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THE DIGITAL ECONOMY: OPENING THE CONVERSATION

DEPARTMENT OF INDUSTRY INNOVATION AND SCIENCE

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1. About This Document

This document captures CSIRO's input on the "National Digital Economy Consultation Paper" issued by the Australian Government Department of Industry, Innovation and Science (DIIS).). CSIRO is Australia's national science agency, and is home to the lead Australian group in digital research Data61 as well as domain specific businesses in Energy, Land and Water, Agriculture and Food, Manufacturing, Oceans and Atmosphere, Mineral Resources, Health and Biosecurity. In addition CSIRO hosts the Landmark National Facilities namely: Pawsey Supercomputer Centre, Australian Animal Health Laboratory, Australia Telescope National Facility, National Biological Research Collections, and the Marine National Facility. Through its services business CSIRO also offers a range of support to industry.

This document has been prepared by Data61 on behalf of CSIRO and provides insight and information to inform the design and implementation of policies, strategies and actions by the Australian Federal Government aiming to support secure and inclusive wealth and opportunity for all Australians.

The document contains a set of key messages relating to the digital economy strategy, a conceptual framework for thinking about digital strategy, a set of policy priorities and the responses to selected questions listed in the consultation paper by the Department of Industry Innovation and Science.

2. Key Messages

- *This is critical and timely work.* CSIRO is very supportive of the Australian Government's initiative on the digital economy strategy. This is vitally important for our society and economy. For current and future generations of Australians to access rewarding jobs, and enjoy continuing growth in wealth and prosperity we need a robust digital economy strategy.
- *Digital disruption is ubiquitous and just beginning.* CSIRO's research indicates that "digital" - a term used in this document to capture digital technologies along with the new paradigms and new ways of doing business they enable - is set to transform practically every industry and every organisation (small to large) as well as impact the careers of the vast majority of Australian workers. Digital will change how (and what) we teach and learn in the education system and how people communicate and obtain trusted information. Australia and the world are still in the early stages of this transformation.
- *Australia needs to keep ahead of the world.* Other countries are moving quickly and there's much reason to believe the effectiveness and efficiency with which a national economy transitions to digital is core to its ability to generate jobs and wealth for its citizens. Australia is doing well on some indicators but not so well on others. For the economy, environment, society, lifestyles, defence and overall wellbeing, Australia needs to make this coherent investment into a digital future. There are some negative outcomes for Australia if we don't.
- *Australia has an opportunity to take a leadership position in cyber-physical systems.* As computers continue to become more powerful and smaller, and connectivity becomes ubiquitous, all systems with a power supply and CPU will connect to the network. This will impact all of Australia's incumbent industries and create opportunities for new industries at the intersection of the physical world or domain, like agriculture and health – and the digital domain. Australia has strength in the physical domains but substantially missed out on the first two global cycles of the Internet and is behind the curve as it relates to digital technologies relative to other parts of the world.
- *Australia's current and future workforce needs to be reskilled for a future digital economy.* Digital technology will transform the labour market requiring new skills and aptitudes for young and old workers. Digital technology will extinguish existing jobs and will create new jobs. Digital will impact practically every occupation. Continued growth of the economy, particularly the creation of new jobs, will depend on a new generation of workers that possess deep data science and digital expertise to seed new industries and help scale existing ones. Data61 is the largest training partner in Australia for

PhD students with over 325 PhD students in our current network. However, not all digital jobs of the future will require this level of training; nor are all people focused on attaining this level of academic qualification. The vocational, education and training (VET) sector has a critical role to play in building digital skills along with all parts of the education system. In summary, a well-equipped and appropriately skilled workforce will be central for secure and inclusive wealth generation in the digital economy.

- *Australia needs to lead global digital research and development*. In terms of digital research, skills development and infrastructure Australia is falling behind some of the world's advanced and emerging economies. Australia's entire investment (private and public) in all types of R&D is A$32 billion/year (Australian Bureau of Statistics). Digital R&D is a fraction of this amount. By comparison, a single company *Amazon* invested A$22.93 billion on R&D over the 12 months ending March 2017 (Bloomberg, 17 June 2017). This one company invests more on digital R&D than Australia (public and private). Amazon's digital tools and services will compete with Australian retailers. The same will happen in other industries. The world's largest companies, which are now digital companies, such as Alphabet (Google), Microsoft and Facebook all invest substantial amounts of revenue on digital R&D. National governments such as Israel, Finland, United States, China and Singapore are also investing large percentages of GDP on digital R&D to build improved capabilities for their industries.
- *Artificial intelligence will have profound implications for our industry, economy and society.* Artificial intelligence and automated systems are advancing rapidly and will have profound implications for industry and security. If other countries are "AI enabled", they may be able to out-compete Australia in the marketplace and the virtual battlefield (where well-resourced foreign entities can attack Australia's economic interests). Australia absolutely has to keep the country at the forefront of AI capability and develop sovereign capability.
- *Energy and Digital are interlinked.* A secure and reliable electricity generation, storage and distribution system is vital for digital connectivity. Put simply, the digital economy simply won't work if the power is down. The financial costs of power outages to digital businesses can be substantial. Digital energy will enable the creation of new fine-grained, broad-scale, integrated information platforms – from source generation through to customer connection point metering – to generate new products, services and infrastructure that are aligned to customer behaviour, need and cost. This coherent digital energy picture will provide fundamental insights about Australia's energy profile which can be used intelligently inform national policy development and industry decision making. Furthermore, digital technologies can improve the efficiency of the electricity network itself. Digital technologies can be used for demand management and optimisation of the electricity grid. Electricity security should be part of the national digital economy strategy.
- *Australia has to keep its finance sector up-to-speed.* Australia has a large and highly successful financial services sector. Australian banks weathered the global financial crisis years of 2008/09 better than any in the world. However, regtech and fintech are set to reinvent the world of banking. Regtech is regulatory compliance technology and fintech is financial services technology. Both are seeing rapid growth in investment and venture capital. Australia has to keep pace with this shift in order to keep the banking and finance sector strong for the future Australia needs to develop, deploy and export the most advanced fintech and regtech systems available worldwide.
- *Australia needs new solutions to cybersecurity, cybercrime and online manipulation.* Cybersecurity and cybercrime are the "tigers in the room" that can tear down our plans for a digital economy overnight if not well managed. Many signs are we're losing the battle. Whilst governments and industry continue to spend more, the number of serious data breaches and the economic costs continue to grow more rapidly. One of the most pressing needs is to raise awareness and educate people about the risks and mitigation strategies; most cybersecurity breaches occur from relatively simple human errors. However, there are also new and emerging deep/complex technological threats from well-resourced adversaries. This issue becomes amplified as physical systems connect to the network and breaches are

considered not only mission critical, but in cases life critical. Australia is in need of new and fundamental solutions.

- *Australia needs to develop systems which ensure privacy is protected but enable useful data to be exploited for better services.* Privacy and identity in the online world work differently to what has previously been the experienced. The coming generations of digital natives (people who grew up in a highly connected online world) may have different perceptions about privacy risks. Many digital solutions which improve the efficiency and effectiveness of government service deliver are limited not by technology but by privacy issues (regulations or social perceptions). Systems which ensure levels of privacy expected by Australians are needed; but at the same time deliver improved and proactive services using potentially sensitive government data. Transparency is one of the most important assets for consumer protection in a data-age so as to provide fundamental trust.
- *Australia needs to get regions connected*. Singapore tops the world's charts for internet speed and reliability. However, Singapore has 5 million people living in an area smaller than Canberra. Australia's population is spread over vast areas. There are huge challenges in delivering high speed and reliable internet connections. However, doing this is vital to allow individuals and businesses to participate effectively in the digital economy and for new digital businesses to grow. As solutions for cost effective digital connectivity are found the capabilities can be sold to the world. Improved systems for appraising the benefits and costs (and priorities) of digital infrastructure supplied to regions and cities are needed so improved investment prioritisation decisions can be made.
- *Australian governments need consistent registries.* Consistent, reliable, accurate and secure registers of information about citizens, licences, businesses and entitlements is needed to improve the effectiveness of government service delivery. At the current time, registers are maintained by numerous agencies and there are substantial costs in ensuring consistency and lengthy remediation activities when this consistency is not successfully maintained. Consistency of registers is not only important within the federal jurisdiction but also between commonwealth and state/territory registers as many state/territory registers require recording of entities (e.g. organisations) which are identified in registers managed by a federal agency.
- *It will be important to ensure digital works for all Australians*. Strong and compelling data from around the world exists indicating that digital may be associated with wealth polarisation and socio-economic divides. However, this doesn't need to happen. Australia can make digital technology work for everyone in all geographic regions by consciously evolving todays vertically integrated platform model, to embrace more distributed, standards based systems. Inclusivity and ease of access are key considerations for a digital strategy.
- *Australia's labour market needs to skill-up for the digital economy and human-differentiated capabilities*. The skills demanded of workers in our future digital economy will look different from the skills of today. Estimates of job/task replacement to digital range from 9 percent to 47 percent of existing jobs. In reality, practically every job will be, to some extent, impacted by automation and digital. Australia needs improved skills in using digital technology (e.g. advanced coding skills) but also needs to ensure human skills are differentiated and compete with computerised skills. The entire workforce needs to transition and tools and systems are needed to help make that happen.
- *Australia needs to address data access barriers* or *lack of data sharing and accessibility* - The ability to discover, access and use information efficiently remains elusive. Efforts to improve other aspects of data supply chains such as improving discoverability and usability of data are patchy at best. Reduced barriers to data access, to enable customer-focussed technologies to be developed that draw on the incredible array of data available. Critically, that data access must be cognisant of privacy and driven by consumer need and consent. Government's role is:
    - to invest in those components of the vision that others within the market are unable/unwilling to provide; and

    - to provide the oversighting/regulatory framework that ensures the best possible outcome for the community as a whole.

- *Better data and/or digital infrastructure are needed* - Our ability to generate value from information is increasing rapidly. There is an opportunity for Australia to become a world leader in the development of techniques and technologies for storing data, transporting data and analysing data are rapidly changing the digital landscape, with an emphasis on cyber physical systems. This requires a well-functioning, efficient information infrastructure to be able to take advantage of these opportunities. A push towards open data alone is insufficient. Curation, connection and context are key. Unified, descriptive, cared for and coherently integrated data should be the goal. Key areas for improvement are:
    - Technologies for data discovery and access – in particular a focus on the ability to determine fitness for purpose.
    - Technologies for improving data usability
- Overall, digital represents a massive opportunity for Australia's economy for continued growth and inclusive wealth generation. But the benefits are not assured and the opportunity is perishable. Much work lies before us to make this transition and we need to take risks as we experiment with digital solutions.

3. Strategies for Digital

CSIRO has been working with thousands of large and small Australian companies and governments across our nation and the world. Through this work, we've identified elements of successful digital strategy. This section presents eight strategic responses to digital disruption that will help Australian governments, companies and communities achieve better outcomes:

1. Accelerate. This involves removing barriers, reducing friction and increasing the cadence of organisational change to match the fast paced digital world. Many digital technologies are following exponential and/or geometric (as opposed to linear) growth curves both in terms of capability and user adoption/uptake. This means that each year (or month) sees markedly more change than the preceding time period. Platform based models such as Uber, Airbnb, Amazon and others are capable of transforming a marketplace within months and existing companies or industries may not have catch-up time. Australia needs organisational structures, cultures and governance models with increased agility and flexibility. Some of CSIRO's observations on this strategy include:

- *When a digitally enabled competitor arrives there may not be catch up time.* The Taxi market in Australia was reshaped within months (not years) following the arrival of the platform based ride sharing app Uber. There was no gradual transition for longstanding market players and catch-up is very hard. Market incumbents needed the same software tools before the competitor arrived. CSIRO/Our researchers expects Amazon to have even greater impact on the much larger Australian retail sector as it gets established this year and next.

- *Digital enables rapid, and often spectacular, scale-up of business*. The Australian software company Atlassian was founded in 2002. Atlassian's IPO on NASDAQ was in December 2015 with market capitalisation of US$4.37 billion. In the June quarter of fiscal year 2016/17 Atlassian reported a 37% jump in revenue to US$174.3 million (Business Insider, 28 July 2017). The group now has 2,300 employees. Growth rates like this are unprecedented in the history of company formation. The founder of Atlassian Scot Farquhar is quoted in *SmartCompany* as saying "*It's not the largest company, it's not the most successful company, it's not the strongest company, it's the most adaptable companies that are going to survive*".

- *Elephants must learn to dance*. The large public and private sector organisations need the speed and agility (involving lean and rapid experimentation with new business models), as the small digitally enabled start-ups. This often calls for changed organisational designs which are matrixed and networked as opposed to the traditional command-and-control hierarchical structures which are slow and cumbersome.

2. Automate. The costs of high powered artificial intelligence, robotics and sensory systems are continuing to decline. These represent more cost efficient, more effective and often safer business processes. For the most part Australia is/organisations are adopting automated systems too slowly given their benefits. The coming decades will see a relentless push by businesses to design, test and implement automated systems. Artificial intelligence can provide more than just an improved way of doing an old process; it can also completely replace the need for entire business functions or operations. Some observations on this strategy include:

- *Automation and artificial intelligence costs are falling*. Between 1990 and 2005, the price of robots approximately halved across 6 major developed economies (Graetz and Michaels, 2017, Robots at Work, Uppsala University and London School of Economics). When robotic quality improvements are considered over the period, robot prices are better understood as being a fifth of their 1990 levels. Going forward, the cost of robots is projected to fall by 22 percent between 2014 and 2025. The 2015 market value for robot systems worldwide has been estimated at US$35 billion.

- *Automated systems are more productive*. A study by Uppsala University and the London School of Economics (Graetz and Michaels, 2017) of 17 countries between 1993 and 2007 found that robot densification was associated with increased labour productivity growth (value added per worker). Robot investments with repayment periods of 2-18 months are highly profitable, with rates of return on the order of 25-200 percent annually. Financial returns will drive automation in many industries.

- *Investment in artificial intelligence (AI) is exploding*. An estimate by KPMG (in a 2016 report "*Employees: An endangered species?*") suggests that from 2010 to 2014, private investment in AI has grown from an US$1.7 billion to US$14.9 billion, and was on track to grow nearly 50 percent year-on-year in 2015 alone. Developments in AI are key to robotic advancements because robots learn from ever-increasing volumes of observational data. The AI tells the robot what to do with these data. This is leading to breakthroughs. For example in 2016 Microsoft researchers reported developing speech-recognition technology that was on par with human performance.

3. Migrate. Despite a few decades of digital, a significant number of government and business processes are still conducted via analogue means. Transferring these to digital format can be costly and risky. However, there are many long term benefits and society, especially younger people, have heightened expectation for user-friendly delivery of seamless and often invisible digital services. Organisations need to identify and prioritise business processes which can be converted from analogue to digital. This can be challenging due to the unfamiliar nature of many new technologies (e.g. blockchain). Improved decision support and appraisal frameworks are needed to identify what processes are migrated to digital. The migration strategy also involves a transfer of human skills and aptitudes suited to the digital economy. Some of our observations on this strategy include:

- *Data and compute are migrating to the cloud*. The Cisco Global Cloud Index forecasts that cloud data traffic will grow at an annual rate of 27 percent from 2015 to 2020 and that global cloud IP

traffic will increase from 3.9 ZB/year to 14.1 ZB/year over the same time period (Cisco, 2016a). Organisations worldwide are storing an increased share of their data, including sensitive data, as well as conducting an increased portion of computations on cloud based systems (as opposed to local networks and servers).

- *Australia's workforce skills need to migrate to digital*. Consulting firm Deloitte estimated that in 2015 Australia had around 628,000 ICT workers, with 53% of them working outside of ICT-related industries. Based on this estimate the demand for Australian ICT workers is expected to increase by around 67,000 in 2020, to 695,000. For every ICT person there will also be the demand for people who can translate from abstract ICT techniques to everyday demands, via creativity and soft skills. The digital economy of the future wants different skills. Australia needs to migrate.
- *There's much room to digitise government services*. According to the OECD Digital Economy Outlook, 50 percent of citizens in Australia use e-government services (up from 38 percent in 2010). However, Australia ranks at position #20 out of the 36 OCED Countries listed. Denmark, Iceland, Norway, Finland are all above 80 percent of citizens using digital government services. At federal, State and Local government levels, many government services which could be digital, and much more cost and time efficient, remain in analogue (paper based) form.

4. Mitigate. The downsides of digital are well known. These include privacy breaches, cybercrime, online manipulation, fake news, information overload, sedentary behaviours associated with excessive screen time and productivity issues for office workers with numerous interrupts. Many of these problems, especially cybercrime, are worsening at accelerating rates. Any digital strategy needs solutions to these downsides. This includes the replacement of human workers with digital solutions and social equality impacts of digital. The aim is to ensure everyone benefits from the digital transformation. Some of our observations on this strategy include:

- *Rising cyber security risks and cybercrime could be a barrier to digital adoption.* In 2011-12, Australian government systems suffered more than 400 cyberattacks, and 5.4 million individuals fell victim to cybercrime, costing the economy an estimated A$1.65 billion. In 2015, 72 percent of government departments and major businesses reported ransomware incidents, compared to 17 percent in 2013 (Australian Cybersecurity Centre, Department of Defence). As reported by KPMG, the global cyber security market is worth more than AU$100 billion in 2015, and is expected to exceed AU$230 billion by 2020. This coincides with the observance of a fourfold increase in the number of respondents of a government and business survey reporting ransomware.
- *Digital workers (and students) spend much sedentary time using screens and this has health impacts.* Health insurer Medibank estimates that the cumulative screen time of an average adult per day was 9.5 hours, meaning that many of us spend more time on the screen than we do sleeping. Yet almost half of the 1,505 surveyed were unaware that excessive screen time is linked to weight gain, attention difficulties, low self-esteem and depression. There are downsides to excessive computer use which need attention.
- *Equality of opportunity in a digital economy.* According to the OECD, Australia has a Gini Coefficient of 0.337. The OECD average is 0.318. Some countries with lower Gini Coefficients include Switzerland (0.295), Norway (2.5) and The Netherlands (2.8). Some countries with higher coefficients include United States (0.394), United Kingdom (0.358) and Mexico (0.459). A Gini Coefficient is a measure of wealth inequality where a score of zero implies a perfectly even distribution and a score of one implies a single individual holds all society's wealth. There are concerns that not everyone in society is benefiting equally from digital technology. Some people are losing their jobs and are not finding new ones. Some people don't have the skills and aptitude to participate in the digital economy.

5. Navigate. Theories of recombinant innovation indicate that technological inventions have a multiplicative effect. One technological innovation creates a platform for numerous further technological innovations which in turn enable new platforms for a multitude of technological innovations. This means company boards and policy makers are facing a continually shifting landscape. This calls for improved

capacity for anticipatory governance; seeing what lies ahead and taking proactive action. Some observations on this strategy include:

- *Digital transformation consulting has become big business as governments and companies seek to understand the impacts of digital*. A report by UK based research company Source Global Research found that the global digital transformation consulting market is worth US$23 billion. This captures US$9.7 billion in technology consulting, US$5.3 billion in strategy consulting, US$0.5 billion in human resource consulting and US$7 billion in other digital services. A key driver is that companies and governments worldwide need help adapting to the digital world.

- *Platform economics is changing business models*. Alibaba, Amazon, Facebook, AirBnB, Freelancer and numerous other online platform models have experienced meteoric growth over the space of years. Australian governments and businesses need to navigate a pathway through the new world of platform economies. These platforms tend to have winner-takes-all characteristics and defy traditional marketplace boundaries. They also span the globe and are easily able to operate across national borders.

- *The new economies of the firm*. Ronald Coase won the Nobel Prize in Economics from his work on the theory of the firm that argued corporations became the dominant way of organising economic activity last century due to their ability to manage transaction costs and information flows. These two principles are being challenged in the digital economy. Online platforms are taking away the transaction costs across borders and large geographic distances. They are also removing the asymmetries of information. Australian companies will need to navigate new economic waters.

6. Innovate. The digital economy lowers the barriers to marketplace entry and decreases the costs associated with designing and testing new business models. This environment is favourable to entrepreneurs. Large organisations in the public and private sector need a changed risk profile and an appetite for experimentation with new technologies and business models. The biggest risk is taking no risk at all.

- Entrepreneurs are the driving force behind a significant portion of the innovation, productivity growth and new employment opportunities in today's business environment, and are key factors in economic growth. In 2013, Ernst and Young named Australia as having one of the world's top five entrepreneurial ecosystems, as determined by measurements of five key elements: access to funding, entrepreneurship culture, tax and regulation, education and training, and coordinated support between the public, private and voluntary sectors.

- Recently, the Global Entrepreneurship and Development Institute (GEDI) ranked Australia third globally for overall entrepreneurship attitude and potential. More specifically, the Global Entrepreneurship Index (GEI) 2015 report indicates that Australia excels in terms of opportunities for start-ups and its tech sector.

- Many businesses fail to investigate and scrutinise available opportunities or opt to employ a 'wait and see' approach – neither of which are realistic in today's competitive climate. Consulting firm PwC estimates that Australian businesses can unlock an additional A$49.2 billion in the private sector over the period 2015-2025 if technologies are used to their full potential (PwC Report, How technology can help small business drive big growth).

7. Cogitate. The world's largest companies today such as Alphabet (Google), Microsoft, Amazon and Facebook are set aside from traditional large companies by the amount they invest in research and development which lies in the vicinity of 10-30 percent of total revenue. Governments across the OECD are also ramping up digital research and development. There's no brute force solution to the digital economy and hard work alone won't be sufficient. A deeper, new or transformative digital capability can place a company beyond the reach of competitors and quickly consume the bulk of market share. It's about working smarter not harder in the digital economy.

- *The productivity slump requires deep/new solutions.* The world's advanced economies are in the grips of a productivity slump. Productivity is the efficiency via which inputs are converted to

outputs and is a critical driver of long term wealth generation. Digital technologies are an important ingredient to boosting productivity, especially within the context of advanced service sector economies. However, the first wave of digital has passed. Australia is now moving into a period where deeper, bolder and smarter digital innovations are needed to boost the efficiency of industry. That requires blue-sky thinking and original research.

- *It's about working smarter not harder*. The technology giants of Alphabet (Google), Microsoft, Facebook, Amazon, IBM and many others invest a large share of revenue in research. The success of these companies, which are now the world's largest, comes from their experimentation. Superior technological capabilities borne from original research is enabling new products for which there is little competition. Another example comes from Tesla which has produced electric and automated vehicles not easily matched by other car manufacturers.

8. Gravitate. As the digital world engulfs everything the marginal value of the physical world rises. Consumers and citizens are likely to place greater emphasis on real human experiences involving social interaction, nature and physical spaces. In this last strategy the importance of gravitating towards the all-important human experience-factor in a digitally immersed economy is emphasised. Often the best digital technologies are invisible and a digital strategy should be wrapped around what people want and need, not the technology itself.

- Despite the growth of Netflix, YouTube and countless online entertainment offerings per capita visitation rates at Australian cinemas, art galleries, museums and libraries show no signs of decline when aggregated at the national level. This is because the real world and physical experience, which includes elements of social interaction, will continue to hold value to people. The implication is that whilst digital solutions are built organisations should stay focused on the physical and real human experience.

4. Government Policy Priorities

What does government actually need to do in light of these issues? By overlaying the digital strategies with the consultation paper on the digital economy, nine high level policy imperatives are identified:

1. Remove barriers and reduce friction, resetting the cadence and ability for the economy to transform, including simplification of compliance obligations.
2. Develop and implement deep Artificial Intelligence capability within the country, while also applying it to transform government and enable commerce.
3. Help move current industries and business processes and functions into digital models for it improved efficiency, effectiveness and productivity.
4. Manage downside risks of participation in the digital economy and its fruits. Protect against cybersecurity/cybercrime, privacy, risk of inequality/access to opportunity.
5. Improve foresight ability around digital disruption and be increasingly proactive.
6. Rapidly and continually experiment with new models, improving our risk tolerance and changing tax and business rules to enable a more targeted exploration and risk-taking, including stock option tax treatment.
7. Work smarter, not harder; focus on improving productivity in our big industries (eg mining, banking) while building the knowledge economy to general new value in new data-driven industries, targeting investment. Consistent and transferrable skills credentialing across educational institutions.
8. Shape the market in our favour: change investment rules to create Australia as a destination for R&D and commercialisation investment funds over others, and provide incentive to support Australian IP

and businesses to be exploited in the global marketplace (building a pipeline of license revenues and profits back to Australia).

9. Position “Australia as a Platform”, creating the regulatory and investment conditions to maximise the share of R&D and Commercialisation activity involving our country.
10. Take a regional view, positioning Australia as a leader within the Indo Pacific Region for digital research and technologies.

5. Responses to Selected Questions

The digital economy consultation paper posed a series of specific questions. CSIRO has identified a sub-set of these questions upon which we feel it’s well positioned to provide comment. These questions are addressed in this section.

How are advances in digital technology changing the way you work, your industry, and your community?

Within the environmental research space, digital technology has advanced on many fronts over recent times. This includes developments in the area of data collection, data transfer and storage, data analysis and the availability of new digital data sets.

For example, the increasing availability of ever higher resolution earth observation (remote sensing) data means that these data are now regularly used in many forms of environmental analysis from understanding stocks and flows of water in the landscape, to understanding changes in vegetation cover to identifying vital refuges for threatened species. Similarly improvements in sensor technology and the rapidly decreasing cost of these is enabling more of the environment to be monitored and the collection of more data for analysis.

High speed networks in conjunction with cloud based data storage and computing now enable researchers to collaborate around the globe in virtual research environments accessing almost unlimited volumes of data and computational power. As a result, our ability to understand the complex interactions that occur within our natural environment, previously too difficult to solve, is growing rapidly. These understandings are now helping in areas such as the ability to forecast various environmental conditions beyond traditional climate and weather forecasting to such as aspects as stream flow, fire risk, agricultural output, etc.

A key component of these advances has been the development and availability of new data sets (eg. 1” Digital Elevation Model and the various water products from the Bureau of Meteorology) as well as the establishment of key research infrastructure facilities such as the Atlas of Living Australia (ALA), the Terrestrial Ecosystem Research Network (TERN), the Integrated Marine Observing System (IMOS). These developments have enable significant achievements in developing our understanding of the environment and hence our ability to manage our natural resources sustainably.

Finally, the use of digital technologies to deliver science outputs to end users have developed to a point where this is becoming routine. While relatively new, the concept of delivering ‘science as a service’ and tools that deliver on this promise are already starting to deliver outcomes.

With regards to the energy sector:

- Automated demand response enabled devices enable dynamic response to peak demand and potential black-out events that may be driven by residential and commercial discretionary loads.
- Smart metering enables remote data collection, new (more flexible) forms of electricity tariff, provide fine-grained insight into the performance of our energy solar systems, and help us understand our own household energy-use in ways that were previously impossible.

- Industry Impacts: Advances in digital technology are changing the way which the mining and resource sector traditionally operates by providing fundamentally new mechanisms for the acquisition, processing, utilisation and accessibility of information. These technologies are directly enabling new levels of situational awareness, decision support and trusted autonomy through the provision of high-quality, real-time actionable information. This is evident in the accelerated deployment and adoption of system autonomy, remote operations, and distributed collaborative interactions. The result is a change in organisational culture, roles and operational processes.

What is your vision for an Australia that thrives in a digital economy? Where would you like to see Australia in five, 10 and 20 years' time?

Australia's thriving digital economy will be substantially built around cyber-physical systems and the digital transformation of incumbent industry sectors like agriculture, healthcare and education along with the creation of new data-driven industries. When it comes to the intersection of the sustainable management of natural resources and the digital economy, the future is exciting. This is a future where those with a right and need for environmental information can discover, access and use this easily and efficiently, a future where the forecasting of many aspects of the state of the environment is undertaken routinely, a future where environmental policy is based on up-to-date knowledge, a future where the impact of decisions and activities on the environment can be easily and confidently determined.

While there have been many advances in digital technology recently, the ability to discover, access and use information efficiently remains elusive. Open data initiatives have helped addressed issues associated with access to those data that can be made public. However, efforts to improve other aspects of data supply chains such as improving discoverability and usability of data are patchy at best. The primary challenge to addressing this issue is that digital technologies alone cannot solve it. Rather, the solution to his challenge requires addressing complex socio-technical issues associated with the economics of data.

Resolving the challenges of data supply chains will enable the generation of significant value from data in the form of new information products and new capabilities. For example, the ability to forecast aspects of the environment such as the weather and climate relies on well understood, robust data supply chains. Imagine if other aspects of the environment could be forecast with the same regularity and confidence. We would able to manage the environment 'looking through the windscreen, rather than rear vision mirror'. Such forecasts would then enable us to confidently make decisions around future economic investments in infrastructure taking into account future environmental conditions. Similarly, at risk fauna and flora could be managed before their situation becomes critical.

Another area where the digital technology will play a key role in the future is at the intersection of environmental research and environmental policy development. The promise of the future is that digital technology will greatly enhance the ability for decision makers (policy, investors, managers) to access scientific knowledge and, as a result, make better informed decisions.

For the energy sector, there will likely be benefits from reducing barriers to data access, enabling customer-focussed technologies to be developed that draw on the incredible array of data available. Critically, that data access must be cognisant of privacy and driven by consumer need and consent. We also believe that increased quality of experience will fundamentally deliver more efficient interactions with people, processes and tasks.

Australia's geopolitical position means that Australia has an ability and opportunity to provide trusted, digitally-enabled global services (technologies and expertise) to international markets. Our further capacity to value-add could also be through intelligent information processing.

What is the role of government in achieving that vision?

Government's role in delivering this vision for the future is much as it is for other aspects of the economy. That is:

- to articulate a clear and actionable plan for Australia's digital future;
- to invest in those components of the vision that others within the market are unable/unwilling to provide;
- to provide the oversighting/regulatory framework that ensures the best possible outcome for the community as a whole; and,
- to create an environment where entrepreneurs are willing to take calculated risks to capitalise on the digital transformation to create economic growth and jobs in existing and new industries.

The vision above can only be achieved with the existence of an economy wide information infrastructure enabling those with a right and a need to efficiently discover, access and use the information they need as and when the need it.

Government has already invested in some aspects of this infrastructure. Open Data policies and tools such as data.gov.au, address key aspects of data discovery and access of government data. However, they do not address the key issue of data usability. Solving this will involve addressing technical and social challenges associated with data sharing.

We note that data access barriers in the energy sector remain. Access to a consumer's own smart meter data is complex and the Rules surrounding access do not encourage real-time access nor do they specify the manner in which requests are to be made (see National Electricity Rule 7). Access arrangements for customer authorised third parties is opaque, and an improvement could be to specify what constitutes an authorised third party. Few consumers access their metering data and many businesses lack the ability to provide insight to consumers based upon that data.

Ensuring transparency and clarity around data ownership and provenance, especially with third-party business utilisation of data, could be beneficial.

What are the key disruptive technologies or business models that you are seeing? What do you predict is on the horizon in five, 10, 20 years' time?

According to the OECD, economic assets are a store of value from which economic benefits may be derived by holding or using them[1]. This is as true for information as it is for assets like transport infrastructure, agricultural lands and hospitals. However, there are some key differentiators[2]:

1. Information is infinitely shareable, reusable and repurposable. Information can be shared by multiple business areas and used to generate the same value for each party as if they had exclusive use.
2. The value of information increases with use. Unlike most assets, the more information is used, the more valuable it becomes.
3. Information is perishable. Like most assets, the value of information tends to depreciate over time. The rate of depreciation depends on the type of information.
4. The value of information increases with accuracy. In general, the more accurate information is, the more useful and therefore valuable it is.
5. The value of information increases when combined with other information.

[1] "Economic assets - OECD.Stat." 2005. 29 Jun. 2015 <http://stats.oecd.org/glossary/detail.asp?ID=721>

[2] Moody, Daniel L, and Peter Walsh. "Measuring the Value of Information-An Asset Valuation Approach." *ECIS* Jun. 1999: 496-512.

6. More is not necessarily better. There are human limits to processing information beyond which decision making performance decreases.
7. Information is not regenerative. In fact, as information is used, derivatives are created and added to the information asset base.

Australia's ability to generate value from information is increasing rapidly. Emerging techniques and technologies for storing data, transporting data and analysing data are rapidly changing the digital landscape. There is an opportunity for Australia to become a world leader in this space. However, this required a well-functioning, efficient information infrastructure to be able to take advantage of these opportunities.

Furthermore, Australia's digital economy will create wholly new industries, but it will also fundamentally change our traditional economic engines.

Historically gains in agricultural productivity have been based on improved breeds and practices. Digital technologies will contribute to these gains continuing, while also enabling new productivity improvements of comparable size through cost management and supply chain efficiencies.

CSIRO are currently building a common big data infrastructure that will support next-generation decision making and using it to transform agricultural industries and environmental action. To achieve this aim, CSIRO are bringing together cutting edge climate science; new sources of locally and remotely sensed data; informatics for agro-ecosystems; rigorous analysis of uncertainties; and innovation in both the ICT (Information and Communication Technology) and social dimensions of systems integration. Currently CSIRO are focusing on six cases (grains yield forecasting, prawn aquaculture, greenhouse gas mitigation, high value irrigated crops, the Great Barrier Reef and on-farm experimentation) and developing various cross-cutting science activities, including the development of a common scientific and ICT infrastructure.

One of CSIRO's key contributions relates to understanding the social, ethical and trust dimensions of digital agriculture. These are pivotal for both adoption and feasibility. Successful development of next generation decision tools needs to embed an understanding of the broader social and institutional context within which individual landholders operate. This is also important in ensuring that ICT systems development focuses on real-world problems that can be readily identified and valued by land sector decision-makers.

By including social aspects as a platform in CSIRO's digital agricultural agenda we will build systems and approaches that build trust, through managing data ownership and stewardship, privacy, confidentiality and associated regulatory issues that need to be addressed across multiple domains. This includes governance challenges such as how to protect individual rights while maximising benefits from disparate data sources.

In the energy sector, there are potential opportunities for innovative demand-side businesses that manage a mix of solar, storage and discretionary load to deliver dynamic response to real-time price signals to enable a sustainable, reliable, secure and thin grid. Those opportunities exist only if live access to a wide variety of digital data streams is available at the customer-grid interface.

A lack of data sharing and accessibility across government and the private energy sector means that few people have access to a complete picture of the rapidly evolving energy system. The consequence is that critical areas like short-, medium- and long-term energy forecasting are working with incomplete information. Dramatic improvements to forecasting accuracy and specificity would be possible with better access to data.

Other opportunities in the energy sector are:

- Pervasive distributed service-oriented delivery: Vastly increased utilisation of subscription and pay-per-use models that integrate customer-oriented services distributed across a global ecosystem is likely to create new business transaction models and mindsets. Moving existing processes and services into the digital space creates opportunity for the development of new distributed, highly customised products and services.

- Hyperlocal services: enabling highly customised experiences delivered based on context and location. Digital technologies could displace the current needs for co-location and proximity to deliver interactive information.

The demand for digital infrastructure for data collection, storage, transmission and analysis is growing. To take part in the digital economy, and to drive innovation and productivity, Australians need access to quality, affordable and reliable communications services, as well as the underlying data, platforms and protocols that support our online activities.

Emerging technologies likely to impact the Australian economy in the coming years include the following. Data61 and CSIRO have work underway in all of these areas;

- Machine Learning and Artificial intelligence
- Computational Law
- Robotics
- Privacy Preserving Data Sharing
- Distributed Ledger Technology
- CyberSecurity
- Augmented Reality
- Synthetic Biology
- Genomics
- Quantum Computing
- Advanced Materials

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

Privacy preserving techniques and tools for data sharing, linkage and analysis are becoming more important. For the use of data by the general public, privacy controls must be strictly applied to the data to keep re-identification risk to essentially zero. Using such controls greatly reduces the utility of the data for analytics, but may be appropriate for release of analytical end-products to a wider audience. There is a constraint on the technological approaches to minimising re-identification risk: some of the approaches that give higher protections are relatively recent and are still undergoing active research and development.

Data linkage, the process of matching records obtained from different sources for a particular individual, is an area that needs to be considered carefully. Current solutions are labour intensive and will not easily support large-scale availability of data analytics across government. Increased automation within the data linkage process and the development of Application Programming Interfaces (APIs) to support data linkage will be necessary in the future to address this. Also, a clear separation between data that is used for linkage and data that is used for analysis will give better privacy and security design.

In terms of implementation, there is a need to quickly establish current best practice, while simultaneously working to progress medium and long-term goals to enable secure, scalable and efficient data analytics workflows across government.

Current best practice involves largely manual data linkage and integration of datasets from multiple departments, and provision of those datasets to trusted analysts in a secure and well-audited environment. Establishing these services will require robust technical solutions for data discovery and meta-data management, removing and detecting personal identifiers, integrating data from multiple sources, and providing modern analytics tools within a secure environment.

In the medium- and long-term, these processes need to become automated and scalable, and different modalities for interactions with data for less trusted users and more sensitive data will become available. These modalities include privacy preserving APIs for:

- data aggregation queries;
- data plotting and analytics; and
- amalgamated and encrypted data analysis.

Given the enormous effort currently being applied to these problems by Government at the Commonwealth level and across other state jurisdictions, effective communication with those parties will increase opportunities for learning and reuse, lessening the overall cost, and contributing significant benefits through broader collaboration in data analytics.

As systems become more connected and we have increasingly automated algorithmic decision making, trust and ethics will become increasingly important. Trust in terms of knowing who an entity is dealing with, trust that connected equipment will perform properly, trust in the ethical implementation of algorithms and trust in the integrity of the underlying data itself.

Australia also has an opportunity to consolidate its spatial data activities to achieve scale that is globally relevant. Doing this will drive operational efficiencies and provide long term stability of activities to more fully support emerging industry sectors

With respect to environmental research and management, Australia needs to invest in the application of technology to predict future state. At present, we are only able to forecast a few aspects of our environment. However, changes to our climate and increased pressure from growing populations will have an impact on the environment. We need to be able to understand and be ready to respond to these impacts before they occur.

To this end, the national Environmental Prediction System proposed within the 2016 National Research Infrastructure (NRI) Roadmap needs to become a priority. This system proposes to enhance Australia's ability to undertake research into environment prediction through improving interoperability between existing data facilities as well as linkages to policy.

With respect to the energy sector, Australia would benefit from a central platform for the collection, curation and sharing of energy-use data. At present, this data is held by a variety of sources (public and private) and is poorly integrated. Data loss, poor documentation of data and heavily constrained access occurs throughout the energy sector. The upshot is that research is seldom able to consider the complete picture, is slowed by a search for data, and often fails to properly leverage the work of other organisations (who often have their own bespoke private data assets). The Energy Use Data Model is one priority piece of work that is looking to directly address these issues in the energy demand space, while the Australian Renewable Energy Mapping Infrastructure (AREMI) project provides public access to geospatial renewable energy data. Extension and integration of such platforms is critical.

Note that a push towards open data alone is insufficient. Curation, connection and context are key. Unified, descriptive, cared for and coherently integrated data should be the goal.

For agriculture a key opportunity is to harness the growing interest from the private and public sectors in providing digital services to farmers and agribusiness. The lack of data and associated knowledge is a significant impediment to new digital businesses entering this market. There are key gaps in the categories of soils, weather, imagery, land use and property boundaries. Acquiring data can be costly and the sales and commercialisation path may be uncertain. Thus, the risk of these investments and the competitive opportunities for the alternate use of this capital means that companies may not invest. Hence, we conclude there is a clear case for targeted investment in foundational information, data and services to increase the pool of potential vendors in the market.

There are other arguments for public investment in this data. An inherent feature of cross-sectoral data is that there are diffuse beneficiaries from its collection and exploitation. This is potentially an advantage, in the sense that there can possibly be greater returns from investment. But it can also be a disadvantage, as

no one sector gets sufficient value to fund an entire program. The lack of a framework for shared investment and ambiguity around relative values is a significant impediment to coordinated action.

Furthermore, a national agriculture data infrastructure should be developed, based on a strategic plan rather than the result of episodic and haphazard development. Targeted research to produce foundational data and models relevant to Australian systems is needed for the development of data-driven decision-support systems, particularly where lack of this information is a barrier to entry. Investment is needed to fully leverage the existing data holdings, and there is a role for industry and government to advocate for FAIR (findable, accessible, interoperable and reusable) storage and dissemination of datasets that are valuable across the rural sector and that are also widely used in other industries. There is a need for a platform or platforms are needed for owners and users of agricultural data to exchange, market and value-add data for a variety of end purposes. A significant systemic constraint remains anachronistic university training that must be reformed to ensure a future supply of agricultural data scientists.

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

A more coherent national approach to horizontal technology development and adoption in areas such as AI and robotics, as well as a national approach to Digital Skilling.

At present there is very little investment within Australia in improving information supply chains. Key areas for improvement are:

- Technologies for data discovery and access – in particular a focus on the ability to determine fitness for purpose.
- Technologies for improving data usability
- Technologies for data integration and analysis.
- Technologies for ensuring trustworthiness in digital interactions and underlying data and systems.

Smart meter data is already being collected for more than 2 million households across Australia (see http://www.smartmeters.vic.gov.au/about-smart-meters/end-of-rollout). Much of that data is collated by the Australian Energy Market Operator. Yet third parties (including energy consumers themselves) cannot access that data from the Operator and must instead consult individually with one of the many energy distribution or energy retail businesses. The procedures, requirements and engagement mechanisms for each of these data holders is inconsistent and the outcomes often slower than is ideal. This inefficiency is illustrative of a need for National Electricity Rule changes to enable improved access to the incredibly powerful dataset that remains largely untouched. Changes that more clearly state the requirements for becoming an authorised third party to access smart meter data on behalf of consumers, and enabling AEMO (or other parties) to provide smart meter data to consenting consumers or authorised third parties in an efficient and consistent manner could benefit the way Australian business operates in the energy sector and the way policy is formed, as this would enable greater understanding of how actual Australian energy consumers actually consume energy.

What opportunities do we have in standards development and regulation to: – enable digital entrepreneurship, innovation and trade? – mitigate the risks associated with digital disruption?

Australia has a long and proud history in leading the development of technology standards. Many international standards in common use, in particular in the environment sector, have been influenced by or developed by Australian groups. This includes standards for water and soil data exchange and more significantly the Observations and Measurements standard (ISO 19156) that underpins many international exchange standards.

Australia's expertise in this space is called on regularly and, as a result we have an opportunity to continue to lead the world. In particular, continuing to invest in the development and management of standards for

information exchange around a range on environmental data will not only enable us to exchange data more easily and confidently but also help to influence practices internationally. This, in turn, influences leads to economic opportunities for Australian companies.

Work needs to be done on more clearly specifying what constitutes personally identifying information in the digital age and what protections/requirements are relevant. This is particularly true in the energy sector, where grey areas are rapidly emerging. Does smart meter data constitute personally identifying data? Is it sensitive? What is appropriate for publication?

More broadly, a lack of clarity around what is appropriate to share, what requires consumer consent and what must be held confidential at all costs is profoundly slowing data sharing. Without a clear view of what is appropriate and suitable, the private sector is typically (and reasonably) unwilling to expose itself to risk in the data sharing space. Data portability, as well as portability of historical online product or service usage patterns is essential for fostering competition to ensure Australia's global competitiveness.

Rather than re-creating standards, Australia can learn from and adopt global standards to ensure global competitiveness and interoperability.

In emerging areas, it is anticipated that regulation will move over time to be more principles driven to deal with added complexity and the speed of change. It will be important to not over regulate and stifle the development and adoption of new technologies and business models.

What digital standards do we need to enable Australian businesses to participate in global supply chains and maximise the opportunities of the digital economy?

Technology is enabled by standards. Without standards at the many levels of technology it simply would not work. Power would not flow, hardware components could not be plugged together, and machines could not communicate.

When it comes to information infrastructure, the key set of standards needed are those that enable exchange and integration of information. That is:

1. Standards for how machines communicate; and
2. Standards for what machines communicate.

A significant opportunity for Australia to improve efficiency of information exchange is the development and adoption of standards for 'what' is communicated. Examples of where this has been done within Australia include the 'Water Data Transfer Format' developed by CSIRO for the Bureau of Meteorology (BOM). Adoption of this standard has greatly improved the efficiency of transfer of data to support the BOMs water program. Similarly the Australian Soil community is adopting standards for data exchange to improve efficiency. Investment in the development and adoption of standards for other communities will greatly improve the ability to share and use data.

Australia should adhere to emerging global data standards and be transparent in the implementation/endorsement of those standards. Bespoke standards in the digital space are likely to lead to fragmentation and slow data connectivity activities.

Standards based approaches will also be needed for domains like cybersecurity and the auditing of a firms cyber security readiness. As SMEs connect into global value chains, they will come under increasing scrutiny around their ability to protect digital assets.

What opportunities do we have to build trust and community confidence through resilience to cyber threats, online safety and privacy?

Education is needed to improve cyber-literacy and to ensure that consumers are aware of both the risks and opportunities of data and emerging energy technologies. Equally, there has been little rigorous threat testing of emerging technologies with a strong consumer focus. The push towards distributed energy

storage, electric vehicles, automated demand response and smart solar inverters is exciting and offers to profoundly change the way that energy is delivered in Australia, but it is unclear whether the potential cyber-threat associated with increasing remote control and digitisation in this space has been properly considered.

An emerging area of interest globally is the introduction of vendor neutral, transparent mechanisms to inform consumers and buyers of connected equipment, what protective measures have been taken to ensure the equipment's security. If connected equipment does not perform properly this can result in economic and life threatening consequences. This approach is analogous to the 5 star energy rating system adopted by whitegoods manufacturers, or underwriters laboratory certifying equipment safety. In this domain Australia should not try to develop its own program but instead influence and adopt global programs.

Another opportunity to build trust around cyber resilience is to ensure the companies are sharing threat intelligence data, leveraging the ACSC program and other industry programs. This data does not represent competitive advantage, but trust being undermined in the system negatively impacts all participants.

What integrity and privacy measures do we need to ensure consumers can protect their data?

Transparency around data access, data use and data risk, coupled with consumer ability to opt-in or out of data sharing opportunities (as fully-informed participants) is the central tenet upon which data privacy and ethics systems should be built. Please refer to the prior section that deals with data privacy in more detail.

What are barriers for business, particularly small business, in adopting cyber security and privacy practices?

Privacy and ethics are non-trivial and there is a lack of robust information to guide SMEs in this space, particularly in the rapidly moving area of energy data. Best practice guides in key emerging data areas would be worthwhile by helping to establish a baseline approach to the management of new energy data.

Another key barrier is access to talent. Australia has a skills shortage in cybersecurity, datascience and digital more generally. This could be addressed with a nationally coherent skilling and employment program. This also represents opportunities for service providers to deliver outsourced cyber security capabilities for protecting physical and digital assets.

What is holding Australian businesses back in terms of benefiting from digital technologies?

Data collection, curation and mining are complex activities requiring specific expertise. Existing Australian business seldom has this capability in-built, meaning that it is difficult to identify new opportunities and then capitalise upon those opportunities. Even where significant data assets are collected as a core part of the business, research with that data is often seen as secondary to more traditional business drivers (i.e. delivery of existing service to consumers).

Another area holding the country back is the lack of digital literacy in Australian Boards and leadership teams. Australian Boards today are not diverse, do not have enough representation from younger generations and are overly focused on governance and compliance versus capitalising on the immense opportunities to grow into adjacent markets globally.

What would help Australian businesses to embrace digital technologies?

Better (low-friction) connection with Australian researchers in the data and digital spaces is key. This could include in-business secondments to grow internal capability. In a similar vein, more structured training and technology development opportunities targeting digital capability are key and currently lacking.

Australian businesses need more global context to understand that embracing digital is fundamental to their survival, growth and competitiveness.

What efforts are you or your organisation making to respond to digital transformation? Why?

CSIRO has built a cross-disciplinary approach to the digital transformation that connects deep data science with domain specific capabilities to deliver both platform and bespoke solutions that cater to the specific needs of Australian industry and consumers. The formation of Data61 underlines a deep commitment to the underpinning data science that will drive Australia's digital transformation going forward.

What opportunities do small and medium-sized businesses have to embrace digital innovation to drive customer value, improve their services and unlock their potential?

A growing range of off-the-shelf business intelligence solutions aim to deliver quick wins to small Australian business with respect to understanding their existing customer base and internal business processes. This is a low-cost toe-in-the-water to the wider opportunities offered by data science services which can be leveraged to generate deeper insight and forecasts. For emerging businesses, the growth in big data (should it be sufficiently accessible) will enable a more complete analysis of market opportunity and customer need. In the energy sector, the lack of energy consumer data has made this difficult in the past, slowing potential growth of innovative consumer-focussed solutions.

What are the key new growth industries that Australia should be tapping into? In what technologies and sectors should Australian businesses take the lead, and where should we be a 'fast follower' of international trends?

Australia is internationally recognised as a leader in the movement towards increasingly decentralised energy systems. This presents a window of opportunity to drive technologies that capitalise on digital energy data streams (including smart metering, inverter data, weather observations and network metering) to provide integrated control solutions that simultaneously reduce residential bills, maximise environmental performance and alleviate electricity network stress. Due to the nature of those streams, solutions built in Australia are suitable for international deployment.

There are many industries where Australia has the core assets and capability to be a global leader. These include; Food Provenance, Aquaculture, Automated Compliance, Personalised Health and Wellness, Lifelong Learning, Electroceuticals, Computational Law and others.

What opportunities do we have to bridge the 'digital divide' and make the most of the benefits that digital technologies present for social inclusion?

Improved data access has the capacity to enable policy and solutions that are tailored to delivering value for the vulnerable and the disadvantaged.

Australia has an opportunity to be a global pioneer in a new model for online industry that is built on a distributed, standards based architecture that removes the need for a trusted intermediary, a role currently played by the global platform companies that have naturally monopolistic tendencies. This new model, that we refer to as "Industry Utilities" resemble co-operatives where a group of entities come together and share in the development of common infrastructure services that all can leverage, and access. Visa and how it got started is an example of this sort of model in the financial services sector. Australia is a global leader in the underlying technologies that would enable this new economic model. It would result in a more even distribution of wealth and financial outcomes from online trade and commerce.

In the energy sector, improved understanding of residential energy consumption and energy consumers enabled by pre-existing smart metering means that tariffs, energy efficiency measures and support can be

designed in a way that minimises risk and maximises value. Without comprehensive data, there is a risk that solutions are grounded on assumptions and anecdote.

Consideration should also be given to:

- Ongoing national reskilling programs, including incentives for corporations to reskill existing employees vs. making them redundant;
- Ensuring providers of paid education and training are accountable for the downstream employability of graduates; and,
- Transparent reporting of the jobs that graduates attain from each program well beyond their initial job, post-graduation.