National Committee for
Information and Communication Sciences

A committee of the Australian Academy of Science

Director, Digital Economy Strategy Team
Department of Industry, Innovation and Science
GPO Box 2013
Canberra, ACT, 2601

Dear Sir/Madam,

Consultation: Digital Economy

Submission by Australian Academy of Science, National Committee for Information and Communication Sciences.

The Australian Academy of Science (the Academy) was established by Royal Charter in 1954 to champion, celebrate and support excellence in Australian science, to promote international scientific engagement, to build public awareness and understanding of science, and to provide independent, authoritative and influential advice. The Academy comprises more than 500 of Australia's leading scientists, each of whom is elected for her or his outstanding contribution to science.

The Academy has 22 National Committees for Science that are widely representative of its disciplines. The broad aims of the Committees are to foster a designated branch or theme of natural science in Australia and to serve as links between Australian and overseas scientists in the same field. National Committees advise the Academy's Council on matters pertaining to their discipline.

This submission in response to the Consultation Paper *The Digital Economy: Opening Up the Conversation*, issued by the Department of Industry, Innovation and Science, has been prepared by the Academy's National Committee for Information and Computer Sciences.

The Academy's vision for Australia's digital economy in 2030

By 2030, Australia's population will have exceeded 30 million, with 6.1 million people in Sydney, 5.9 million in Melbourne and 3.1 million in each of Brisbane and Perth. 18% of the population will be over 65; up from 15% in the mid-2010s. On current trends our economy will have been surpassed by those of a number of rapidly developing countries, to be placed outside the G20 at 23rd largest in the world.

By 2030, the Academy anticipates:

- A world's climate that has warmed by more than one degree Celsius over pre-industrial levels with the social and economic impacts felt around the globe
- A new mining boom, driven by a global shift towards renewable energy and a consequent demand for copper, lithium, rare earths and other commodities

- Advanced satellite imaging technology, with sophisticated analysis capacity that feeds into agricultural, mining, tourism, environmental monitoring, and other sectors
- Extensive and detailed monitoring of urban environments via the so-called Internet of Things
- Expanded data analytics, machine learning and artificial intelligence leading to large efficiencies in cybersecurity, energy technology, energy generation, distribution, storage and demand management, medical technology, agriculture, mining, finance, city management and planning, and other diverse fields
- Significant developments in nanoscale fabrication, and automation
- Australian leadership in a number of niche areas such as cybersecurity, medical technology, neurotechnology, energy technology, environmental technology, remote area automation and distance education.

All of these changes and developments will depend on Australia's digital economy capability, which in turn depends on decisions being made now. Such decisions should cover development of an agile and responsive ICT curriculum for schools, direct stimulation of large-scale industry-academic collaborations, increasing investment in the research capacity of the nation's institutions, establishment of a national open research cloud, maintaining and developing supercomputing infrastructure and coordination support for key disciplines. Skills and capabilities grounded in Australia's information and communications science, engineering and related technology systems underpin growth and innovation throughout the Australian economy.

What is the role of government?

Government must promote the development of the digital economy, by fostering and role-modelling innovation, and by providing policy settings that are conducive to digital entrepreneurship.

There are a variety of indicators that measure a country's ability to participate in the digital economy, such as the World Economic Forum's Networked Preparedness Rankings and Akamai's Internet Connectivity Report. These rankings are indicators of a country's ability to engage with the worldwide digital economy. Australian governments should develop policies and actions that substantially lift Australia's place in these rankings, so that within five years we are among the top 20 countries in the world in these rankings within five years, and in the top five countries in the world within 20 years.

There are two key areas where Government can make important contributions:

1. Education

There is a need for more investment in education to ensure the whole spectrum of players in the digital economy are able to develop the necessary skills to participate. Some examples include:

- Develop a flexible and agile high school curriculum for digital literacy that focuses on basic capabilities in statistics and data. As well as curriculum materials that reflect and respond to technological development in order to maintain relevance, this would require supporting teacher education with training and professional development programs.

- Encourage more students to undertake vocational training in digital technologies through technical colleges and TAFEs. This will help produce a digital workforce with a broader balance of digital literacy and ICT skills. As part of the training in these institutions, students should have periods working in businesses, where they can pass on their technical knowledge to the business and learn about the business. This will help businesses make greater use of digital technology.
- Facilitate adult education so that businesses employees can train in digital technologies and applications. Many small businesses do not have the skills to embrace digital technologies themselves, and hiring in support is currently too expensive. This will change if business employees are able to enrich their present skills with practical, job-relevant training.
- Encourage universities to include more information technology content in business courses, and encourage students in IT and/or business courses to do internships in businesses as part of their degree. Internships provide vital exposure for tertiary students to business processes, and also promote knowledge and technology transfer from universities to businesses.
- Provide HECS concessions to fields that fuel the jobs of the future.

2. R&D engagement and collaboration

The Cooperative Research Centre (CRC) program and ARC Linkage Grants have been successful in fostering links between Universities and Industry, and between Universities. These linkages and collaborations have accelerated the development of a number of technologies.

It would be beneficial to expand these programs, with flexible, innovative models that operate on a shorter timeframe than the CRCs and provide a wider range of collaborations across universities and industry. Schemes of this type have been successful in Europe and North America, and generally provide two key benefits:

- Each group/university/company owns its intellectual property, providing clarity and streamlining an issue that has been known to adversely affect ARC Linkage grant.s
- The project is managed by an expert from outside all of the collaborating parties who is both a skilled manager and a researcher in the field.

Key disruptive technologies or business models

All of the emerging technologies listed in the Discussion Paper are relevant but counting on them alone will not prepare Australia for the unexpected. Rather than attempting to predict, focus instead should be on *defining* what future we as a nation envisage and then empowering the people to create it. In the words of distinguished computer scientist Alan Kay, '*the best way to predict the future is to invent it.'*

Some business models to pay attention to are:

- The leasing economy as opposed to ownership. Software subscription models and cloud computing are already leading this trend. This approach is attractive due to elasticity and pay-as-you-go options. This is likely to extend into service rental models as can be observed in the provisioning of cloud computing – which will disrupt other business models. Amazon's Mechanical Turk is already

used across industries for elastically provisioning human annotators for relatively simple tasks. Task Rabbit is a service in the US that enables outsourcing of almost anything quickly and cheaply.

- (Re)focusing on core business. Under this model, everything else (HR, finance, procurement etc.) is automated or available as a service. No human is doing the same thing twice – all repeatable tasks are automated. This raises the bar for specialist knowledge and importance of customer experience.
- Artificial intelligence, machine learning, data science are clearly areas that will have impact. It is less clear whether some areas identified in the Discussion Paper, such as quantum computing will have a large impact. Governments should not to try to pick technology winners, but rather to equip industry and researchers to develop and exploit opportunities as they arise.

What communication services, and underlying data, platforms and protocols, does Australia need to maximise the opportunities of the digital economy?

There are three key services and platforms that are important:

1. A fixed-line broadband and wireless network that provides excellent service at affordable prices. It is particularly important that small businesses can achieve connectivity with sufficient bandwidth for these businesses to embrace digital services. Network management should be neutral, with anti-competitive behaviours on the part of providers identified and sanctioned to prevent market distortions. It is important that net-neutrality is maintained.

2. Infrastructure for delivery of open data and improved ways for the public to visualize published open data. This will involve addressing a number of challenges:
   - Providing data in formats so it can be easily understood, accessed and used.
   - Maintaining and developing delivery platforms, systems and data access protocols.
   - Learning about use cases and success stories about applications of the data.
   - Developing collaborative relationships to identify appropriate and emerging technologies for the delivery of science open data.
   - Maintaining appropriate resources to manage the open data sets and encouraging internal data custodians to publish, update and maintain their data on the Portal.
   - Ensuring consistent data quality so that it is fit for purpose and communicating these issues to others. In addition to technical means for visualising data, suggest that a point of friction is privacy. Platforms that employ privacy-enhancing technology (in addition to having legislation more aligned to privacy) can also be seen as enabling open data.

3. Invest in an Australian Research Data Cloud (as recommended in the 2016 National Research Infrastructure Roadmap), and upgrade the National Computational Infrastructure to maintain high end, national supercomputing capacity.

What opportunities do we have to accelerate the development of technologies that will underpin Australia's digital economy?

In Australia, there is outstanding R&D in a number of technology areas that will play an important role in the digital economy. Improving collaborations between research groups and industry can accelerate the development of these technologies. We recommend the following approaches:

- Research hubs in collaborative settings to build powerhouses in specific areas through schemes that are ICT-specific, such as Centres of Excellence, Research Networks (inactive scheme of ARC at present), and managed research programs.
- Nurturing and incubating open source initiatives to allow for organic growth and innovation. Successful examples of this kind of activity include Apache Spark (Berkeley) and open NLP (Stanford). This will require an intellectual property culture that appropriately supports innovation.
- Building on Australia's world-class University-based expertise in artificial intelligence. Technology hubs that are driving the use of AI in industry overseas are frequently leveraging University-based expertise. Examples include Stanford's well-publicised impact on Google or Facebook and Google and Microsoft's recently opening up of multimillion dollar research centres in Montreal.
- Increased participation of women in fields underpinning the digital economy. Currently, the number of women in computer science, engineering, mathematics, telecommunication, and information technology is very low. Targeted programs on improving gender diversity will accelerate and diversify innovation and development.

The National Committee for Information and Computer Science is available to provide further advice on any matter raised in this submission. For further information, please contact in the first instance Meaghan Dzundza, National Committees Coordinator, at meaghan.dzunda@science.org.au.

Yours sincerely,

Rod Tucker

Chair, National Committee for Information and Computer Science