.

¹ http://about.unimelb.edu.au/_data/assets/pdf_file/0006/1462065/11364-GROWING-ESTEEM-2015-WEB.pdf

As a leading institution for STEM education and research, we recognise, that we have a role to play in driving improvement in the nation's efforts to boost its competitiveness through harnessing innovation and increasing the numbers of graduates able to contribute to a workplace requiring STEM skills. To this end, *Growing Esteem* will guide the identification of those disciplines, areas of research concentration and interdisciplinary fields that merit significant additional investment. The convergence of many aspects of the biological, mathematical and engineering sciences, for example, creates exciting new opportunities and will require teams that run across faculties' boundaries.

The University has identified this evolution as an opportunity at an institutional level to target research investment, projects and partners to compete in a globally competitive environment. The strategy also embeds a focus on engagement with industry and new ways to translate research into useful outcomes. This in turn will support richer learning opportunities for our STEM students. As a reflection of this approach, the University, as part of its internal operations, brings together its STEM Faculties with the Faculty of Medicine, Dentistry and Health Sciences and works as a STEM-M strategy team to facilitate collaboration.

As further examples on this point:

- The University hosts the Australian Mathematical Sciences Institute on our campus. The Faculty of Science, along with academics in Engineering and Medicine, are engaged in building much stronger computational biology capability across the campus and with our affiliated partners such as the Peter MacCallum Cancer Centre, the Walter and Eliza Hall Institute of Medical Research, and the Murdoch Childrens Research Institute. These measures are influencing new academic courses, have led to the recruitment of brilliant new staff and offers new research opportunities for our students.
- Through the Victorian Life Sciences Computational Initiative (VLSCI) we have developed high performance computing leveraged by a sophisticated community of computational scientists that support our biologists, geologists, materials scientists and engineers in their research.
- The University hosts an ARC Centre of Excellence for Mathematical and Statistical Frontiers of Big Data, Big Models, New Insights collaboratively with other universities. The Centre will produce a lasting body of influential research, which has the potential to add real value to a range of areas from health care services and road traffic networks, to marine ecosystems, astrophysics and more: <http://www.arc.gov.au/news-media/media-releases/big-data-big-models-new-insights%E2%80%94launch-new-arc-centre-excellence>
- The University has launched an international Mathematics Research Centre called Matrix@Melbourne hosted by the Department of Mathematics and Statistics. The Centre will bring the world's finest mathematicians to Melbourne to workshop near insoluble mathematical problems.

2. Research

The University of Melbourne is positioned within the top 50 institutions in the world across all rankings and much of this success is driven by research excellence. The number of highly cited researchers at Melbourne has doubled since 2010. Twenty-five per cent of all highly cited

researchers within Australia (and 40 per cent of those within the Go8) are employed by or affiliated with the University.

There is an important link between excellence in research and international rankings. The quality of research is central to our global rankings, which in turn attracts the best and brightest to our institution and attracts international research funding and collaboration.

As one of the largest research organisations in Australia, the University is dedicated to maximising excellence and the impact of our research efforts, which is exemplified by the *Research@Melbourne Strategy*. In this strategy, the University aims to improve tangible impact through working across disciplinary and sectoral boundaries. The strategy recognises that national policy and practice emphasises teamwork across the University and with external partners, as the basis of additional future funding.

In our experience, building innovation ecosystems is also an important enabler through which research, discovery and commercialisation can be achieved. Particularly as the cost of research infrastructure escalates, fewer universities can manage large-scale research agendas alone. Precincts and hubs that bring together government and researchers, established industry and start-up companies to address global problems will become important for research and contribute to national prosperity.

The University of Melbourne already works within a number of such precincts and we are working to support the culture change that will be necessary to make the most of collaboration between academia and industry.

For example, the Melbourne Biomedical Precinct at Parkville is an internationally significant aggregation of medical research and clinical practice that brings together 10,000 medical minds conducting high impact research. The precinct houses nationally important NCRIS research infrastructure including at Bio21 and 7T magnetic imaging.

These precincts will allow the University to integrate research with broader economic and social planning priorities. The precincts bring complementary users together around major infrastructure to contribute to the broader system of innovation. Precincts provide distinctive spaces for engagement, providing pathways for students to work with industry, researchers to engage with peers, and companies to acquire and support new ideas.

We also see great merit in developing the co-location of industry and academic partners, and in supporting secondments and staff exchanges between universities and industry. Greater knowledge and technology transfer between the nation's universities and industry could be encouraged through redirecting funding to support a program that encourages academic secondments to industry.

Industry can play an important role not only in commercialisation of research, development and deployment of technological innovations but also in support of pure research. The University's strategy recognises there are potentially significant benefits to Australia's STEM performance

through greater industry-university engagement. Through the University's strategy, the University will leverage existing industry partnerships to expand opportunities for work-integrated learning for our students, facilitate staff exchange between academia, government and industry, and establish professional advisory boards for all graduate schools where not already in place.

To capture the benefits of industry-university engagement, significant drivers for researchers to engage with industry (and vice-versa) are important. Current methods of measuring research excellence and impact could be improved to further promote innovation and entrepreneurship. Nonetheless, any engagement metric will need carefully designed principles to ensure that if it is used to drive research funding that it does not create perverse outcomes.

More broadly, getting the research funding fundamentals right - the policy principles and system design - is critical so we can advance both research and commercialisation outcomes. We see there is a need for a balance between basic, translation and applied research across the system. Through a balanced system we can leverage the significant public investment in science. Importantly, there is scope to develop new ways to drive innovation that are not dependant on additional funds.

Funding mechanisms that support the spectrum of STEM should be considered - success in medical research is underpinned by success in all STEM fields. The best institutions in the world are embracing the concept of 'convergence'. In the field of biomedical research physics, mathematics and engineering fields are driving new frontiers in research. Further, a vast majority of the imaging revolution has come out of physics and engineering which is revolutionising the treatment of neurological disorders, deep brain stimulation for Parkinson's disease, and Cochlear implants. It will therefore be important to ensure that funding mechanisms facilitate this new, collaborative, interdisciplinary approach to research.

In a related development, the University considers the Medical Research Future Fund to be a potentially powerful mechanism for supporting biomedical and health research in Australia. The University recommends that in the design of the Fund, independent expert review of research applications should be central to reflect best practice in the transparent, efficient allocation of competitive research funding. We also recommend it adopt a broad, inclusive definition of 'medical research' to reflect the multidisciplinary nature of modern medical research.

3. Education, Training and Community Engagement

The University of Melbourne's Faculty of Science, comprising seven schools, offers a range of undergraduate, honours, graduate and research degrees enrolling over 6,500 undergraduate and graduate students. The Faculty also supports industry partnerships based on a foundation of research in the pure and applied sciences.

The Faculty of Science also plays an important role in Australia's participation in the global knowledge economy. The Faculty participates in collaborative research ventures, staff and student exchanges, and overseas student recruitment – all of which ensures Melbourne Science maintains an international perspective.

The University also supports a number of access programs specifically promoting STEM study for rural and remote and socially disadvantaged students. For example:

- The Excellence in Science, Technology, Engineering and Mathematics Education (ESTEME) program, is a partnership between the University of Melbourne, Collingwood College, the Inner Northern Local Learning and Employment Network, Yarra Education Youth Commitment and six local primary schools formed to improve the quality of STEM learning and associated outcomes.
- The Strengthening Engagement and Achievement in Mathematics and Science (SEAMS) program, is a collaboration between the University of Melbourne, Monash University, John Monash Science School and the Elizabeth Blackburn School of Sciences to encourage Indigenous students and those from low SES backgrounds to pursue science and mathematics to senior secondary level and through to tertiary level.
- The Residential Indigenous Science Experience (RISE) program is held for Year 9 and 10 students with a strong interest in science.

A key resource on the University of Melbourne campus is the almost 5000 researchers enrolled in doctoral programs. We are working to increase the number of researchers who bridge commercial and academic appointments and recognise and reward this kind of industry engagement as mainstream university activity.

The University is supportive of developing career structures for the current and future STEM workforce. Developing broad-based training and career structures for STEM graduates (including structures that provide incentives for working with industry) will be important in opening multiple pathways for STEM graduates to enter the workforce. Creating STEM graduates and workers who are innovative and entrepreneurial will be important to pioneer new inventions to drive Australia's competitiveness.

The STEM agenda at Melbourne also actively engages its humanities, arts and social science community in providing a broad understanding of science and technology in our daily lives. For example, we have led discussion and interaction across faculties round the ethics of stem cell biology and its applications in medicine, the role of genetically modified organisms in agriculture, cyber security of personal and community data, the emergence of the digital humanities and the geopolitics of water management and energy efficiency.

The University is supportive of improved community STEM engagement as a way to inspire Australians and attract more talent into the STEM workforce.

For example, the University has signed a MoU with Science Gallery International (SGI)² to establish the Australian node of Science Gallery in Carlton Connect – a science engagement initiative, aimed at 15-25 year olds. The concept entertains through science by encouraging scientists, artists and designers to engage with young adults and the community through interactive science-related

² <http://international.sciencegallery.com>

exhibits. Topics covered so far through SGI exhibitions include:³ water sustainability, blood, nutrition, infectious disease, and Biorhythm: music and the body. Exhibitions can be designed in Australia, bringing artists and scientists together, or the Gallery can host exhibitions created elsewhere through the SGI international network.

The Government's proposal to 'boost community engagement by working with states and territories to build on its regional hubs and develop a national programme of year-round events' promises to be a valuable initiative. Strong engagement with universities and institutes will be vital for such community engagement programs. The related proposal to support communication training for students undertaking STEM degrees also promises to be valuable.

The University supports efforts to focus on and improve teacher training in the areas of mathematics and science. This will be critical in developing and nurturing an innovative STEM workforce for the future. Inspired and adequately trained STEM teachers will equip students with the necessary skills to be able to choose further education in STEM disciplines, to work effectively in STEM-oriented workplaces and help students to recognise the widespread application of STEM to work opportunities and their quality of life.

Diversity and equity in STEM is an important objective for the University, which is committed to engaging with the community to work toward increased STEM participation of women, disadvantaged and marginalised students. In May, 2015, the Australian Mathematical Sciences Institute, of which the University is a member, along with the BHP Billiton Foundation, launched *Choose Maths*. This is a five-year national program that aims to turn around public perception of mathematics and statistics as a career choice for girls and young women. It demonstrates that this is a shared priority for government, industry and education institutions.

4. International Engagement

International engagement is, and will continue to be, an important component of Australian STEM competitiveness. The University is strengthening links with leading universities internationally, through joint research, commercial endeavours, and student experiences.

The University has established internationally focused alliances with the Indian Institute of Science, the Australian-German College of Climate and Energy Transitions, EMBL-EBI Laboratories in Cambridge (UK), India Institute of Technology Kanpur, Peking University, Tsinghua University and Vanderbilt University. Raising the University's profile in Asia and leveraging existing relationships through dedicated interfaces, such as Asialink, Asia Institute and the Australia India Institute, will extend connections to the region.

As part of our strategy, the University will establish joint research centres providing access for Melbourne researchers, research higher degree candidates and postdoctoral fellows to international

³ Illusion: www.youtube.com/watch?v=R_5rsqsx4IY
Strange Weather: www.youtube.com/watch?v=v-DOrviV1s0
Oscillator: Everything in motion <https://www.youtube.com/watch?v=WLPJxEIL1ZM>

disciplinary expertise and infrastructure. Such joint research centres will provide a platform for greater involvement by a broader range of industry partners and therefore opportunities for additional collaborative or contract research.

Government support for international engagement will greatly benefit the University's capability in enhancing this important knowledge exchange. The University supports development of an international science engagement strategy.

Programs that enable the University to attract, train, and support the best researchers will enable the University (and others) to contribute to Australia's STEM performance. Incentives for engagement with industry, support for international engagement, continuity for early and mid-career researchers, appropriate support for female researchers, more scientifically engaged secondary school leavers, and ongoing investment in internationally competitive research infrastructure will underpin our ability to contribute.

The University welcomes further engagement with the Government as the vision for a science nation evolves.

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