



Australian Government
**Department of Industry,
Innovation and Science**

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Introduction

The Australian Government's vision is for an agile, strong and diversified economy, capitalising on Australia's commercial, innovative and scientific strengths. This is a time of rapid technological advances along with other longer-term trends including globalisation, increasing consumer engagement, the rise of Asia, demographic change and sustainability challenges. Adapting to these forces will enable the Australian economy to continue to grow and improve the well-being of Australians.

We live in a world where advancements in technology are constant and ongoing. There have been many waves of technological disruption throughout human history that have changed the way we live and the industries we work in. The horse-drawn carriage made way for the automobile; advances in agriculture enabled farmers to become more efficient and feed more people; and improvements in healthcare and inventions such as electricity, sanitation and refrigeration have all improved standards of living and economic wellbeing.

Emerging digital technologies such as artificial intelligence, robotics and the Internet of Things provide significant opportunities for economic growth. Embracing these new technologies can boost national productivity and enhance the competitiveness of Australian industries. This in turn will increase investment, exports, wages and living standards.

While technological advances can have benefits, there may also be costs and uneven impacts on individuals, industries and regions, particularly where the transition is rapid or unexpected. Such significant structural adjustment challenges are viewed by parts of the community with apprehension, especially where workers and industries are at risk of major disruption.

To create new economic opportunities Australia must promote the adoption and development of new technologies and ensure that Australians have the right skills to keep pace with change. This includes an adaptive education and skills system that is responsive to the changing demands of businesses and workers. Australia's ability to take advantage of technological progress will be key to its economic success and will be measured by the extent to which it has a diversified, flexible, resilient and dynamic economic base that can secure jobs and prosperity. Innovation is critical to promoting growth and productivity and positioning Australia as a leader in the industries of future.

From the perspective of the Department of Industry, Innovation and Science, the key areas of focus for the future of work and workers are: technological change; education and skills challenges and their impacts on employment; changing industrial composition and the growth of non-market services and digital industries; and the impact on regional Australia. The role of the department is to facilitate the growth and productivity of globally competitive industries. It also supports the building of a strong scientific and business capability, business innovation and the commercialisation of new ideas and technologies as critical

requirements for productivity and economic growth. We have addressed the Terms of Reference with this focus.

Australia's economic transformation

Australia is in its 27th year of uninterrupted economic growth. This performance has been one of the best amongst comparator nations in the Organisation for Economic Co-operation and Development (OECD). The success of the Australian economy is the result of strong institutional frameworks, economic reform, population growth and a once in a generation mining boom. Over this time Australia has sustained high living standards, attracted and grown competitive businesses, and developed a highly skilled workforce.

The success of the Australian economy, however, should not be taken for granted. Total factor productivity growth—one of the most important long-term drivers of living standards—is growing slowly by historical standards with negative implications for wages growth. The end of the mining investment boom poses new challenges for new sources of growth.

Recent OECD evidence suggests that slowing productivity is not a slowing of innovation but rather the pace at which innovations spread throughout the economy. Their analysis shows that the productivity growth of the most productive global firms remained robust in the 21st century, despite the aggregate productivity slowdown, but the gap between those global firms and the rest had been widening over time (1). This raises concerns about firms' ability, particularly SMEs, to adopt technologies and knowledge developed by frontier firms. According to the World Economic Forum's Digital Readiness Index, Australia's business use of ICTs is ranked 24th and has been trending downwards since the early 2000s. And a recent Ai Group report concluded that Australian manufacturers are unprepared for the fourth industrial revolution (2).

As a relatively small open economy, Australia is exposed to changes in global markets. These are accelerating and becoming increasingly dynamic in nature due to globalisation, the rise of Asia, technology disruption, increasing consumer engagement, demographic change and sustainability challenges. By understanding the impact of these changes and how they will influence the types of skills demanded of Australian workers, education and training providers will be better able to offer training that responds to the emerging skill demands in the marketplace.

Technological advances are particularly important to increase productivity, allowing businesses to produce goods and services at a lower cost and leading to higher wages for workers. Lower costs and higher wages increases real incomes and profits, enabling consumers to buy more goods and services and businesses to increase investment. As a result of this additional demand for goods, new jobs are created to supply consumer demands and meet business investment needs.

Technology is also raising incomes (which creates more jobs) by encouraging more people to increase their education levels. New technology is typically complementary to high skilled workers, meaning that financial returns to education, such as university degrees, are higher and these higher returns encourage more people to increase their education levels.

Technological change

There have been many waves of technological advances throughout human history which have changed the nature of jobs and industries. The First Industrial Revolution from the late 18th century used water and steam power to mechanise production. This transition included going from hand production methods to machines, new chemical manufacturing and iron production processes, the development of machine tools and the rise of the factory system. While it caused disruption, it also made workers more productive, led to improvements in standards of living and created many more new jobs to replace those that were lost.

This was also the case in subsequent waves of change with the Second Industrial Revolution, which used electric power to create mass production, and the Third, which used electronics and information technology to automate production. The Fourth Industrial Revolution, the digital revolution, has been occurring since the middle of the 20th century.

In this latest wave of change, emerging technologies will affect productivity through many channels including (3):

- Combination of control devices, data analytics, cloud computing and the Internet of Things is enabling intelligent and autonomous machines and systems, which can almost entirely eliminate errors in production processes.
- Robotics have raised productivity as robots are faster, stronger, more precise and consistent than workers.
- Data driven supply chains greatly reduce the time to deliver orders.
- Mixing industrial biotechnology with chemistry can increase the efficiency of bioprocesses. Bio-based production of chemicals could substantially reduce greenhouse gas emissions.
- 3D printing can remove the need for assembly in some stages of production.

These technologies are changing the nature of economic activity and the way we work. In the United States, output and productivity in firms that adopt data-driven decision making are 5 to 6 per cent higher than otherwise. Improving data quality and access by 10 per cent is associated with a 14 per cent increase in labour productivity (3).

Developments in emerging technologies will affect business processes and inputs (including labour) and assets used to produce goods and services. However, the mere availability of technologies will not guarantee benefits and value for the Australian economy. To successfully capture the benefits from major technological changes, it is essential that these technologies are translated, commercialised and adopted. Greater benefits are likely to be

captured where technological change is adopted early, or driven by innovation and research from within the Australian economy. By developing the capacity to drive change internally through science and the development of new technologies, Australia will be increasingly capable of producing people with these skills.

The net effect of technologies on employment has been positive. According to the World Bank, product innovations—created using new technologies—give rise to new industries, firms and jobs (4). Similarly, greater access to markets and resources due to improved connectivity helps firms grow and create jobs. However, employees in industries that are adopting new technologies can experience job losses in the short run, particularly those in lower skilled jobs.

Technological advances will continue to change the types of work in which people engage. While jobs and occupations have been lost since the First Industrial Revolution, many new and higher skilled jobs have been created. History also suggests that key tasks of existing jobs will evolve, as they have done over time. People with a strong skills base, including those with the ability to perform non-routine tasks, and the ability and willingness to adapt as the needs of businesses change will be increasingly sought after by business (5).

Employment and skill changes

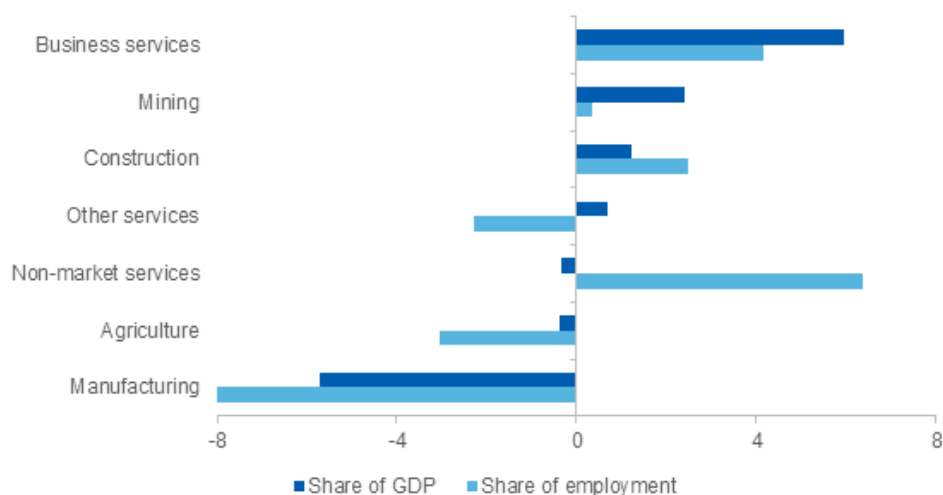
Structural change occurs when there are lasting shifts in the patterns of economic activity and employment by industry, occupation or location. Shifts can occur quickly and unexpectedly or be part of a steady evolution. Change is an ongoing and important feature of the Australian economy. At the macro level, the movement of workers and resources between jobs and industries leads to improvements in productivity and economic growth and shapes our future prosperity.

Technological change, along with the other megatrends identified earlier, are driving structural change in the Australian economy and helping increase productivity and living standards.

The share of GDP and employment in manufacturing and agriculture has fallen over the last thirty years (Figure 1). These sectors have increased their productivity partly through the application of technology and freed up labour that has been absorbed in service-based industries. Additionally, technological improvements have lowered the cost of communication and logistics, allowing industries to become more specialised in their core activities and outsource non-core activities to the business services sector (6).

Technological advancements have also allowed a greater number and variety of services to be exported without the need for the physical movement of people between countries, contributing to the growth in the relative share of services across developed countries, including Australia (7).

Figure 1: Change in GDP and employment share by industry, 1987 to 2017



Notes: Seasonally adjusted data. Business services includes: Financial and Insurance Services; Rental, Hiring and Real Estate Services; Professional, Scientific and Technical Services; Administrative and Support Services. Non-market services includes: Health Care and Social Assistance; Education and Training; Public Administration and Safety. Other services includes: Wholesale Trade; Retail Trade; Accommodation & Food Services; Transport, Postal & Warehousing; Arts & Recreation Services; Other Services; Electricity, Gas, Water & Waste Services; Information, Media and Telecommunications. Source: ABS cat. no. 5206.0, table 2 and table 6, ABS cat. no. 6291.0.55.003, table 4

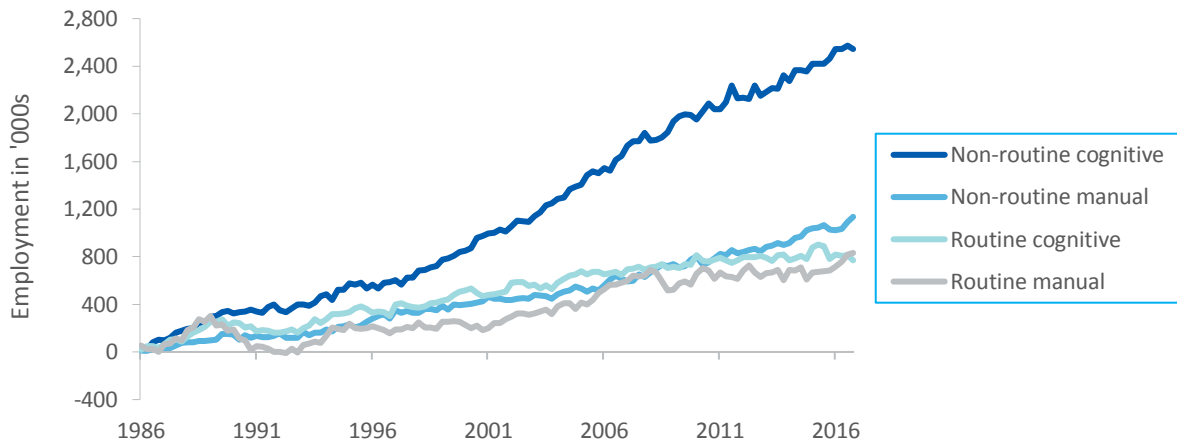
Most of the increase in non-market services employmentⁱ over the last thirty years has been in the health care and social assistance sectors. Factors including low trade exposure and demographics — including rising incomes and population ageing — have led to higher demand for non-market services.

One way to look at the changes in the Australian workforce is to classify the skills required in a job into cognitive or manual and also into its level of routinenessⁱⁱ. The composition of the workforce by skill type has changed markedly since the mid 1980's (Figure 2). The majority of employment growth has come from non-routine cognitive jobs in sectors such as healthcare, education and professional business services (e.g. IT, engineering and design). The increase in non-routine cognitive jobs may be explained by the fact that these type of jobs tend to be more difficult to automate as they require creativity and the ability to solve non-routine problems (8). Non-routine manual jobs have also contributed to employment growth in sectors like healthcare (e.g. nursing) and hospitality.

ⁱ Refers to services that are free of charge or at prices that are well below the cost of producing the service and typically provided by or heavily subsidised by governments. Examples include health care and education.

ⁱⁱ Cognitive skills are those that include the ability to process and apply knowledge, to analyse and reason, and to evaluate and decide. Routine cognitive tasks generally follow well-understood procedures (e.g. bookkeeping and clerical work). Non-routine cognitive skills are those that require high levels of analytical capability, intuition and persuasion. Non-cognitive/manual skills are required in occupations such as construction, transportation and repair.

Figure 2: Employment by skill type, cumulative change since 1986



Source: Reserve Bank of Australia

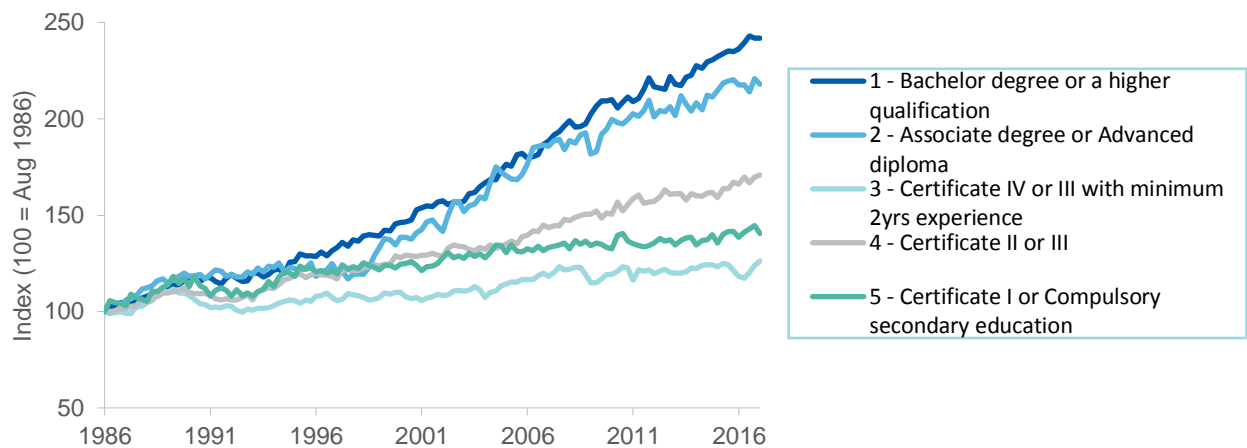
Contrastingly, employment growth in routine jobs (manual and cognitive) has been slow as these jobs are more susceptible to labour-saving capital investments such as the machinery and tools used in construction to increase productivity.

Growth in high-skilled jobs has dramatically outstripped growth in all other jobs over the last 30 years (Figure 3). Employment in the top two skill levels (skill level 1 and 2) — comprising primarily managers, professionals and technicians — has more than doubled. This trend is expected to continue through as technology and globalisation continue shaping the Australian economy.

Workers that are most susceptible to dislocation from ongoing technological change are low skilled workers (skill level 4 and 5). An inability to relocate to growing regions and/or reskill to transition into jobs that are more non-routine and cognitive will increase the risk of this cohort becoming structurally unemployed and not transitioning to other sectors of the economy.

Emerging technologies are challenging the adequacy of skills and raising the importance of interdisciplinary education and research, and clearly outlining the need for workers to be more open to the need to upskill and engage in lifelong learning. Digital skills and skills that complement machines are increasingly important for workers.

Figure 3: Employment growth by skill level, 1986 to 2017



Source: ABS cat. no. 6291.0.55.003

****Skill level** is defined as a function of the range and complexity of the set of tasks performed in a particular occupation. The greater the range and complexity of the set of tasks, the greater the skill level of an occupation.

Concentration in non-market services and digital industries

The Australian economy is becoming more knowledge-intensive and services-based. Within the trend to services, non-market services and digital industries are growing particularly quickly.

As noted earlier, most of the increase in non-market services employment has been in health care and social assistance. In many outer metropolitan and regional centres, this industry has been responsible for most employment growth over the last ten years.

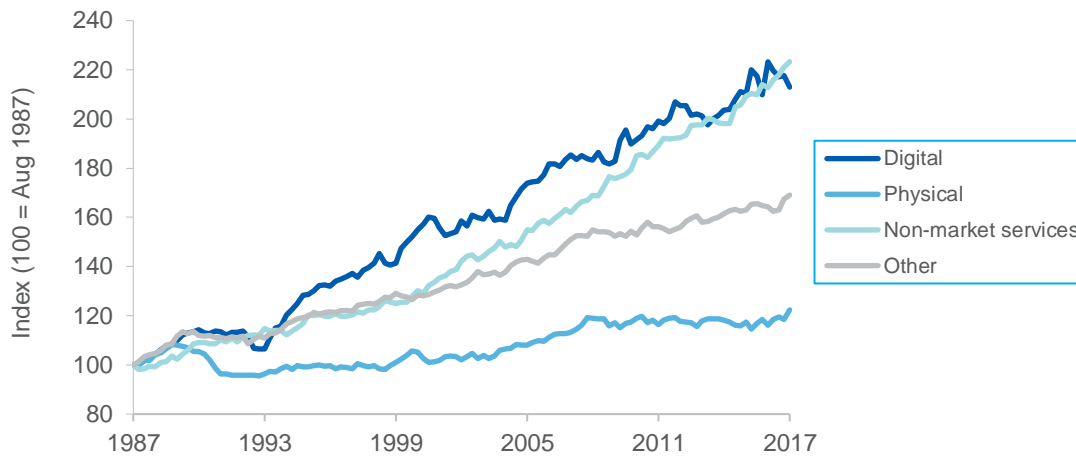
The impact of three long-term trends has contributed to the rise of non-market services in the economy. First, demographics including rising incomes and population ageing are driving higher demand for health and education services. Second, the proportion of automatable tasks within these industries is lower as associated occupations involve a higher proportion of non-routine tasks. Third, non-market services have low trade exposure and are not as affected by the competitive pressures from globalisation.

Employment in digital-intensive industries is also growing stronglyⁱⁱⁱ (Figure 4). Industries where the main output can be easily provided in a digital form, and readily delivered anywhere in the world, are embracing and being complemented by technical advances. As technology costs have fallen, the demand for digital outputs and the workers required to produce them has increased. Digital industries are also 60 per cent more likely to invest in

ⁱⁱⁱ Digital industries are classified as the Information, Media & Telecommunications Services, Finance & Insurance Services, Professional, Scientific & Technical Services and Administrative & Support Services given the outputs of these industries are more able to be digitised.

new technologies and infrastructure (9). These industries are also less susceptible to automation.

Figure 4: Employment growth by industry



Notes: Seasonally adjusted
Source: ABS cat. no. 6291.0.55.003, table 4

The confluence of technologies such as mobile, cloud, social, and data analytics is accelerating the pace at which today's businesses are evolving. Technological advances and increasing digitisation are profoundly changing global labour markets and the wider economy. However, Australian businesses rank in the middle of the pack of advanced economies on a number of digital engagement indicators (10). In addition, McKinsey found that the rate of digitisation in Australian industries is uneven—knowledge-intensive industries like financial and professional services lead while construction and agriculture have low levels of digitisation (11).

Technological change is not only creating new jobs but also the way existing jobs are performed. A recent study shows that 71 per cent of the total expected reduction in work time will come from people doing different tasks within the same job and completing fewer manual and routine tasks. For instance, accountants increasingly need strong analytical skills as more routine tasks are performed by computers; teachers will have more time to interact with students due to new learning programs and platforms and increasingly automated grading (5).

A major challenge for Australia is ensuring that the expected transformative breakthroughs such as in artificial intelligence, robotics and the Internet of Things—that are yet to be fully exploited—benefit all industries across the economy. In particular, supporting those industries of competitive strength and strategic priority to take advantage of the benefits provided by emerging technologies is crucial to stay competitive and/or find better ways to compete internationally.

Regional impacts

While technological change underpins economic growth and raises productivity, it also may bring structural change and labour market disruption. Australia is well placed to capitalise on emerging technologies with strong institutional frameworks, a highly skilled workforce, world-leading scientific research, global trade and investment.

Technological advances are likely to continue to improve standards of living in important and unforeseeable ways. However, the transition will create challenges for those employed in adversely affected industries and regions. Workers in these industries or regions may experience periods of unemployment and require retraining or reskilling in areas of job growth. There is a need for governments to support workers, industries and regions to transition and take advantage of emerging opportunities.

As noted previously, there has been a structural shift away from industries such as manufacturing, agriculture and, more recently, mining towards service-based industries. For agriculture, technology has greatly increased the productivity and competitiveness of farms but led to less employment in that sector. Problems can occur when these shifts result in business impacts leading to job losses that are not able to be readily absorbed by the local economy and there are limited alternatives for transition.

Regional economic performance in Australia has been uneven and the ability of regions to adapt depends on a range of factors, including: skills and education of regional workforces, the age profile, underlying economic conditions, distance from major cities, access to infrastructure and services, financial resources, availability of natural resources and industry diversity. The Australian Government has a broad approach to manage transition which includes monitoring emerging vulnerabilities and adaptive capacities of regional economies, and the consideration of possible early steps that can be taken to better equip workers and affected regions embrace new opportunities. State, territory and local governments as well as business also needs to be aware of the possible impacts of economic transition.

The role of the Department of Industry, Innovation and Science

The Australian economy is always undergoing change, and rapid technological advances is just one of the many forces impacting local businesses and industries. Attempts to slow disruptive change will make Australians worse off. Instead Australia needs to take advantage of the opportunities new technologies and innovation present and to drive change in our areas of competitive advantage. Helping to promote the swift adoption of new and emerging technologies will also help mitigate some of the negative impacts of technological change. A fast growing economy is the best way to manage the risks of technological change. To meet the challenges and take advantage of the opportunities created, Australian businesses must be innovative, adaptive and digitally capable.

The department works closely with industry, business, the science community and other stakeholders, and across other governments to help build a globally confident and outward looking Australian economy through: supporting science and commercialisation; growing business investment and improving business capability; and simplifying doing business. Supporting businesses in this way helps them adjust to disruptive forces and promotes flexibility throughout the economy.

Supporting science and commercialisation

Commercialisation transforms ideas and research into marketable products and processes. A business environment that facilitates the translation of new ideas and technologies into commercial activity encourages entrepreneurship, employment growth and improves business competitiveness. According to OECD indicators, Australia's performance in knowledge creation is above average. Australia is a world leader in a number of research areas such as biomedicine, astronomy and quantum computing, and has many areas of strength. Both maintaining these strengths and addressing weaker areas requires continued Government support. Evidence also suggests that there is room for improvement in translating and commercialising Australia's strong research base (12).

Launched in December 2015, the National Innovation and Science Agenda (NISA) recognises the importance of science, research and innovation as a long term driver of economic prosperity and growth. NISA identified four areas of emphasis to catalyse change and deliver improved innovation performance over time. These are: culture and capital; collaboration; talent and skills; and Government as an exemplar. The Government is spending \$1.1 billion over four years to support 24 NISA measures which are at an advanced stage of implementation. NISA builds on the Government's \$10 billion per annum investment in Australia's science, research and innovation system, supporting Australian businesses and researchers to innovate and succeed.

A key aspect of NISA is to promote a culture of entrepreneurship and to encourage increased investment in innovative Australian businesses. Measures under the 'culture and capital' theme include tax incentives for early stage investors and new arrangements for venture capital investments. There are also new venture capital investment funds such as the \$500 million Biomedical Translation Fund, which is investing in companies commercialising biomedical discoveries and the \$200 million CSIRO Innovation Fund, which is making investments to commercialise Australian research.

In addition, the Accelerating Commercialisation element of the Entrepreneurs' Programme provides advice and funding to businesses taking novel products, processes and services to the world. The Incubator Support Initiative develops Australia's innovation ecosystem, including in regions, to improve the prospects of innovative Australian start-ups achieving commercial success in international markets. The establishment of new and expansion of existing incubators will improve the prospects of Australian start-ups by assisting them to develop their required market capabilities faster than they otherwise would and getting them in contact with top quality research, managerial and technical talent.

Skills

Skills need to be adaptable for workers to take advantage of the new job opportunities technological advances create. High-skilled jobs are necessary in a technology rich environment, enabling businesses to obtain the right skills and successfully adapt to technological changes. Skills in science, technology, engineering and maths (STEM) are seen as essential to interact with new technologies and many jobs in the fastest-growing industries require these skills. It is crucial for successful businesses to demand the right skills to ensure they maintain competitiveness. Evidence shows that Australia's most successful manufacturers, like the top global performers, tend to employ more workers with crucial STEM skills (13). Additionally, research by the Office of the Chief Scientist estimated that 65 per cent of economic growth per capita from 1946 to 2005 is due to improvements in the use of capital, labour and technological innovation made possible in large part by STEM (14).

Ensuring there are sufficient graduates in STEM fields is essential for business competitiveness and growth. Under the NISA, the Government has initially invested over \$34 million from 2016-17 to 2019-20 to encourage Australians to engage with STEM in study and work and \$13 million over five years to encourage more women to choose and stay in STEM related careers. This aims to support the broader goals of science and technology engagement in Australia by supporting wider community participation and inspiring excellence. Of this, the Inspiring Australia – Science Engagement Programme provides funding of \$22.57 million from 2016-17 to 2018-19 and ongoing funding of \$7.23 million per year from 2019-20 for a range of activities that will be delivered under the Inspiring Australia banner. This includes supporting young people to engage with STEM through initiatives aimed at schools and students. It is also helping develop skills in creativity, problem solving and critical thinking, which are also essential skills for the jobs of the future.

For example, Maker Projects grants support schools to create maker spaces in which they can provide hands on science and technology projects for students. Sponsorships Grants for Student Science Engagement and International Competitions helps Australian students participate in STEM competitions and events around the country and overseas. They also encourage engagement with science and technology by all Australians, through initiatives such as National Science Week, the Prime Minister's Prizes for Science and grants to support citizen science projects. These initiatives help all Australians to see technology and science as something they can pursue as an interesting, rewarding and valuable career, and support the development of digital and technical skills.

Business R&D and collaborative research

The Research and Development Tax Incentive provides \$3.1 billion in financial support to over 15,000 businesses to encourage research and development activities that might otherwise not be conducted and where the knowledge gained can benefit the wider Australian economy and lead to new, higher wage jobs. Business tends to underinvest in R&D because of an inability to capture all the benefits of their R&D for themselves and difficulties in financing due to the uncertainty around the likely success of an R&D project. The Incentive is the Government's primary mechanism to address declining rates of business investment necessary to underpin Australia's innovation, productivity and future economic growth.

Collaboration between businesses and researchers is also an important element that contributes to successfully commercialise new ideas and technologies. However, Industry-research collaboration is weak (12), in particular for small and medium enterprises (SMEs) as many may lack the capabilities and networks necessary to identify and engage high quality research services. To address this issue, the NISA also focuses on increasing collaboration between SMEs and researchers to foster the development of new ideas with commercial potential. The Government has expanded the Entrepreneurs' Programme to assist SMEs to collaborate with the research sector to access knowledge, engage with researchers and innovate.

Importantly, the Australian Government also encourages and facilitates industry participation in collaborative research through the Cooperative Research Centres (CRC) Program. It provides grants to foster high quality research and solve industry-identified problems through industry-led and outcome-focused collaborative research partnerships. Since its establishment in 1990, governments have committed over \$4.3 billion to support the establishment of 217 CRCs and 63 CRC Projects. Participants have committed a further \$13.7 billion in cash and in-kind contributions. The introduction of a CRC Projects element to the program in 2015 is providing opportunities for SMEs to build their capacity to grow and adapt in changing markets. In 2012 the Allen Consulting Group found that the program delivers a 3:1 return on investment, citing examples such as \$120 million in value added by the HEARing CRC technology used by Cochlear.

Science infrastructure

Science research infrastructure is a critical part of Australia's economic base. It enables the development of breakthroughs in knowledge and technology, solves problems for industry and maintains a highly skilled workforce. Importantly, it also sustains Australia's competitiveness and global relevance. For example, the Australian Government is investing \$520 million additional resourcing in the Australian Nuclear Science and Technology Organisation's Australian Synchrotron. Scientific research and innovation at the synchrotron spans a huge diversity of activities from medical and life sciences to advanced materials and engineering, and from earth and environmental sciences to accelerator science and synchrotron research methods. The facility also plays a vital role in training and education of our next generation of scientists and the scientifically aware.

Growing business investment and improving business capability

Within a global and increasingly digital economy, Australia's future prosperity and continued jobs growth relies on a diversified, flexible, resilient and dynamic economic base that can identify and adapt to new markets and emerging opportunities. An agile Australian economy will support the transformation of existing industries and the growth of new ones, enabling access to new markets and increasing competitiveness in new markets.

Digital capability

The adoption of digital technologies can lead to productivity gains through enabling efficiencies within business, automating processes, and producing better quality goods and services at lower prices. Businesses need to ensure they are digitally capable to remain competitive and continue to provide employment. It has been estimated that the adoption and use of digital technologies could contribute between \$140 billion to \$250 billion to Australia's GDP by 2025 (15). To succeed in a more digitally enabled and internationally competitive market, our businesses need to be innovative and digitally capable.

While many Australian businesses are well placed to embrace these opportunities, this capability is not universal. The rate of digitalisation in Australia appears uneven and dependent on by industry sector and business size (15).

The Digital Economy Strategy, announced by the Government in September 2017, will help provide a focus for the investment the Government is making in digital infrastructure and technologies. It will also provide a vehicle for advancing the development of digital skills, bolstering digital capabilities of businesses, unlocking the power of data and computing capability, and addressing new digital market access and regulatory issues. The Strategy will be released in the first half of 2018.

In November 2017, the Government also established a Small Business Digital Taskforce which will work to ensure that more Australian small businesses can thrive in an increasingly digital economy by identifying potential impediments to small businesses adopting digital technologies.

Digital infrastructure and platforms

A modern digital economy requires high quality digital infrastructure and platforms to meet the increasing demand for data collection, storage, transmission and analysis. The Jobs and Innovation Portfolio's science agencies support a modern digital economy by providing a range of digital technology solutions, ranging from robotics to digital infrastructure.

For example, CSIRO research contributes to the development of robotics, digital infrastructure and platforms, and 5G networks. In the area of space technology, CSIRO has secured access to the high performance NovaSAR satellite to contribute space enabled data analytics which will be available to the wider Australian research community. The data and associated projects will help develop technical and analytical modelling capabilities, monitor and analyse natural resource management and progress Australia's economic development through better and more informed policy and decision making.

Geoscience Australia is piloting a world-first technology in Australia and New Zealand: a second-generation Satellite-Based Augmentation System (SBAS). The second generation SBAS provides centimetre-level positioning accuracy – quite a leap from the metre-level currently available. When combined with on-ground operational infrastructure and services, SBAS overcome the current gaps in mobile and radio communications to ensure that accurate positioning information can be received anytime and anywhere. Positioning data is now fundamental to a range of applications and businesses worldwide. SBAS provide the highest integrity positioning information currently available and are used across the Northern Hemisphere. The two-year project is testing multiple positioning technologies across 10 different sectors.

Digital Earth Australia (DEA), delivered by Geoscience Australia, provides access to reliable, standardised and freely available satellite data that can be used to create new products for commercial purposes. This will generate new jobs and commercial opportunities, particularly in SMEs where such data was previously out of reach. For example, an SME might build and sell a mobile app to farmers combining paddock greenness data from DEA with rainfall forecasts. This would show farmers what to plant and when, and, as a crop progresses, how to estimate yield. For agricultural enterprises, this would translate into more efficient use, higher output, increased profit and downstream jobs. There is significant opportunity for Australian businesses to quickly develop products using DEA and gain comparative advantage internationally.

Growing competitive industries

Strengthening industry competitiveness and diversification will be key to driving future productivity growth in developing new industries based on emerging science and technologies. This has the potential for employment growth, higher incomes and to maintain our living standards especially where Australia's highly skilled workforce, natural resources and strong international reputation has created a strong competitive advantage.

The Industry Growth Centres Initiative is driving innovation, productivity and competitiveness by focusing on areas of competitive strength and strategic priority to underpin industry transformation. The six industry-led Centres are in advanced manufacturing; cyber security; food and agribusiness; medical technologies and pharmaceuticals; mining equipment, technology and services; and oil, gas and energy resources. The Centres are taking action on key issues such as increasing collaboration and commercialisation, enhancing management and workforce skills, optimising regulatory environment, and improving businesses international engagement in global supply chains. Each Centre has a sector competitiveness plan which sets a 10 year vision addressing these key issues.

A focus of the Centres is to improve the development and adoption of technologies by identifying knowledge gaps associated with emerging technologies. Knowledge priorities identified include developing and adopting technology and systems associated with automation and digitisation.

Complementing the work the Centres are undertaking, the Government, through the Advanced Manufacturing Fund, is supporting the innovation of Australia's manufacturing sector by encouraging further research and investment in a highly skilled workforce—such as engineers and scientists—and developing business capabilities. To drive the development of new industries in high growth sectors in states affected by the wind-down of car manufacturing in Australia, the Manufacturing Future Growth Fund supports the transition of workers to new jobs, and helps businesses find new markets and invest in capital equipment. It also supports regions to invest in infrastructure projects.

To succeed, firms need to be able to identify and attract talent with the right skills. Through the Industry Growth Centres, the department is working to help understand future skills demand and engage business in supporting lifelong learning and the development of transferable skillsets. The Cyber Security Growth Centre is engaging with Skills Australia to influence VET reform in the sector. The Oil, Gas and Energy Resources Growth Centre is undertaking ongoing work to identify and support workforce skills mapping of the energy sector to identify gaps in skills and opportunities to support the industry. Similarly, the Medical Technologies and Pharmaceuticals Growth Centre has identified gaps in management and workforce skills and developed strategies to address these gaps. It has also jointly funded the Industry Mentoring Network in STEM to bring together mentors and mentees to develop industry learning partnerships and commercialisation skills.

The department also supports businesses to attract the skills they need through the Ribit program. Ribit is a free online marketplace underpinned by a matching algorithm developed by CSIRO/Data61. It connects university students in STEM and related fields to work opportunities with innovative companies. The service is delivered through in-person job matching events (which follow a “speed dating” format) as well as the online platform.

The Entrepreneurs’ Programme supports and builds industry competitiveness. It helps build connections between businesses and researchers, accelerate the commercialisation of novel products, processes and services, and supports innovative start-ups to grow internationally. The programme includes support to improve management capability, in recognition of the important role leadership plays in business competitiveness. This includes advice and support to engage digitally, improve productivity and competitiveness, and access global markets.

The emergence of technologies such as artificial intelligence, robotics and the Internet of Things is optimising operations and linking manufacturing processes along the whole global value chain. Improving Australian businesses’ place in global manufacturing requires aligning digital systems with world-leading best practice to improve interoperability with global partners. The Government has established the Prime Minister’s Industry 4.0 Taskforce (the Taskforce) to lead a united front on the adoption of Industry 4.0 and provide recommendations to Government across five key work streams: security of networked systems; support for SMEs; standards; testlabs; and workforce education and training. The Taskforce has undertaken a collaborative approach and has signed a formal cooperation agreement with its German counterpart, Plattform Industrie 4.0. Building on Taskforce recommendations, the Government has used its platform at multilateral fora to advocate for the development of global interoperability standards and reference architecture models. Government will also provide funding to establish Industry 4.0 testlabs across Australian educational institutions. The department has a leading role in implementing the Taskforce recommendations.

Northern Australia is one of the few regions with proximity to Asia’s emerging markets and has potential for growth in sectors like agriculture and resources. Investing in critical economic infrastructure is an important part of connecting business to markets and lowering transaction costs to ensure the north can operate as a trade gateway. The \$5 billion Northern Australia Infrastructure Facility (NAIF) supports the construction of northern Australia’s economic infrastructure to underpin economic growth and stimulate population growth. It does this by providing finance for projects of public benefit and which are unlikely to proceed, or will only proceed at a much later date, without the NAIF’s assistance.

Simplifying doing business

The Australian Government plays a key role in ensuring that the business environment enables businesses to compete, innovate and take up new technologies. While regulatory practices in Australia are robust and well regarded globally, it is important for Australia to

have regulatory frameworks and digital services that foster business innovation and leverage opportunities to improve our global competitiveness. Reducing inefficient regulation and ensuring that regulatory frameworks are fit for purpose will support businesses to innovate and grow, while allowing new business and employment models to emerge. This will boost productivity and jobs, and enhance Australia's international competitiveness.

As part of the broader Australian Government approach to regulatory reform, the department is working to make it easier to start and grow a business in Australia through the National Business Simplification Initiative (NBSI). The NBSI is an agreement between federal, state and territory governments to work together to reduce the complexity of regulation for business, simplify the process of complying with regulation, and make it easier for businesses to deal with governments by providing better digital services. This will save businesses time and money. The department has been working with other agencies to examine the barriers to small businesses taking on their first employee.

Through the NBSI, the department is also working with other Commonwealth agencies and state and territory governments to progress regulatory reform, including reform opportunities that will support innovation and the adoption of new technologies. As part of this collaboration, the Council of Australian Governments (COAG) Industry and Skills Council agreed in August 2017 on a set of principles to support a nationally consistent approach to regulating technical innovation and disruptive business models. The principles will assist all jurisdictions when considering their regulatory responses to disruption and, by extension, labour market disruption.

The Government has allocated \$300 million to a new Small Business Regulatory Reform Agenda for state and territory governments that reduce regulatory burden for small businesses. The department is working closely with The Treasury to provide input to their consideration of proposals.

One of the objectives of the Industry Growth Centres Initiative is to identify high priority regulatory reforms across all levels of government and industry self-regulation to facilitate the adoption of digital technologies. Progressing these regulatory reform opportunities will also contribute to the NBSI goal of making it easier to do business.

Lastly, the Government is working to improve intellectual property (IP) arrangements by ensuring they provide the flexibility needed for a modern economy. An important mechanism for this is through implementing recommendations from a recent Productivity Commission review of IP. Key priorities include aligning the Australian inventive step law for patents with international best practice, and reducing regulatory burden on businesses by phasing out innovation patents. Reforms such as these will help to ensure that Australia remains globally competitive.

Conclusion

The Australian economy is constantly changing and while it is difficult to precisely predict how emerging technologies, along with the other major trends, will change businesses and industries, attempts to slow change will make Australians worse off. The negative impacts of technological change can be offset by promoting the swift adoption of new and emerging technologies and assisting workers and firms to adjust. The department works closely with industry, business, the science community and other stakeholders to facilitate the transformation of industries, encourage the adoption of emerging technologies and build an awareness of the changing skills required to drive productivity and economic growth. This will help ensure Australian businesses and workers are better equipped to adjust to disruptive change and promote flexibility throughout the economy.

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