University of Sydney submission to the Department of Industry, Innovation and Science Digital Economy Strategy Consultation: Opening up the conversation

November 2017

The University of Sydney welcomes the opportunity to contribute to the Australian Government's new Digital Economy Strategy. In this submission we provide responses in relation to the three thematic areas developed in the consultation paper.

The University of Sydney, and our sector as a whole, has a huge contribution to make to building and enabling our nation's digital economy, as well as ensuring that all members of society can participate equally in its benefits. We make this contribution through focusing internally on our core activities of education and research, including the development of a new set of relevant graduate attributes, and through our external engagement with business and government. Below, we provide some case studies to illustrate this contribution, and to direct the Department's attention to some of our recent work and evidence on matters of importance in the development of the national Digital Economy Strategy.

Consultation Theme 2: Enabling and supporting the digital economy

Station Q Sydney – Quantum Nanoscience Laboratory

A new 'quantum economy' is predicted to emerge from rapid acceleration of quantum computing technology and its applications into fields as diverse as medicine, communications, transport and global security. The University of Sydney has partnered with Microsoft to develop Station Q Sydney, the premier centre for quantum computing research and implementation in the southern hemisphere.

The focus of the work at Station Q Sydney is to bring quantum computing out of the laboratory and into the real world where it can have genuine impact. Professor David Reilly, the scientific director of the centre, has said, "We've reached a point where we can move from mathematical modelling and theory to applied engineering for significant scale-up."

Leveraging his research in quantum computing, Professor Reilly's team has already demonstrated how spin-off quantum technologies can be used in the near-future to help detect and track early-stage cancers using the quantum properties of nano-diamonds.

Centre of Excellence in Telecommunications: Wireless Networking Lab

The future of the digital economy requires fast and reliable data services through advanced, scalable, and upgradeable communications technologies. Wireless technology is a potent example of a technology that self-adapts and can be adopted as the service requirements change for a digital economy. At the University of Sydney we have been working to develop a wide range of heterogeneous technologies to collectively create not just the connection performance required of end users in a digital economy, but within buildings and the backhaul network.

Fifth generation cellular networks – 5G – is promising to create such heterogeneous network technology through multiple mechanism such as ultra-small cell infrastructures, millimetre waves, massive multi-input-multi-output systems, software defined networking, caching, WiFi, and wireless powered communications. At the Wireless Networking Lab within our Faculty of Engineering and Information Technology's Centre of Excellence in Telecommunications, we are working on a variety of such topics to improve the reliability and speed of the future wireless cellular networks. In addition, we are working on securing wireless networks to the extent they will become more secure and private than any existing wired network.

The future wireless networks, 5G and beyond, will create an end-to-end network infrastructure that could replace the existing low-speed connections to home and offices and their related backbone network, and at the same time prepare the country for future applications such as autonomous driving. If this fundamental piece of digital infrastructure is worked out carefully then many other dependent questions can be resolved. Wireless technology is an enabling solution to the future digital economy including the reduction of level of digital divide. Wireless will not discriminate users on geographical or socio-economic basis and provide equal performance to all.

Consultation Theme 3: Building on our areas of competitive strength to drive productivity and raise digital business capability

Agricultural innovation

Advances in agricultural digital technology are disrupting the way that agricultural production and supply chain operate. If this technology is exploited appropriately, there is significant potential for on-farm agricultural production to be optimised further, and for traditional supply chains to be disrupted. This could potentially lead to a substantial intensification of agriculture, supporting population and economic growth in regional communities.

The Sydney Institute of Agriculture is developing a new concept for Australian agriculture (including aquaculture) based on a model of digital decommoditisation of supply chains for agricultural products. This is seen as a potential way forward for high value-added, sustainable and food security agriculture for Australia and the region. The Institute conceives of a peer-to-peer (producer-to-consumer) market relationship, with this model in place in the next 5-10 years.

Digital agriculture connects producers and consumers for improved mutual understanding. Unlike the traditional supply chain, in the new supply chain, consumers and producers have visibility of each other. Using blockchain supply technology, new or existing businesses can supply products with embedded quality, provenance and environmental information delivered securely to consumers in import and export markets.

In the agricultural sector, multiple appropriate technologies will link properties, homesteads, supply chains, consumers and governments, a highly connected approach that will maximise opportunities for economic growth and efficiencies. Ownership of agricultural data is an important issue here. The Australian government needs to incentivise the use of data into the common pool for the common good, e.g. for environmental monitoring. Regulation of blockchain standards for all agricultural products will also contribute to enabling disruption and increased productivity of the sort we foresee.

The Sydney Institute of Agriculture concept for digital decommoditised agriculture is an approach appropriate for both micro, small and medium-sized enterprises (SMEs) and large vertically integrated enterprises.

The transition to a highly productive, decommoditised, supply chain model will gather pace as the population's levels of digital literacy continue to increase. To support and enable maximised benefits of the digital economy, Australia should aim to be in the OECD top 10 for digital and technological literacy.

Australian Centre for Field Robotics and the Centre for Robotics and Intelligent Systems

Our Australian Centre for Field Robotics (ACFR) at the University of Sydney is one of the largest robotics research institutes in the world, focusing on the research, development and application of autonomous and intelligent robots, and systems for use in outdoor environments. The Centre has been instrumental in developing breakthrough technologies, conducting world-renowned research and developing field robotics principles and systems.

Through the work of the ACFR, the University of Sydney has made internationally acknowledged contributions to robotic principles and systems, particularly in the area of field robotics, including agricultural robotics and environmental monitoring. The ACFR conducts more than half of all Australian research training in robotics and delivers almost all industry courses in the field. ACFR graduates make up a significant proportion of mechatronics teaching staff nationally. Internationally, the ACFR benchmarks itself against CMU, MIT, Stanford, the University of Michigan, Oxford and ETH Zurich, all of whom employ ACFR PhD graduates. The Australian Centre for Field Robotics is recognised as one of the largest field robotics groups in the world and one of the largest robotics research organisations.

The Centre's mission is to undertake research to develop new field robotics and intelligent systems theories and methods, and apply them in industrial, social and environmental settings.

They work to develop technologies in four core areas:

- sensors, fusion and perception
- movement, control and decisions
- modelling, learning and adapting
- architectures, systems and cooperation of robotics and intelligent systems.

Building on the strength of the ACFR's work is the newly created Centre for Robotics and Intelligent Systems: Science and Society (CRIS) which will take a multidisciplinary approach to exploring the global impact of robotics and intelligent systems.

This Centre researches the social, ethical, legal and economic implications of robotics and intelligent systems, particularly in areas of transportation, health and medicine, the environment, primary industries, emergency services, the workplace and home.

The CRIS looks at the social impact of robots becoming an integral part of the world, and the value and effect of this technology, from an ethical, economic, educational and employment perspective. It also analyses the latest technical developments with an aim to put Australia's reputation for developing world-leading technologies on the world map.

In collaboration with the ACFR, CRIS is uniquely at the forefront of advancements in robotics and intelligent systems, while also being able to address the impact of this technology on society. The Centre brings together researchers and practitioners within robotics, automation, science, business, humanities and arts disciplines from across the University.

Consultation Theme 4: Empowering all Australians through digital skills and inclusion

Educational Innovation

The digital divide and its potential impact on social inclusion is a key concern for the University of Sydney. First, we must challenge the common assumption that young people are inherently digitally literate. This can be a damaging presumption. For example, we should not assume that a young person knows how to interact with the media in a secure or socially appropriate way just because he or she knows how to use social media features and buttons on a device. For our students, the emphasis on broader graduate qualities provides a sound basis for the development of appropriate digital skills where they are needed, and the critical resources to understand and challenge modes of digital usage throughout their lives.

The University's new educational experience for all undergraduates commencing in Semester 1, 2018, a Distinctive Undergraduate Education, is underpinned by a set of graduate qualities that have been designed to equip Sydney graduates for the contemporary world.

The University has restructured its curriculum to ensure that:

- all students achieve a level of digital literacy that ensures the capability to utilise contemporary digital technologies in their primary field(s);
- all students can access through our Open learning Environment a broad range of units that develop an understanding of computational thinking, and skills in coding and data science; and
- all students enrolled in one of our broad-based or specialist degrees can access through our shared pool a major in computer science, data science, information systems or software development.

THE UNIVERSITY OF SYDNEY

University of Sydney Graduate Qualities

Graduate Quality	Purpose
Depth of disciplinary expertise	To excel at applying and continuing to develop disciplinary expertise
Broader skills: – Critical thinking and problem solving – Communication (oral and written) – Information/ digital literacy – Inventiveness	To increase the impact of expertise, and to learn and respond effectively and creatively to novel problems
Cultural competence	To work productively, collaboratively and openly in diverse groups and across cultural boundaries
Interdisciplinary effectiveness	To work effectively in interdisciplinary (including inter-professional) settings and to build broader perspective, innovative vision, and more contextualised and systemic forms of understanding
An integrated professional, ethical and personal identity	To build integrity, confidence and personal resilience, and the capacities to manage challenges and uncertainty
Influence	To be effective in exercising professional and social responsibility and making a positive contribution to society

As digital disruption causes industries to change rapidly, there is a need for greater emphasis on lifelong learning to support people to transition across different careers throughout their lives. Traditionally, education has typically been 'front loaded' into an individual's lifespan with the majority of formal education occurring during childhood and early adulthood. Though tertiary courses have always admitted mature students, they are far outnumbered by school leavers. However, as globalisation, digital disruption and the rise of interdisciplinary 'wicked problems' cause mass change, there is a need for alternative ways to support continual lifelong learning so that individuals are supported in navigating a rapidly changing economic and workplace landscape.

Massive Open Online Courses (MOOCs) are one potential form of supplementary education of this kind (e.g. the University of Sydney offers MOOCs in eHealth and data-driven astronomy, as well as a university preparation course in information and digital literacy). Other avenues may include workplace training and continual professional development (CPD) for some of the professions. Outside of these formal options are informal learning approaches, many of which are afforded by the internet. Online resources such as the Khan Academy, Wootube, TEDed, and the ability to search, access and self-teach new skills are valuable.

While there is undeniable power and opportunity for digital resources and online tools, there will always remain a need for face-to-face teaching and education. Learning is a social occurrence and lifelong

learning is a skill that, we might argue, might be more easily practiced by people who have already learnt how to learn within a formal taught program. That is to say that we might expect that someone who has already experienced a face to face program might be better able to navigate and learn from additional digital resources.

We must also consider how to equip people to be lifelong learners and avoid putting all responsibility for this onto the individual or an approach whereby individuals can be blamed for not "keeping up". This may lead to increasing social exclusion and a greater digital divide. Wider policy and practices should be used to support people in learning how to learn and learning how to navigate the potentially overwhelming number of formal and informal pathways to adult learning. Also, as self-directed learning can be hijacked by unreliable sources on the internet there is a need to ensure authority and reliability of sources and communities for informal learning.

While informal and lifelong learning might be something that we connect to employment, it is worth recognising that this has a wider impact and may be able to tackle other societal issues such as community health awareness, environmental protection and improving social engagement, and not solely restricted to traditional academic subjects.

There is an opportunity for the tertiary sector to better equip its graduates for a changing workplace and economy through curriculum redesign. In offering supplementary Open Learning Environments (OLEs), Project Based Units and emphasising graduate qualities, the new University of Sydney curriculum is will support students in escaping disciplinary silos so as to be more flexible.

A renewed emphasis on the development of graduate attributes is especially important for the tertiary sector. While many academics may have attended university during a time when they as students were expected to pick up various skills and abilities with little in the way of instruction or support, this form of teaching is insufficient for the scale and speed of change that forms today's environment. Tertiary educators have a responsibility to consider how the more generic and flexible graduate qualities are included in all of their courses. This thinking does not detract from the disciplines but reinforces the disciplinary learnings.

The current focus at the University of Sydney on its new curriculum and the graduate qualities is, we believe, one effective way of equipping our own graduates with the skills they need for the digital economy. A focus on graduate qualities that allow for graduates to be more adaptable means that they are better prepared for change. This approach is less likely to date than alternatives that focus on specific skills that may date (for example, learning how to program in Visual Basic). This approach may be of use to other education providers or may inform how we design other forms of learning.

As the cost of technology reduces and levels of mobile device ownership increase, there is an opportunity to design and develop learning to fit the devices that people own. Mobile learning has huge potential since the majority of the adult population in Australia own a mobile phone. Learning and digital experiences can be designed for individuals' own consumer devices in their own contexts (for example, homes, buses, trains, and so on.)

There are potential issues around the impact of digital technology on the cultural practices and social relationships of Australians. There are real concerns about the impact of a fast pace of change on

existing cultures, particularly those that are already vulnerable, for example, Australia's indigenous cultures. These must be balanced with issues of equity of access and societal participation.

Where possible, supporting more participatory or co-design practices for the design and development of new technologies will mitigate the issues raised above. There may also be a need for regulation around technologies, particularly to protect vulnerable members of our community such as children, the elderly, and those with disabilities.

As with possible jobs of the future, some of the societal problems that might come with the rapid adoption of digital technology cannot yet be anticipated. We would advise government to continue to engage with the thought leaders in this space, including universities and centres such as our CRIS, to stay abreast of the latest in research and evidence around the social and cultural impacts of digital technology.

Thank you once again for the opportunity to contribute to the conversation on Australia's Digital Economy Strategy. We hope you have found our examples useful, and look forward to working with the Australian Government to maximise the potential of digital technology to increase the productivity and competitiveness of the Australian economy, whilst ensuring that the benefits flow to all Australians regardless of their geographic, social and economic circumstances.