AIIA Skills for Today.
Jobs for Tomorrow

aiia
australian information industry association

About AIIA

The Australian Information Industry Association (AIIA) is Australia's peak representative body and advocacy group for those in the digital ecosystem. AIIA is a not-for-profit organisation that has, since 1978, pursued activities to stimulate and grow the digital ecosystem, to create a favourable business environment and drive Australia's social and economic prosperity.

AIIA does this by: providing a strong voice on policy priorities and a sense of community through events and education; enabling a dynamic network of collaboration and inspiration; and curating compelling content and relevant information.

AIIA's members range from start-ups and the incubators that house them, to small and medium-sized businesses including many 'scale-ups' and large Australian and global organisations. We represent global brands including Apple, Adobe, CISCO, Deloitte, DXC, Gartner, Google, IBM, Infosys, KPMG, Lenovo, Microsoft and Oracle; international companies including Optus and Telstra; national companies including Ajilon, Data#3, SMS Management and Technology and Technology One. While AIIA's members represent around two-thirds of the technology revenues in Australia, more than 90% of our members are SMEs.

Our national board represents the diversity of the digital economy; more detailed information is available on our web site.

Acknowledgements

AIIA would like to acknowledge the contribution of members to this research, including through their participation in AIIA Special Interest Groups (SIGs).

AIIA would also like to recognise the contribution of Futurist Shara Evans who has actively participated in a workshop and multiple conversations shaping examples of the jobs of the future.

Further Information

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1. Overview

Whether you are the optimist that looks to the future of work augmented by automation, robots and AI as the panacea for opportunity or subscribe to the more pessimistic view that automation will disrupt and displace jobs and the people in them, both require essentially the same response: the need to build the human and workforce capabilities and skills required to exist in our modern digital age.

Unlike previous industrial revolutions in which education, training and labour market systems adapted over time to advances in technology, this current 'Fourth Industrial Revolution' commands a more urgent response. Preparing for the jobs of tomorrow means we need to start building the skills we will need today.

While history shows that technology has and continues to be a significant driver of job creation this does not mean we afford to be complacent this time round. In writing this paper the Australian Information Industry Association (AIIA), the industry body representing Australia's technology industry – the sector that is driving both the change and developing the solutions for our future, aims to tackle this head on.

With the aim of facilitating the development of appropriate action plans in response to the impact of emerging technologies on the existing labour market AIIA focuses on three areas:

1. Identifying the technologies impacting Australia's core industries and the new jobs and roles that will emerge to serve them. We speculate about the new job opportunities that have emerged or are on the horizon, which jobs may be lost and where transition planning is required.
2. Identifying the skill requirements for these jobs including the evolution from existing skills sets and the increasing importance of digital literacy; and
3. Surfacing priority policy issues relevant to planning and preparing for the workforce of tomorrow:
    a. digital inclusion;
    b. transition arrangements as jobs of the future emerge;
    c. skills, education and training requirements; and
    d. the impact of changes in technology on existing industrial relations frameworks.

During the next 12 months, AIIA will engage stakeholders from industry, government, community groups and more, to investigate these issues further and help facilitate the development of appropriate policy responses and plans for action.

In summary, this paper is about starting a serious and focussed conversation across the broader community about how we best prepare to be workers in an ubiquitously connected and digitally smart world.

2. Time for a new narrative

An important learning from the last Australian federal election is the importance of getting the narrative 'right'. Despite both parties supporting messaging about innovation being key to Australia's competitiveness and growth, in the end what the electorate heard was - innovation means using more technology, technology means disruption, digital disruption means jobs are disappearing - 'I'm going to lose my job'.

Technologies including artificial intelligence (AI), robotics and machine learning are surfacing a fresh anxiety. Claims that nearly half of our modern-day workforce will be replaced by these technologies ignores that technology has been a major feature of modern economies and risks slowing its adoption, undermining the global competitiveness of local industries – and their ability to create new, sustainable, job roles.

This is not to say that technological change does not affect the labour market. Technology disruption, as it has through history, will displace some industries, companies and workers, particularly workers that are vulnerable, or older and lack the skills and flexibility to adapt. But The policy issues that arise to manage this are, arguably, no different today than at any time in the past. What is different, is that the pace of technology coupled with the rapidly contracting lag between when new technologies emerge and new skills are required demands a more urgent response.

This paper is about a new narrative – one focussed on the urgent need for a practical strategy and action plan for the future of jobs.

At the heart of this needs to be a positive and confident narrative about a future in which technology will be integral to the way we work and assurance that mass unemployment is literally not around the corner. While some jobs and people will be impacted more than others, new opportunities and new jobs will emerge.

Importantly, Australians need a narrative about how the impact of technology on how we work and the types of jobs we do will be managed. This includes a clear strategy for preparing for this future and specific policy responses to issues such as the adjustment and re-employment of workers who are displaced; concerns about digital exclusion; and more broadly an understanding of what skills will be required and how they will be developed.

This paper initiates a conversation that technology and digital leaders are driving. Working with governments, industry peers and educators, AIIA's goal is to help stakeholders, and the community generally, understand how best to prepare for a future workforce in which technology is an inevitable and integral part of how most work is done.

3. Technology drives growth

Technological progress is a fundamental driver of productivity growth and increased living standards in Australia.[1] According to Deloitte Access Economics' 2017 Australia's Digital Pulse Report, Australians are each better off by A$4,663 a year because of digital technology. Amongst other things, digital technology has increased the productivity of workers and businesses, improved the quality of products and services, and reduced prices.[2]

Over the next three years the contribution of digital technologies to the Australian economy is forecast to be $139 billion - some 7% of Australia's GDP.[3]

According to recent analysis by alphaBeta, automation alone has the potential to significantly boost Australia's productivity and national income—adding up to 2.2 trillion Australian dollars in value to our economy by 2030.[4]

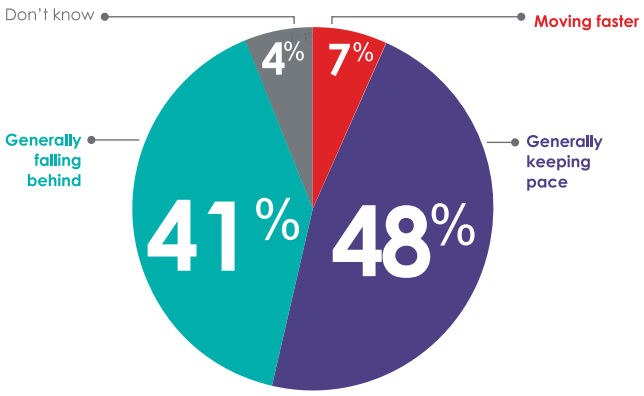
This scale of growth during a relatively short period is indicative of the significant role technology plays and will continue to play in Australia's economic landscape.

In a Galaxy Poll undertaken by the Australian Information Industry Association (AIIA) earlier this year shows that the Australian public's understanding of the importance of technology and innovation in Australia's future should not be under-estimated.[5]

Despite Australia's innovation narrative not resonating in the context of the 2016 federal election, AIIA's research finds that virtually all Australians (99%) believe that innovation and the development of new technology is important to Australia's future prosperity.

Confidence in Australia's performance in generating and adapting new technologies however, is more lukewarm. Many more Australians believe that Australia generally (government, businesses and consumers) is falling behind (44%) rather than moving faster than (7%) other developed countries in how quickly we innovate and generate new technologies.

How Australia compares to other developed countries in adopting new technologies



SOURCE: Australian Information Industry Association / Galaxy Poll, 2017

Only 43% of Australians think we are keeping pace with other developed countries.

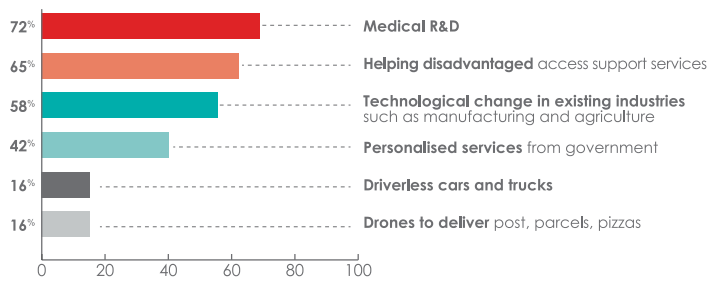
Claims that Australia is typically a leader in new technology adoption (as opposed to innovating and generating new technology)[6], were not supported in this analysis with many more Australians believing we are falling behind (41%) rather than moving faster than other countries (7%) in how quickly we adopt new technologies. Less than half (48%) believe we are keeping pace with overseas peers.

When asked where they would like to see Australia embracing innovation and technology more, the majority indicated investment in medical research and development to deliver cures and better health management (72%), helping people who are disadvantaged gain better access to appropriate support services (65%) and investing in technological change in existing Australian industries such as manufacturing and agriculture (58%).

Nearly all Australians (97%) feel positive about work and job opportunities in Australia in the future

SOURCE: Australian Information Industry Association / Galaxy Poll, 2017

Areas Australians would like to see embracing innovation and technology

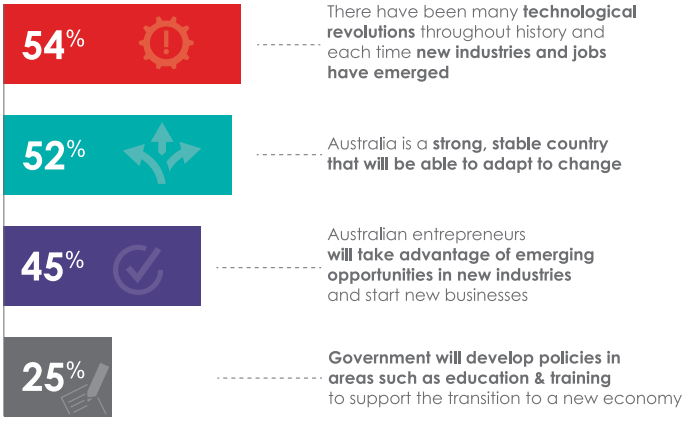


SOURCE: Australian Information Industry Association / Galaxy Poll, 2017

4. Technology creates jobs

Despite the concerns about the impact of emerging technologies such as Artificial Intelligence (AI), automation, data analytics, robotics etc, most Australians (97%) feel positive about their ongoing work and job opportunities.

The reasons why Australians feel positive about future work and job opportunities:



SOURCE: Australian Information Industry Association / Galaxy Poll, 2017

Australians believe that while there have been many technological revolutions throughout history, new industries and jobs have emerged (54%) each time. Over fifty per cent indicated a strong belief that Australia is a strong and stable country that can adapt to change (52%) and that Australian entrepreneurs will take advantage of emerging opportunities in new industries and start new businesses (45%).

AIIA observed that those aged 65 years and older are more positive about overall job prospects in the future than Gen Y – those aged between 18 and 34 years. This could reflect personal experience through previous eras of technology disruption – or the issue is less relevant as they move into retirement.

Only 1 in 4 Australians attributed their positive outlook in the future to the belief that the government will develop the right policies in areas such as education and training.

SOURCE: Australian Information Industry Association / Galaxy Poll

While a growth-oriented innovation narrative failed to resonate in the 2016 election, people still perceive the importance of technology and innovation to Australia's growth and largely feel positive about work and job opportunities in the future. This is not because they believe the government will develop policies in education and training to support the transition to the new economy but simply because history shows that technology stimulates new industries and jobs.

To best adapt to technological change, most Australians (76%) think that workers need to is to stay up to date with changing technology in their own industry, irrespective of what industry they are in.

This distinction between government-driven or individual accountability points to a lack of confidence, at a national level, in a clear vision, shared commitment and plan for how Australia will adapt to and leverage technology in the future.

The fact that history shows that technology has been a significant driver of job creation is important.

While the move from agriculture to manufacturing to information- based economies worldwide has cost jobs in some sectors, this has been more than offset by rapid growth in the technology, creative, caring and business services sectors - – typically with a corresponding increase in productivity, growth and global competitiveness.

In Australia alone, during the first 15 years of the 21st century the workforce increased by some 32% with job growth outnumbering job losses by a ratio of 10 to one. The loss of 220,000 jobs, mostly in the manufacturing and agriculture sectors has been more than compensated for by the 3.9 million jobs that have been created in sectors including mining, business services, social services and construction.[8]

Pessimistic claims that almost five million Australian jobs – around 40% of the workforce, will be replaced by computers in the next 10 to 15 years[9] are unhelpful on two counts. First, they fail to consider the new and additional jobs that will be created by new technologies. Second, they ignore the fact that job disruption and destruction have been features of economic development across the centuries.

The fact that previous fears about the impact of technology on jobs have led to nothing does not of course, mean it will be the same this time round or that we can afford to be complacent. However, experience as recent as the rise of computerisation and the Internet in the latter part of the 20th century which predicted mass displacement of millions of jobs and workers indicates this scenario is also unlikely.

McKinsey analysis indicates that while some work in almost all occupations will be automated, only a small percentage (5%) of jobs can be fully automated by adopting currently known technologies.[10] Amplifying this, alphaBeta research shows that rather than changing what jobs we do, automation is changing the way we do our jobs. Machines are predicted to take over an additional 2 hours of routine and manual work in an average Australian work week by 2030. Most of this change won't come from people changing jobs but from people doing the same job with fewer manual and routine tasks – typically tasks that are the most dangerous, tedious and the least likely to pay well[11] - and includes blue and white-collar jobs that involve mostly routine, repetitive and predictable tasks.

As it has in the past, the labour market will change in response to new technology – as well as other developments including demographics, consumer preferences and government policy.

The fact that each year more than a million Australian workers (almost one tenth of the workforce) change jobs (600,000 change industry, around 450,000 change occupations) [12] reflects the vitality and resilience of the modern workforce - a trend reflected worldwide[13].

Rather than mass unemployment predicated on a surplus of labour, shifts in demographics from an aging workforce and declining birth rates are likely to drive a deficit of human labour.[14] According to some analysts, roughly half the sources of economic growth from the last half century will evaporate as populations' age.[15] Assuming this is the case, emerging technological developments such as automation, AI and robotics will be key to compensating for some of the shortfall in human capital.

Further, history repeatedly shows the effective augmentation (rather than substitution) of human labour by technology – both directly and indirectly. The shift to automated teller machines for example, freed up staff and created new opportunities to sell a greater range of services.

Reductions in the cost of production of goods and services, only made possible through technology, has in turn increased supply, driven demand and ultimately created bigger and more complex supply chains powered by human labour. The automation of shopping through e-commerce coupled with increased access to information and public recommendations (of sites and products and services) has not just led to people buying more but also increases in retail employment - across the supply chain and in back office operations and logistics.[16]

Despite the change brought about by modern digital technologies – even within the last 20 or so years, our ability to adapt and optimise the opportunities of digital change is testament to human innovation and resilience on the one hand, and the imperative for growth on the other. But again, this does not mean we can be complacent. The pace and pervasiveness of technological change is a clear signal that focussing on a debate about whether we are on the brink of mass unemployment is pointless. Accepting that automation and new technologies will impact, to at least some degree, the nature of jobs and our workforce and developing and committing to a planned response is where attention needs to be focussed.

In addition to three quarters (76%) of Australians believing that workers need to stay up to date with changes in their own industry, irrespective of what industry they are in, over half (55%) also placed a high premium on workers undertaking self-learning and further education or accessing professional development through their workplace (53%) to adapt to technological change. Quite a significant proportion – just over 50% also thought that workers need to be prepared to change careers or jobs as new roles emerge (51%).

Further, Australians believe that STEM skills – an understanding of science, technology, engineering and math subjects – are part of the answer. When it comes to preparing young people for the jobs of the future, Australians identified the need to improve education standards and the curriculum in STEM subjects (68%). Only marginally less important was the need for more workplace training and mentoring opportunities for students in secondary schools and at university (64%), and more relevant vocation and educational training programs (59%).

Australians, it seems not only acknowledge that change is coming but that they have responsibility themselves to adapt and that being more STEM literate to deal with an inherently more technological world is important. The fact that only one in four Australians (25%) believe that the government (this is government generically) will develop policies in areas such as education and training to support the transition to the new economy highlights the concern that there is no clear plan or confidence that this will be done.

5. Thinking ahead

Thinking ahead is important.

Although predicting what jobs will look like decades away cannot be done accurately, the next 10 to 15 years will see the use of data and analytics and technologies such as automation, AI, augmented and virtual reality and robotics increasingly integrate into the workforce – and at a much faster pace than we have experienced previously.

Predictions about which jobs will exist in the future may not be perfect but we can speculate, with a level of confidence, about some of the new types of roles and skill sets that will be required as these new technologies build momentum.

In the present context, this is important. Firstly, because we need to avoid unnecessary public anxiety about the impact of digital disruption on the availability of jobs. To build confidence about our future and the reality that is technological disruption, the community needs a positive and realistic narrative that resonates with them about where we are heading and how we propose to 'get there'.

Secondly, by articulating the sorts of jobs that are emerging or on the horizon we are better placed to prepare. This includes anticipating the scope, scale and priority of skills required and how these can be developed and delivered.

While ICT professionals have been largely driving the development of new technologies across a broad range of sectors and disciplines, workers across the board will need to embrace new digital and technological advances and opportunities to ensure all our industries remain competitive.

Sectors need to be thinking now about the technologies specifically impacting their businesses and the implications for skills development and workforce planning.

As a starting point, we select 10 key industry sectors, those growing fastest and slowest, and examine recent labour market trends and project them forward. This approach works relatively well for short-term predictions, and is also useful for identifying general trends over longer time horizons. We then make separate longer-term predictions about new technology trends and assess how this is likely to affect the labour market in these industries.

Importantly we speculate about the new types of job opportunities that have emerged or are on the horizon, which jobs may be lost and where transition planning is required. While the commentary is by no means exhaustive it provides the basis for constructive planning in response to further and some predictable technology developments.

5.1 Economy wide employment trends

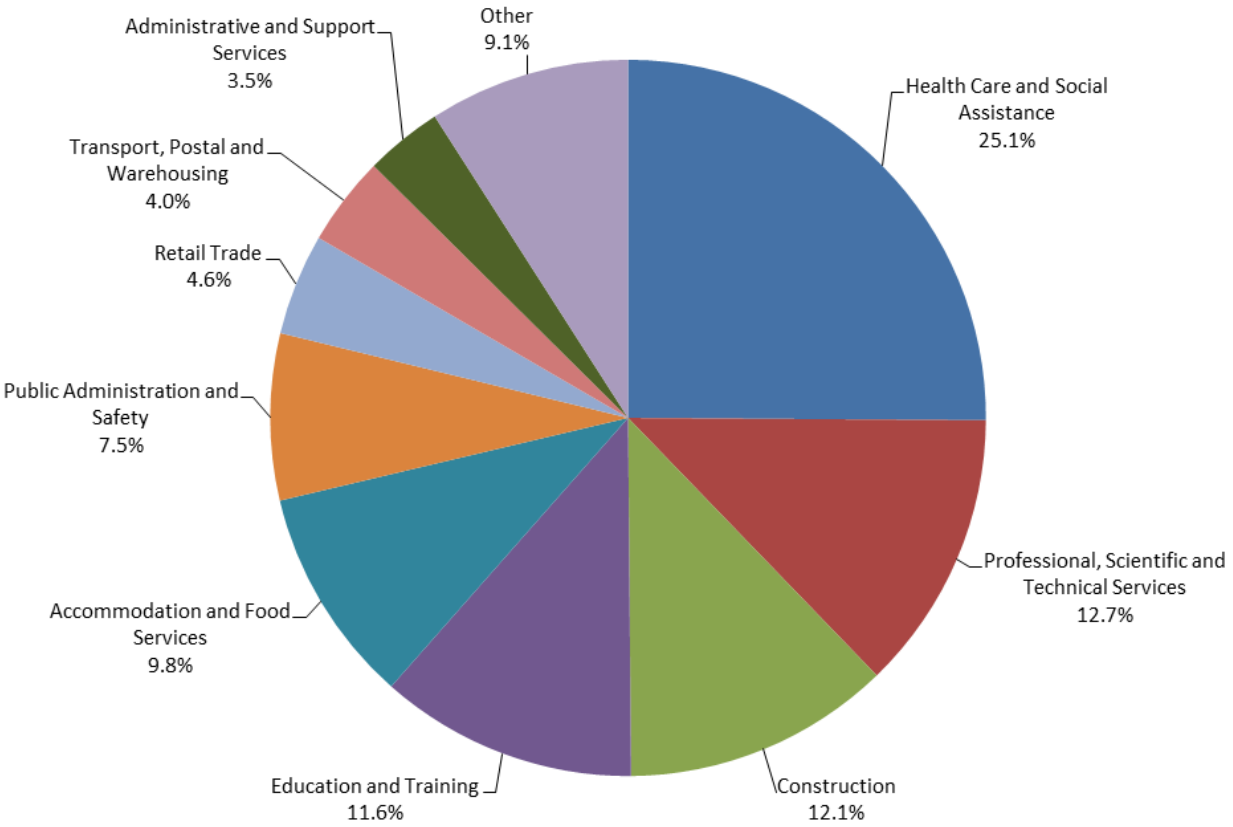
In a 2017 report, The Department of Employment projects total employment to increase by 948,400 (or 7.8 per cent) over the five years to May 2022[17].

The winners with the biggest projected employment growth are:
- Health Care and Social Assistance (up by 250,500),
- Professional, Scientific and Technical Services (up by 126,400),
- Construction (up by 120,700) and
- Education and Training (up by 116,200).

Together, these four industries are projected to provide 61.5 per cent of total employment growth over the five years to May 2022.

The non-winners with projected employment downturn are:
- Manufacturing (down by 38,300);
- Electricity, Gas, Water and Waste Services; (down by 9,000) and
- Agriculture, Forestry and Fishing (down by 2,400).

Share of projected employment growth, by industry - five years to May 2022.



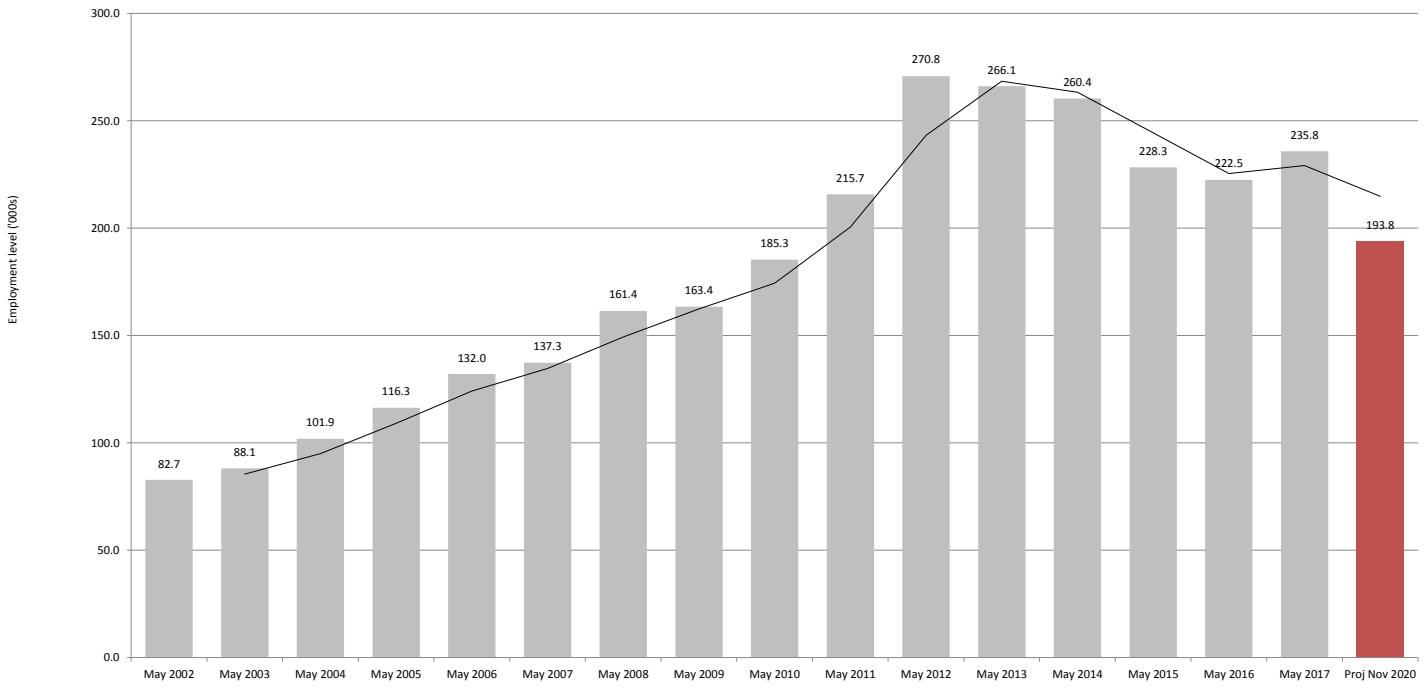
Department of Employment, Industry Employment Projections report 2017

5.2 Mining

After recording strong employment growth over much of the past decade, employment in the mining sector has declined. While technology has driven some of this, other factors include weakening demand from China; cost cutting by firms in response to a fall in the price of commodities; a peak in capital expenditure; and the transition of new mines from a construction to a less labour intensive operational phase.[18]

According to a recent report by the Department of Employment, employment in Mining is projected to grow by 5,600 (or 2.4%) over the five years to May 2022. While this is lower than the halcyon days of Australia's mining boom it is more positive than some earlier estimates. Employment growth in the industry is expected to be supported by increasing investment in exploration.[19]

Past and future employment levels - Mining



Department of Employment, Industry Employment Projections report 2017

TREND	JOBS	DESCRIPTION
USE OF AUTONOMOUS VEHICLES	• Central controllers • Pit patrollers • Fault diagnostic technicians	• Control and monitor autonomous vehicles • Manage how trucks operate in pits • Identify and resolve system/ equipment
USE OF AUTOMATION & ROBOTS	• Remote drill operators • Automated tool and robot cleaners and technicians	• Operate and control multiple drills remotely • Clean, service and repair automated tools/machinery
USE OF DATA ANALYTICS	• Data scientists	• Validate, interpret data
USE OF AUGMENTED & VIRTUAL REALITY	• Visualisation system designers and operators	• Control and monitor autonomous vehicle and robots • Build visualisation models for new sites, drilling techniques etc

The mining industry has a long history of using technology to extract resources more efficiently and safely. More recently this has translated to the use of digital tools and systems including big data and data analytics and AI to improve decision-making and enhance competitiveness. Automation and autonomous vehicles, including remote controlled drilling tools, loaders, haulers and trucks are used to improve the efficiency and safety of mining operations. Augmented and virtual reality is enabling simulated training approaches, robotic remote control and the ability to visualise new mine sites and drilling techniques even before they exist. In developing next generation systems and technology and removing the need for workers to be on-site, mining companies are reporting improved safety outcomes[20], increased productivity and a reduced operational footprint[21].

The use of automation and data is driving a need for specialists in computing, systems and diagnosis, and the upskilling of maintenance people to service and maintain the technology. People skilled in validating and interpreting data are needed to challenge traditional and/or existing operational and system behaviours.

While the new wave of data analytics and automation will change the employment landscape of the sector, potential job losses will occur over a long period of time, with other job opportunities emerging in the meantime.[22]

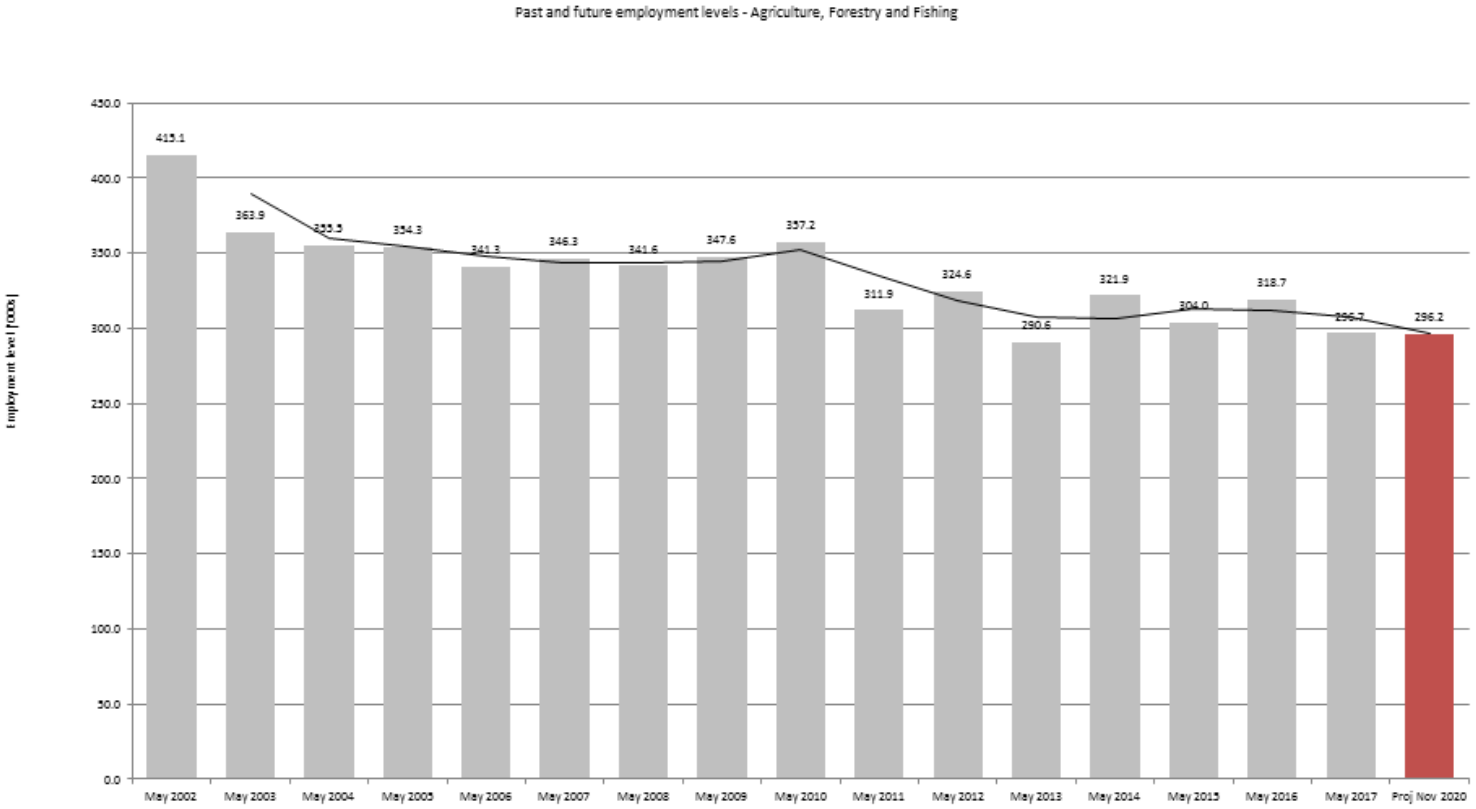
Existing jobs such as mine managers, production managers, operations and project manager roles will increasingly be assisted by new digital systems and tools.

Trades jobs (electricians, plumbers) and maintenance workers will need to apply their skills to new systems and equipment. Up-skilling to undertake existing roles with new tools and technology is already part of doing many of these jobs. While over time trucks and machinery will be replaced by autonomous vehicles, robots and automated tools, upskilling workers to supervise fleets of autonomous vehicles or remote machines will provide new opportunities for some.

5.3 Agriculture

Employment in the agriculture sector is projected to continue to decrease.[23] This is mainly due to an acute shortage in skilled labour with farmers ageing combined with uncertain returns and price volatility deterring new entrants.[24] Ironically while the contribution of agriculture to Australia's gross domestic product (GDP) has declined in relative terms, efficiency of the sector is high with Australia one of only 11 countries who are net exporters of food.

Unemployment due to technology is arguably old news for the farming and agriculture sector. With this new wave of technology - data analytics, AI, robots, drones and the Internet of Things, the sector has much to gain in terms of productivity improvements, reduced production costs, food provenance and environmental sustainability.



Department of Employment, Industry Employment Projections report 2017

TREND	JOBS	DESCRIPTION
USE OF AGBOTS (robots) & DRONES	• Robots as a Service • Drone operators and managers	• Provides a range of robots fit for purpose to specific agricultural functions/tasks. People will be required to market, monitor and manage these new services • Operate and manage drone fleets for specific and specialised agriculture/ primary industry functions
USE OF DATA ANALYTICS	• IoT Data readers • IoT sensor installers and maintenance workers • Data Scientists	• Analyses data collected from drones and robots and actions as required • Integrate data from a range of traditional data bases (weather, crops, rainfall etc) to inform decision making • Install and maintain IoT sensors and networks • Extrapolates and applies data from broader sources including from overseas and determines and applies best practice approaches

The proliferation of on-farm sensor technology using IoT, enables farmers to remotely monitor and capture data on soil moisture, crop growth and livestock feed levels. These can be processed in real time to analyse conditions and aid decision making to boost crop productivity and yields while also reducing on-farm costs.

Robots the size of lawnmowers can be used to move between rows of crops to monitor water levels and soil conditions, detect and remove weeds and even 'see' and diagnose bugs on plant leaves. Drones collect farming and environmental data as well as undertake controlled releases of herbicides.

While these developments change the nature of modern day farming and the typical profile of farmers they also drive potential for new employment opportunities and arguably, will attract new types of people into a career they would otherwise not have considered.

Current roles such as service technicians and mechanics will likely need to evolve their traditional skills to adapt to and support new equipment and tools. Roles such as drone operators, IoT sensor installers and maintenance workers will require a level of digital skills but these are not highly technical roles.

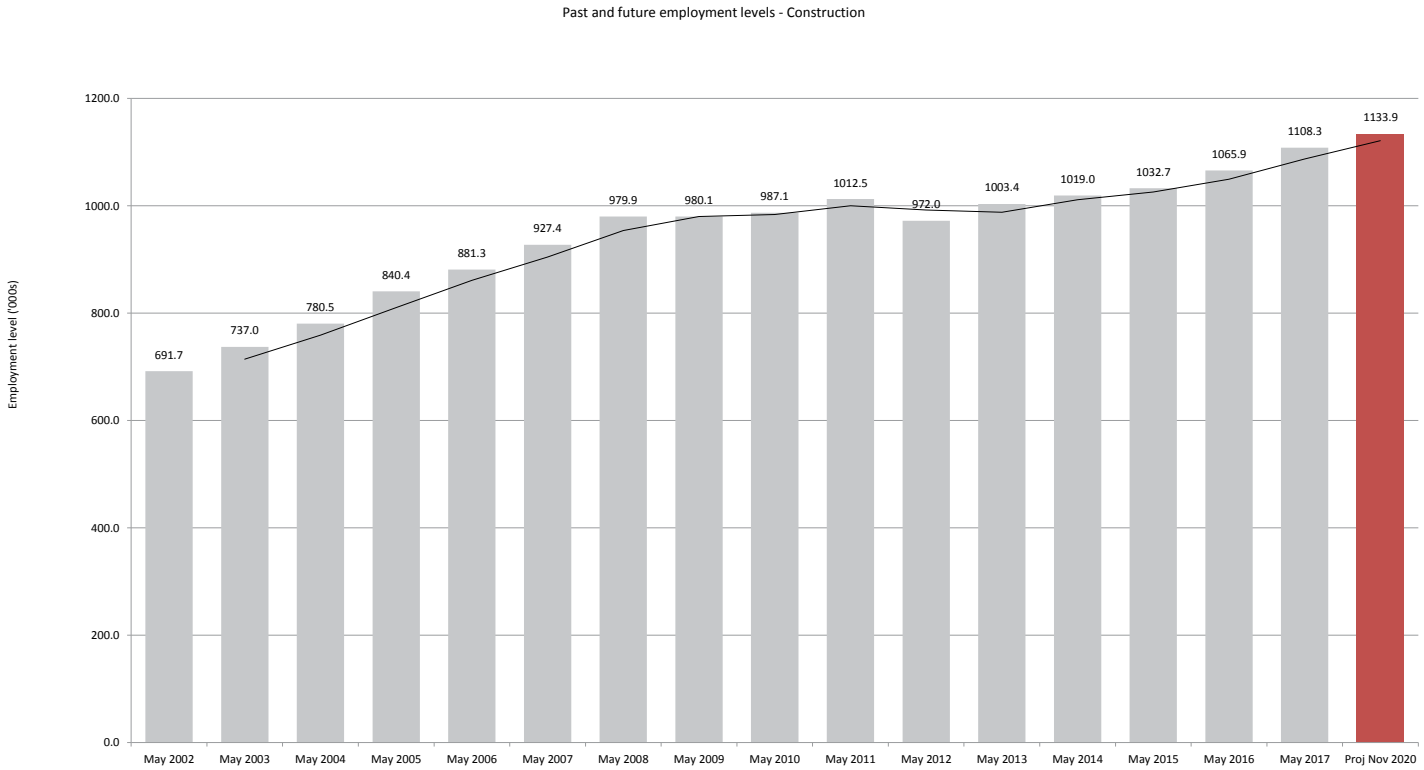
While IoT, RFID technology and AI will assist livestock management and food provenance, workers will still need to oversight production, execute and supervise crop and property management activities.

5.4 Construction

Employment in Australia's construction industry is projected to grow by around 10.9% over the five years to May 2022. Growth in residential construction employment is expected to be at a slower pace than over the past five years, while significant infrastructure investment is expected to underpin employment growth in the engineering construction sector.[25]

As the industry is dependent on physical outdoor labour, research and innovation has focussed on ways to reduce the risks presented by environmental conditions and improve the safety of workers. To this end drones are being introduced for difficult, dangerous or 'dirty' site inspections, to alert the need for maintenance and to deliver 'parts' to locations within sites.

Cheaper and faster 3D printers, including printers that can print multiple material types are delivering more versatile and sophisticated printed products. This includes innovations such as using refuse and 3D printers in combination to develop materials for home and apartment construction which simply need to be assembled onsite.



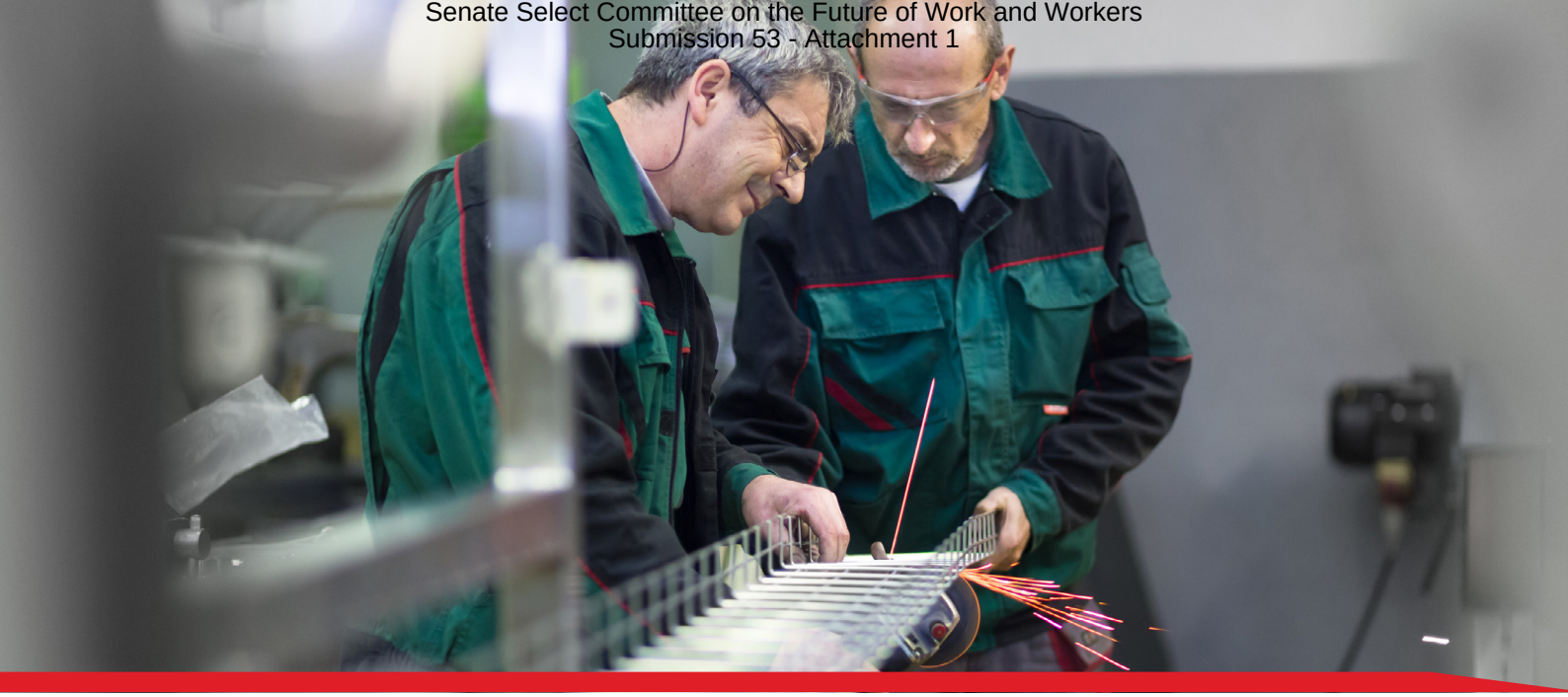
Department of Employment, Industry Employment Projections report 2017

TREND	JOBS	DESCRIPTION
 USE OF 3D PRINTING	• 3D Printer "Ink" Developers • Design Engineers • Maintenance Guys	• Develop and source material for printing different types of products • Designs printers for specific use or materials • Repair and maintain 3D printers
 USE OF ROBOTS & DRONES	• Drone Operators • Assembly Technicians • Robot resource managers • Robot repairers	• Control and program drones to carry out complex tasks such as site inspections, deliveries and maintenance • Oversees robotic systems and examines data feeds • Responsible for commissioning, software programming, maintenance and re-purposing or recycling of robotic parts • Different types of robots will require different expertise – which could also be assisted by virtual and augmented reality tools
 USE OF AUGMENTED & VIRTUAL REALITY	• Virtual and Augmented Reality Trainers • Office of the future design-ers • Augmented Reality Design specialists	• Provides training using augmented reality tools without the need to be onsite • Use technology tools to design office of the future models and systems • Provide expert design advice using augmented reality tools
 USE OF INTERNET OF THINGS	• Smart home handy advisors	• People who advise on, install and maintain home based IoT systems

Demand for products and materials that are more customisable and sophisticated provide new employment opportunities in product design and production, printer engineering and servicing.

Virtual and augmented reality is providing low-cost immersive environments where apprentices and trainers can meet virtually in any training situation with simulated construction projects and methods in purpose specific environments such as a worksite, factory or design studio. Using the same immersive technologies real time design decisions can be coordinated between architects, construction workers and clients – literally seeing and experiencing changes as they are made.

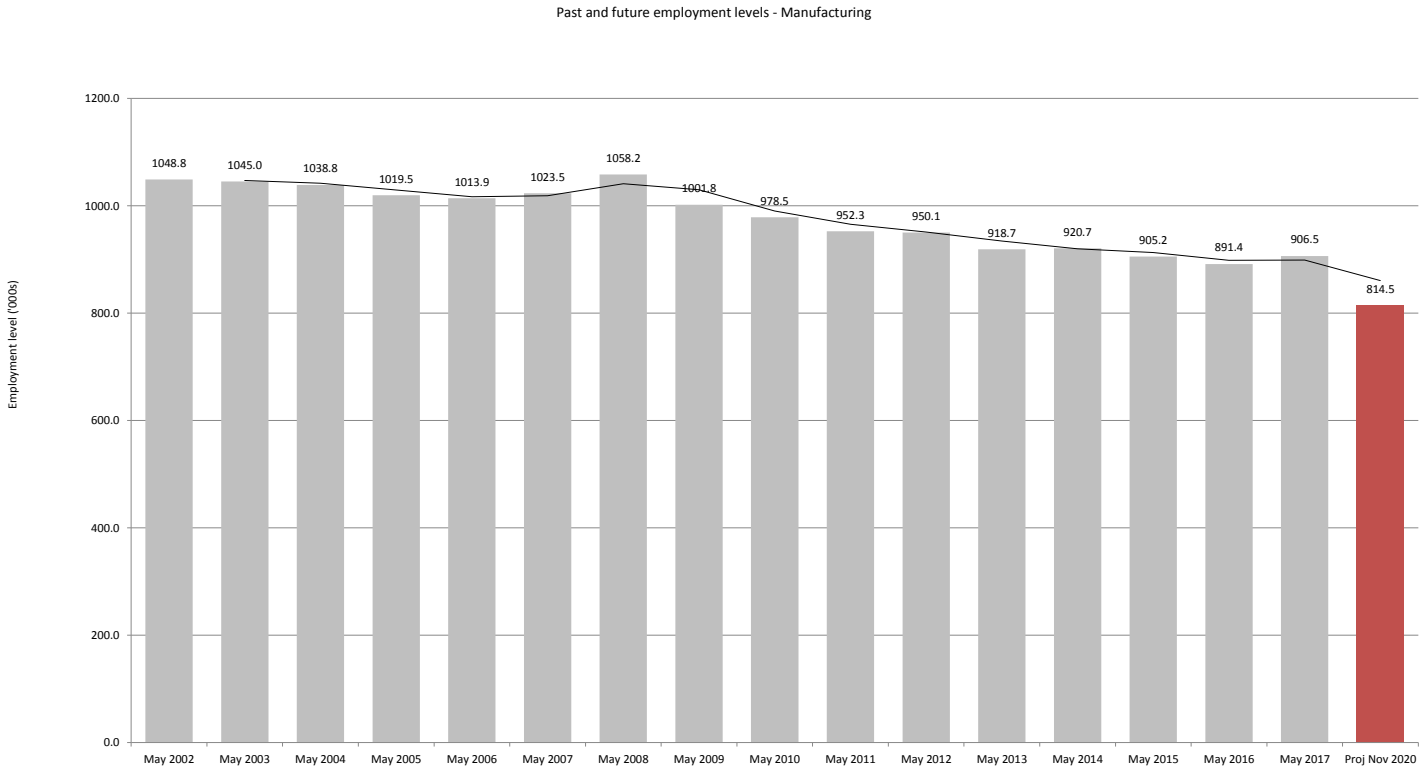
Jobs in construction are expected to grow. While some of these jobs require routine tasks, the work is typically not repetitive and predictable as individual jobs differ in nature and context. Automation is developing in areas such as aspects of bricklaying but carpenters, construction labourers, electricians, big equipment operators are essential in future job scenarios and are the core 'blue' collar jobs we know today. The key is keeping pace with technology developments such as 3D printing so that skills and expertise develop alongside these trends. Workers will need digital literacy to take advantage of technologies that improve efficiencies in client communication, design, billing and payments. As 3D printing makes construction cheaper across the board being able to use technology to maximise profit margins will be a key competitive advantage.



5.5 Manufacturing

The long-term decline in manufacturing employment is expected to continue, with employment in the industry projected to decline by 4.2% over the five years to May 2022. This decline is primarily driven by a projected fall in Motor Vehicle and Motor Vehicle Part Manufacturing.[26]

Major technologies impacting the manufacturing sector include AI, the Internet of Things, general automation, robotics and augmented reality.



Department of Employment, Industry Employment Projections report 2017

TREND	JOBS	DESCRIPTION
 USE OF DATA FROM INTERNET OF THINGS (IOT) TO IMPROVE EFFICIENCY	• Data analysts • Sensor network designers and installers • Data Transmission Optimizers	• Interprets the data and actions as required • Install, design and service IoT sensor networks • Ensures the flow of data is as efficient as possible
 USE OF ARTIFICIAL INTELLIGENCE (AI)	• AI specialists	• Train robots through inputting relevant data and guiding the process for more complex decision making as more data is available
 USE OF AUTOMATION & ROBOTS	• Automation manager • Fleet managers • Robots as a service	• Oversights automation processes and outputs • Operates and managers fleets • Provides a range of robots fit for purpose to specific manufacturing functions/ tasks. People will be required to market, monitor and manage these new services

Manufacturers are using sensors, controllers and smart, networked cameras or RFID readers to monitor and measure a range of operational processes. For example: to determine the amount of voltage used to produce a product, inspect parts with greater speed and accuracy and monitor and test the performance of equipment.

According to the International Federation of Robotics, the manufacturing sector is by far the leading user of automation in the workplace. According to AlphaBeta, process automation technologies are 'shouldering' the physical part of factory work with the result that those doing routine work such as packers or assembly-line workers are spending more time training and doing non-automatable tasks.[27]

Typically, roles in assembly, fabrication, and production have been moved offshore or replaced by technology. However, maintenance, installation and basic troubleshooting will be on the rise given the pervasiveness and boom of the internet of things where whole houses, offices and cities are connected.

Re-shoring manufacturing especially in the US as innovation and meeting customer needs suffer from the distance between manufacturing and design, and quality control, is also on the rise. According to PwC[28] new technologies are driving the return of manufacturing especially IoT, robotics, augmented reality and 3D printing closer to the source of delivery and demand.

Those engaged in routine, repetitive and predictable tasks such as assembly line work will likely move into higher value training jobs and operating and maintaining equipment, scheduling and supervising 3D printing runs and quality assurance roles.

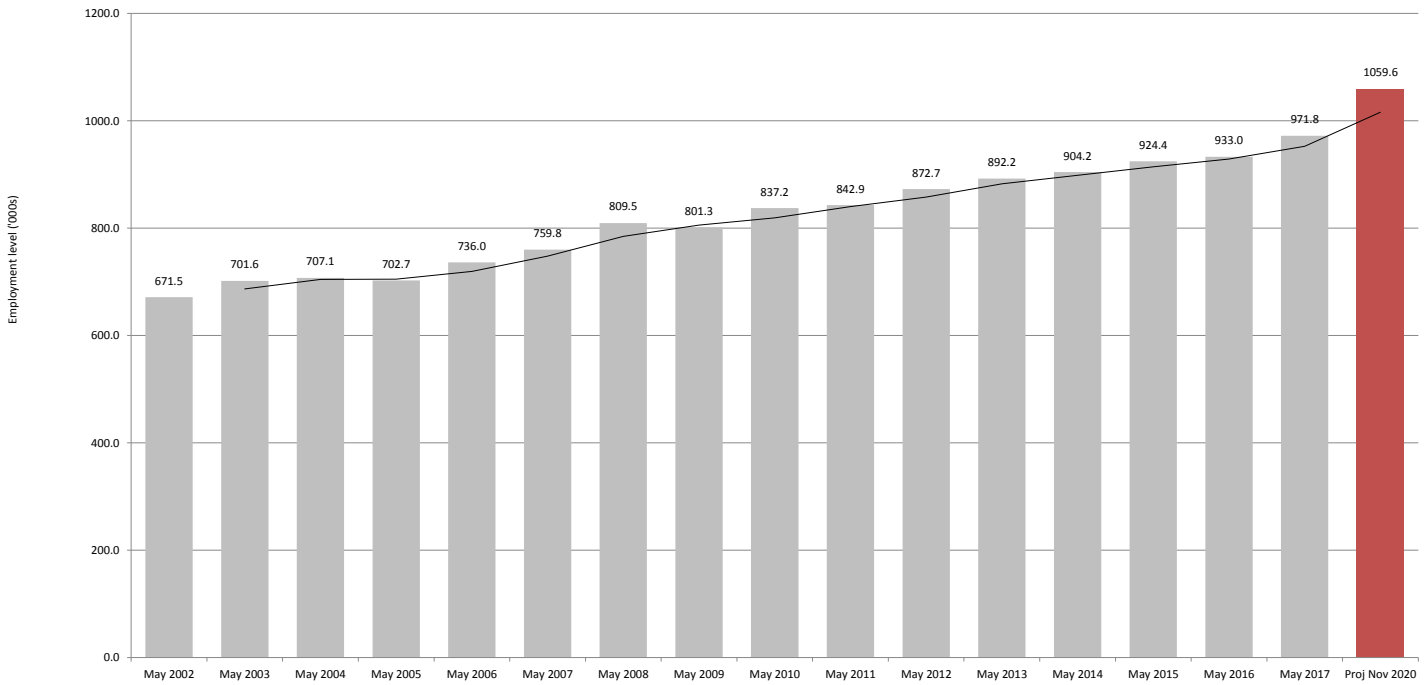
5.6 Education

Employment in Education and Training is expected to have the fourth largest increase by 2022 – an extra 116,200 new jobs or 12.0%.[29] This will be driven by above average growth in the school aged population, improving competitiveness in the international education sector because of the lower Australian dollar, and continuing growth in part-time workers and non-teaching staff.

Thinking ahead, growth will continue – and possibly more rapidly given increasing demand for new skills in response to new technologies and the focus on more agile skill acquisition.

With the anticipated increase in the numbers of people changing careers, re-skilling and up-skilling, experts[30] predict the rise of a new wave of full-immersion skill training centres/environments, or specialised 'Micro Colleges'.

Past and future employment levels - Education and Training



Department of Employment, Industry Employment Projections report 2017

TREND	JOBS	DESCRIPTION
 TECHNOLOGY SUPPORTED MICRO COLLEGES	• School Designers • Career Transitionists	• Develops tailored higher impact shorter curricula • Advises on pathways to move from one career to another
 TECHNOLOGY DRIVEN CONTENT DEVELOPMENT & DELIVERY (AI, virtual & augmented reality)	• Online Education Material Developers • Virtual Teachers	• Uses technology to develop new and smarter ways to present content such as AI to disseminate and breakdown textbook content into digestible "smart" study guides that includes chapter summaries, true-false and multiple-choice practice tests, and flashcards, etc. • Instead of class rooms, teachers work through a digital content platform that allows customised content delivery, practice exercises, and real-time feedback and assessment
 TECHNOLOGY DRIVEN CHANGES TO STUDENT ENGAGEMENT	• Digital Classroom Developers	• Creates the IT platforms that allow educators to design digital curriculum and content across devices, integrating rich media like video and audio, immersive augmented and virtual reality scenarios as well as self- or online-instructor assessment. Education is increasingly 'an experience'

AI's digital, dynamic nature also offers opportunities for student engagement that cannot be found in often out-dated textbooks or in the fixed environment of the typical four-walled classroom. Using AI and machine learning courses/curricula can be customised to meet individual learning needs and styles, monitor student engagement and performance and signal when targeted teacher intervention is required.

The combination of AI and machine learning can provide feedback to both students and teachers about the success of a course and iteratively incorporate improvements based on real time use and feedback. As well as assisting with keeping course material up to date, AI can enable repurposing content for different formats and learning modalities.

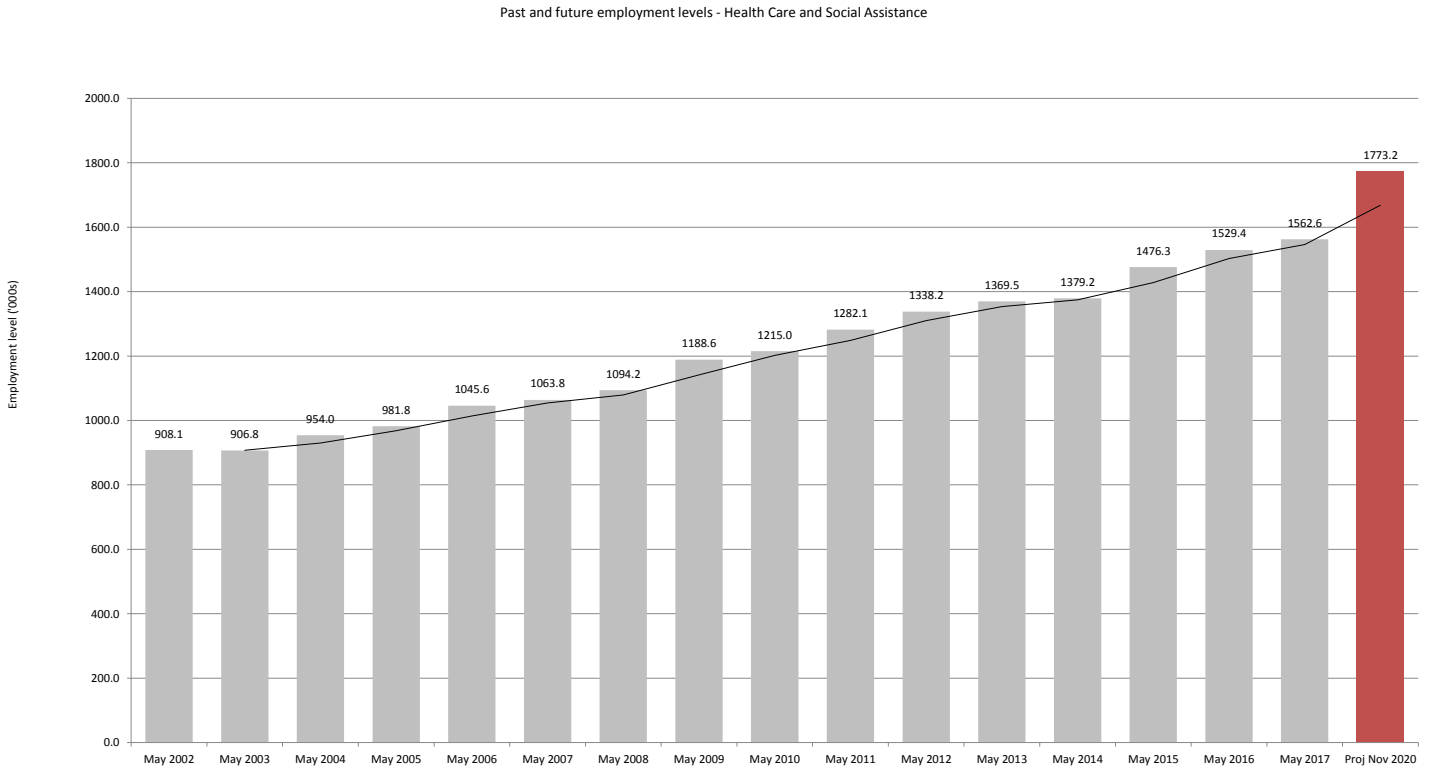
While it is hard to imagine a robot substituting for a teacher, there is a range of tedious grading and testing tasks that could be automated, freeing teachers up to interact with students or undertake professional development.

Although jobs in education are expanding the challenge is that there will be new ways to engage and teach through technology platforms and offerings. Educators will have to be more tech savvy and comfortable teaching from a distance and through a screen. Live and instant feedback are also likely to become the norm. These changes mean educators may need to reskill and adapt to a different teaching models and mediums.

5.7 Health

Health Care and Social Assistance is projected to make the largest contribution to employment growth - up by 16.1% by 2022 with 250,500 new jobs.[31] Australia's ageing population and increasing demand for childcare and home-based care services and full implementation of the National Disability Insurance Scheme underpins this growth.

The emergence of wearable devices and AI is empowering patients to self-manage their health and wellbeing. From monitoring temperature, blood sugars and blood pressure to cognitive coaching systems that analyse a person's daily movements, sleep and food data to offer tailored insights to maintain their health and nutrition, AI is informing better health decisions and flagging potential risks and ailments before they occur.



Department of Employment, Industry Employment Projections report 2017

TREND	JOBS	DESCRIPTION
 INCREASE ACCESS TO REMOTE CARE	• Portable equipment hardware engineers and manufacturers	• Develops and builds medical hardware that are smaller and requires less power
   USE OF WEARABLES, CLINICAL DATA & PREDICTIVE DIAGNOSTICS	• Digital/bio sensor engineer • Health data interpreter	• Develops sensors that track and monitor the body's functions and performance • Provides customer based health advice based on collation and interpretation of different personal health data sets
  USE OF PRECISION TECHNOLOGY & ROBOTIC ASSISTANCE	• Robotics engineers and manufacturers • Policy advisors	• Develops and builds robots and robotic devices to execute medical procedures • Advises on the risk/reward of the use of technology in healthcare

Remote patients benefit from wearable technology that perform diagnostics and monitoring as well as kits that allow medical practitioners to conduct tests and ultrasounds up to 1,000 kilometres away. New technologies in surgeries to augment precision medical tasks such as stitching small wounds to reduce scarring are also available. Other trends include automation in clinical data and predictive diagnostics and robots assisting in areas from nursing to hospital logistics to pharmaceutical dispensary.

While the nature of the health and aged care industry relies heavily on personal interaction, interpersonal and social skills and nurturing, and are therefore less exposed to automation, AI and robotic technologies are increasingly integral to assisting in a broad range of medical, surgical and general healthcare activities. As healthcare workers and medical specialists up-skill to keep with technological developments, new specialties and jobs are also emerging.

Roles such as case managers, nursing assistants and aged care assistants will grow alongside the aging population – irrespective of technology change. These are not technical jobs and do not require a university degree. However, in future they will be aided by data from wearable technologies and other sources. Digital literacy and ability to use technical devices and equipment will be an important part of these and many other jobs.

As roles such as billing managers, prescription dispensers and front office clerks decline with the integration of new technologies and software tools, workers will be freed up to transition into more case work roles, directly helping and interacting with patients and carers.

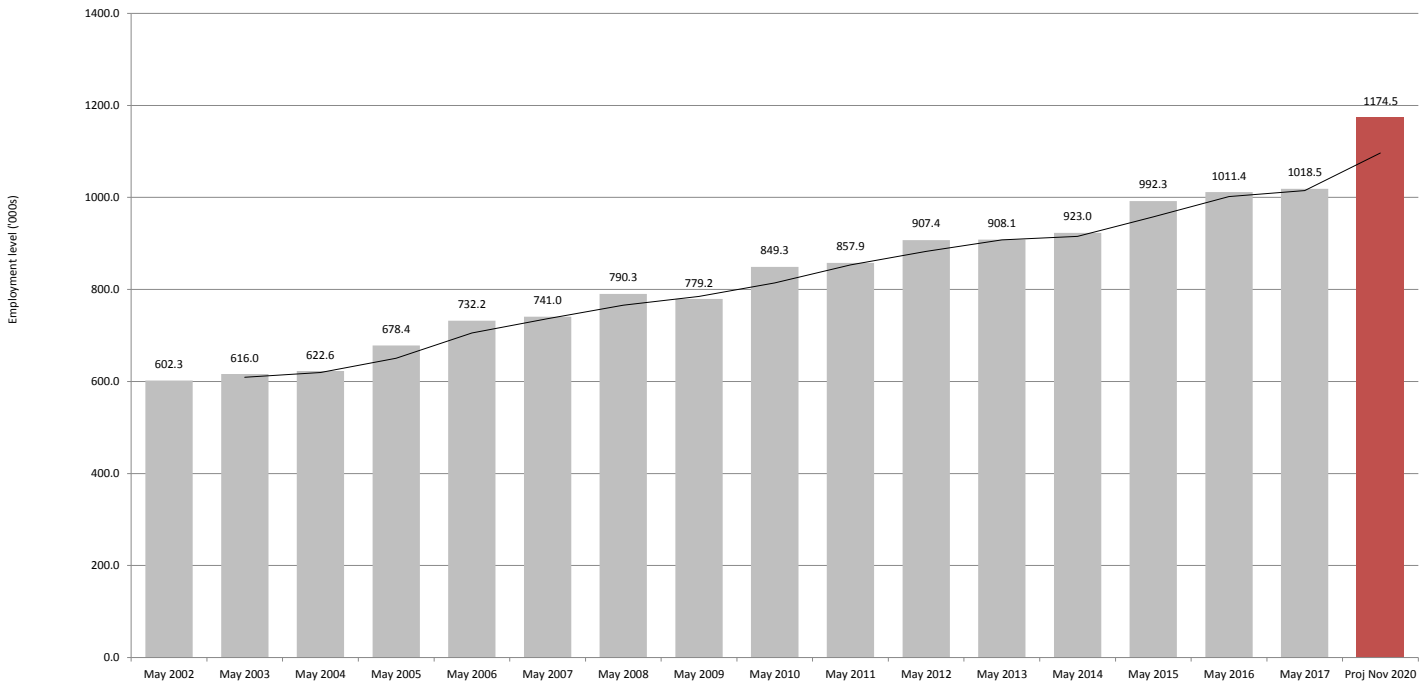
5.8 Professional Services

Employment in Professional, Scientific and Technical Services is expected to have the second largest increase of any industry by 2022. Jobs will be up by 12.5% or an extra 126,400 new jobs.[32] This is largely due to ongoing demand for the services of qualified and highly educated workers. Unsurprisingly within the sector, the highest employment growth is projected in the Computer System Design and Related Services as well as Architectural, Engineering and Technical Services.

Professions including scientists, accountants, advertising and marketing specialists, lawyers/solicitors, veterinarians, management and other consultants, photographers, architects, engineers and computer system designers are being impacted by number of technology trends.[33]

New technologies and the business models they spawn will drive a range of new professional, advisory and policy services. And as technology integrates into all aspects of how we live and work the need for new regulatory, legal, policy and compliance expertise will emerge. This includes experts in personal privacy, security and even identity management, human and robot workplace integrators, and OH&S advisors, new types of HR consultants and augmented reality design architects.

Past and future employment levels - Professional, Scientific and Technical Services



Department of Employment, Industry Employment Projections report 2017

TREND	JOBS	DESCRIPTION
DIVERSE EXPERTISE TO REGULATE TECHNOLOGY CHANGES	• Regulators, law makers, policy advisors • Personal privacy and security advisors	• Administrators that oversee the public interest and implementation of technology • Provides advice on managing personal privacy and security in an always connected world
UBIQUITOUS NATURE OF SOCIAL MEDIA	• Social media image monitors and improvers • Social media lawyers and mediators	• Advises on what types of posts, links and content can best promote personal branding • Settles disputes
NATIVE ADVERTISING	• Localisation Professionals	• Ensure company products such as advertisements are appropriate to their audience in different cultures and locations around the world
THE RISE OF THE SHARING ECONOMY	• 'Sharability' Auditors • Corporate Sharing Managers	• People who assess homes, businesses etc for sharable assets • People who implement the sharing and manage the relationships

Expertise will emerge in areas such as drone licencing and privacy, AI ethics and compliance.

As social media becomes pervasive we will see growth in social media lawyers and mediators to handle online legal disputes. Demand for people with expertise in social media image and branding for individuals will increase[34] as more people move to freelancing.

A new development, native advertising, which aims to make advertising as natural, unnoticeable and 'customised' as possible is emerging and the sharing economy is delivering new business models based on "other people's stuff". Overlaying all of this, data analytics and machine learning will inform and transform decision making, develop, monitor and manage processes and recruit and measure performance of the business and individuals.

Whereas automation was once thought to only impact low skilled works, advances in technology are resulting in the automation of more highly skilled, cognitive tasks.

Developments in cognitive computing are enabling computers to learn and adapt to themselves and to understand and communicate using human language.

Contract law, legal research and accounting are already experiencing increased automation of what was once considered high skilled tasks. Automated pharmacy systems, where robots dispense individual medications have been launched in the US. AI based platforms, including games and simulations are being used as recruitment and training tools.

Payroll, book keeping and other back end accounting functions are moving offshore or online. Bookkeepers and clerks will likely move into more customer facing roles using data analytics to offer more personalised products. It's likely that a skill shift will be required moving away from numbers to people. Those interested in numbers can upskill into non-routine cognitive roles which are harder to automate. Roles like administrative assistants and diary managers may still be required but are likely to decline given the available technology platforms that help people organise all aspects of their work and life. Because strong organisational and coordination skills are required in these roles, there are many opportunities to move into complimentary roles, such as project management and coordination, supply chain logistics, event planning etc.

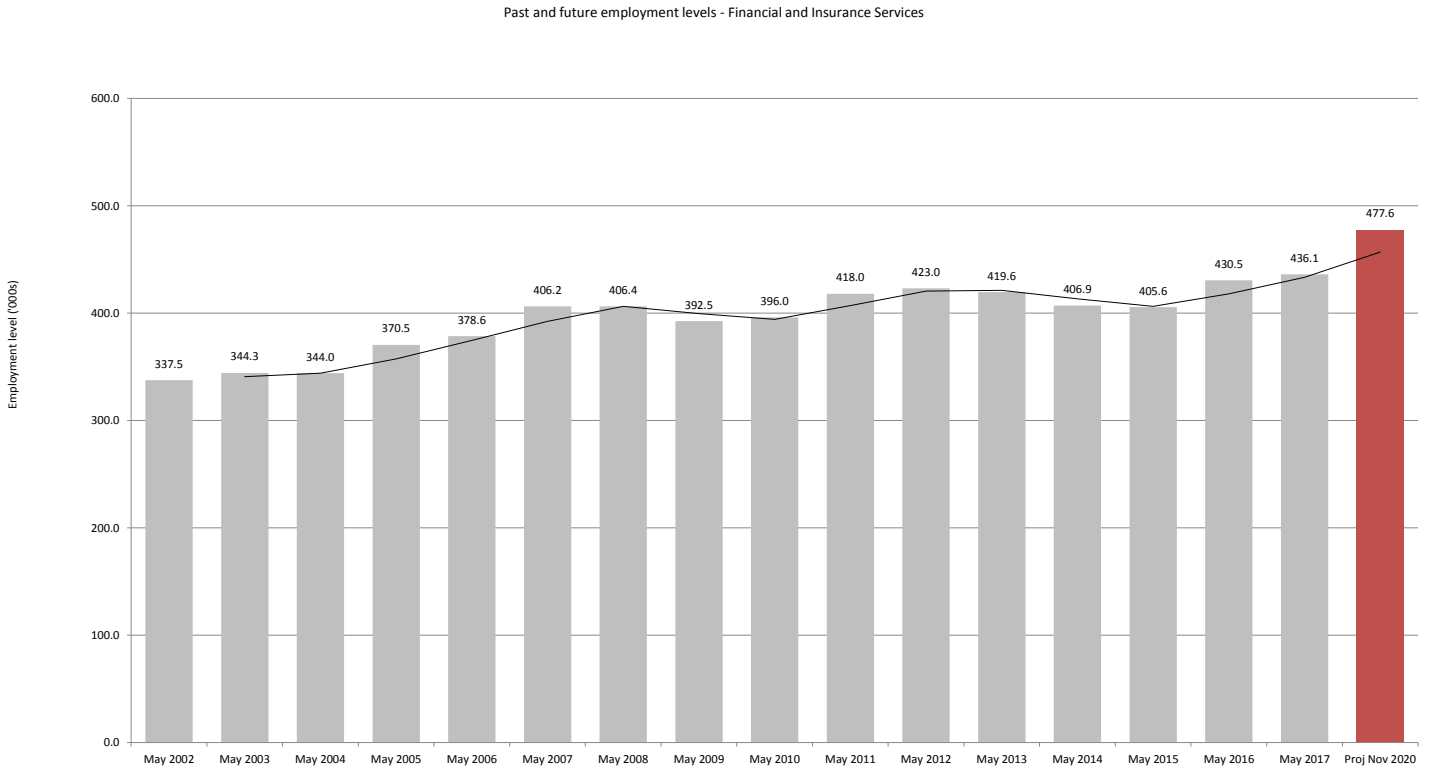
Digital literacy and being comfortable using different technology platforms will be key to a successful transition.

5.9 Finance

Employment in financial and insurance services is expected to grow by 5.6% or 26,400 new jobs by 2022.[35]

Major technologies impacting this sector are cryptocurrency, blockchain and AI.

The rise of Cryptocurrencies, such as bitcoin combined with blockchain technology is enabling end to end digital financial transactions from anywhere to anywhere around the world in real time and without intermediaries such as traditional banks.



Department of Employment, Industry Employment Projections report 2017

TREND	JOBS	DESCRIPTION
THE RISE OF CRYPTOCURRENCIES & BLOCKCHAIN	• Currency Adoption Specialists • Crypto Currency investment bankers • Regulators and Lawyers • Blockchain application designer	• Helps consumers transfer from traditional currencies to virtual currencies • Similar to today's bankers they safeguard assets and raise money • Develops and implements policies and laws to protect consumers • Develops blockchain applications
THE USE OF AI IN CUSTOMER SERVICE	• Financial technologist	• Uses data, numerical or quantitative techniques to analyse and optimise the market and develop and manage customer services

Banks and financial institutions are also adopting new generation AI to automate financial tasks including routine operations, wealth management, algorithmic trading and risk management. Voice services (chat bots using natural language processing) now interact through virtual conversations with customers seeking financial advice. Algorithms analyse customer requirements such as product choice, allowing later human interface to be more efficient, evidence-based and accurate. Advisory bots are allowing companies to evaluate deals, investments, and strategy in a fraction of the time it takes today's quantitative analysts using traditional statistical tools.

AI has also made inroads in the investment industry, where a sophisticated trading machine capable of learning and thinking can make today's most advanced and complex investment algorithms look primitive.

The sophistication of these technologies however, also raises questions about transparency and appropriateness of automated decision making – not just in this sector but across a range of industries. Huge quantities of data will feed into important decision-making processes. The ability to isolate potential biases, ensure outputs are consistent with expectations and monitor and assess the ethical basis of critical decisions in a human context will also be important.

The finance sector has seen shocks before with the introduction of the ATM. We will see similar shifts this time.

With the rise of cryptocurrencies and blockchain there are opportunities for sales roles that explain the benefits and opportunities of these new technologies in financial and related transactions. These don't require technical skills in developing the products but the people and communications skills to identify opportunities and sell them. Those who prefer numbers might move into fraud detection and investigation, reading data and patterns to identify risk and putting in process remedial action.

This is a strong and growing area given the pervasiveness of online transactions.

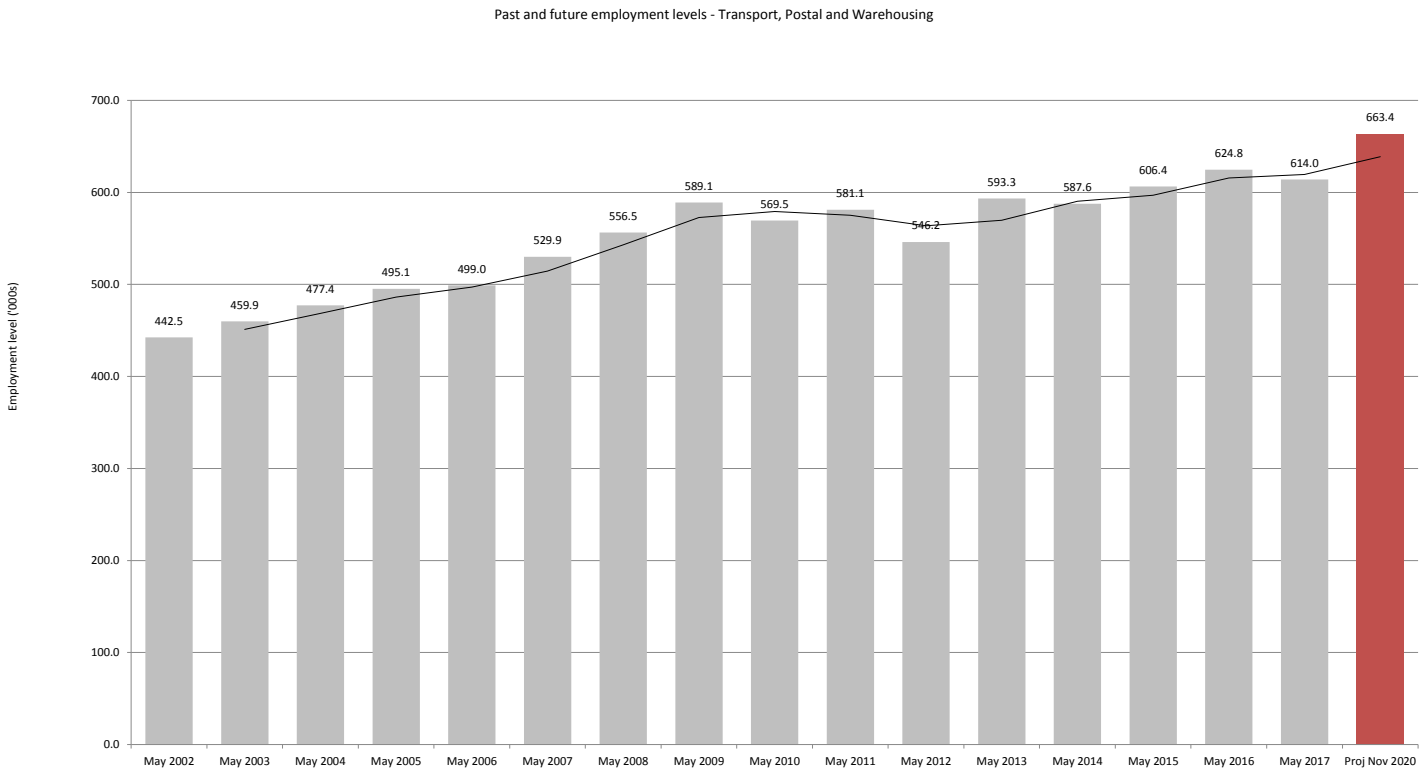
5.10 Transport and Logistics

Employment in transport, postal and warehousing services is porjected to grow by 6.5% or 40,300 new jobs by 2022.[36]

Major technologies impacting this sector are drones, sensors and automated vehicles.

Transport drones are rapidly becoming a prevalent part of the modern logistics industry. This is already the case for last mile delivery of goods and services. For example, transport drones can be deployed from docking/warehouse points to deliver parcels and potentially from moving vehicles such as trains as they approach designated destinations. They can similarly be used on cargo ships to automatically update information as cargo is unloaded and loaded as well as in the actual loading/unloading process.

Driverless trucks will be safer and cheaper than their human-controlled counterparts.



Department of Employment, Industry Employment Projections report 2017

TREND	JOBS	DESCRIPTION
 THE USE OF DRONES & AUTOMATED VEHICLES	• Drone drivers/operators • Automated traffic architects and engineers • Drone docking station designers and developers • Transport schedulers and r oute controllers	• 'Drives' the drones or automated vehicles • Develops traffic platforms for the smooth operation of drones and automated vehicles • Design and develop docking stations for drones • Manages scheduling and routes of drones and autonomous vehicles

The sensors in autonomous trucks and cars can sense when other vehicles or obstacles are close and can automatically respond as appropriate. Autonomous trucks can cover more territory by traveling longer distances without stopping for breaks.

This not only reduces delivery times but in some instances will allow users to establish warehouses in more remote locations where land is less expensive, also lowering overall transportation costs.

Driverless technology will mean loss of jobs for some truck drivers. However other opportunities present themselves. Instead of driving a truck they can be trained to remotely drive a drone or a fleet of drones. Alternatively, they may move into tracking and scheduling of drones or goods or quality assurance and compliance related activities building on existing skillsets. People will still play a role in coordinating where and when drones need to be, providing docking infrastructure and services and service and maintenance activities.

Packaging designs and materials suitable for drone delivery will also demand new skills and jobs.

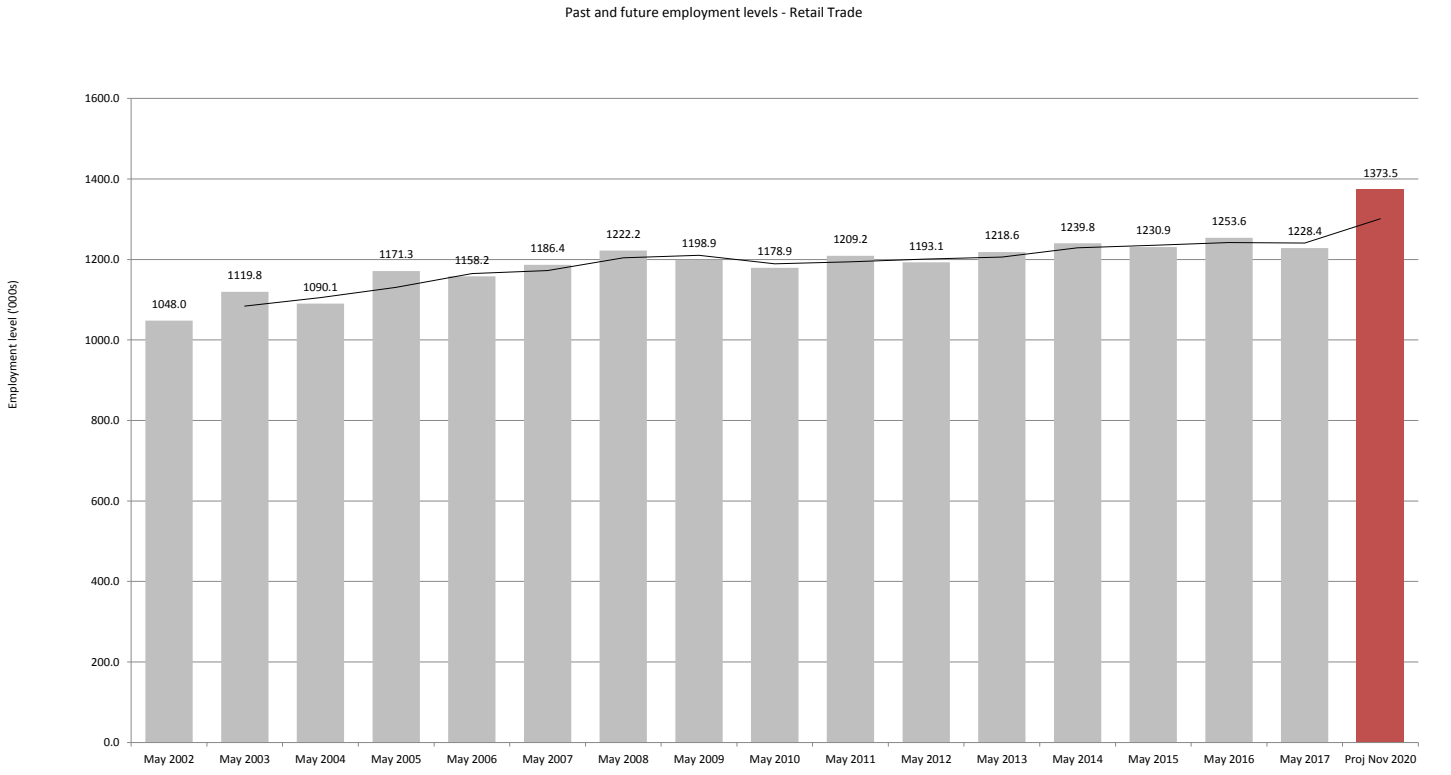
Robotics will impact the current roles of warehouse foreman/ woman but opportunities will arise in complementary areas such as space planning and management with the aid of sensors and live stock data from drones. As real estate prices become more expensive experience on how to maximise space of constantly moving stock will be highly valuable. There may be less of these jobs but they are also more highly paid.

Jobs in global supply chain logistics will also grow given the rate of globalisation and may compensate for the decline of other roles - as already evidenced in developing nations as their demand for goods and services increases.

5.11 Retail

Employment in retail is expected to grow by 3.7% or 45,600 new jobs by 2022. This relatively slow growth is likely due to reduced consumer spending and more intense online competition forcing retailers to keep staffing costs down. On the upside, employment is expected to grow quite significantly in supermarket and grocery services due to population growth - up by 8.1% or 24,000 new jobs over the same time.[37]

Progress in AI and machine learning, combined with cloud and big data, is transforming the retail industry. As AI leverages big data to automate, predict, personalise and target shopping experiences, retail is testing and implementing new approaches to build brand profile and gain competitive advantage. The key focus for AI in retail is customer relationships and understanding customer behaviour and preferences.



Department of Employment, Industry Employment Projections report 2017

TREND	JOBS	DESCRIPTION
USE OF SENSORS IN RETAIL STORES & RISE OF CUSTOMER SERVICE BOTS	• Behavioural specialists • Quality customer service professionals	• Analyses customer response to automated processes and advises on how best to accommodate customer expectations • Provides face-to-face service. This will be a key competitive advantage for traditional retailers and human interaction could even become a luxury or brand differentiator
UBIQUITOUS USE OF MOBILE PAYMENTS	• Payments switching and authorisation professionals • Security and compliance professionals	• Signs up customers and ensures the process of switching payment systems is as seamless as possible • Monitors fraudulent activities and ensures the company has checks and balances in place to comply with laws and regulations

Emerging technology use includes:

- Chat Bots and Virtual Assistants: Leveraging AI these tools enable direct but remote engagement with customers looking for and ordering products. Chat bots have question-answer and recommendation capabilities enabling both a highly personal and scalable sales channel.
- Marketing and Segmentation: AI models can use data sets to predict and prioritise the most successful campaigns and channels, and provide these insights to decision makers.
- Inventory and Supply Chain Optimization: In addition to increased accuracy and timeliness over traditional systems, AI tools can predict future supply-demand scenarios.

In addition to these, sensor technology is used to collect shopper demographic data and activity detection used to understand what activities/customer behaviours are being undertaken inside the store, by whom, and how they're being undertaken.

Mobile payments are also predicted to become ubiquitous and estimated to reach some $2010 billion in the US in a few years.[38]

While roles like cashiers and stockers will evolve, store operation roles to ensure the smooth running of a store will still be required. Floor staff will move from service of people to reading data on human spending behaviour and where best to place merchandise aided by sensor technology. Sales Assistant roles will transition to offer higher quality in store services and advice as brands use the human factor as a luxury and differentiator.

More opportunities will emerge for Style Advisors and Personal Shoppers as the demand for the personalised retail experience grows.

6. Build tomorrows jobs today

6.1 Digital literacy the new norm

Irrespective of where the change takes us, one thing is certain: universal digital literacy must be the new norm. Without basic digital competencies, a person will not have the skills to negotiate the digitally connected world that is now a reality. They will not have the skills, information or communication networks to negotiate opportunities and as a result they will have fewer job prospects and be more exposed to social and economic exclusion. Their disadvantage will be compounded by a corresponding reduction in access to government services.[39]

Everyone in the workforce will need the ability to use digital technology to do their job, to confidently communicate, find information and purchase goods/services.[40] This is not a job displacement issue but the inevitable reality of operating in a modern, global and digital economy. It is as essential as numeracy and literacy is to everyone participating in a post-industrial revolution economy.

At a minimum, it will require everyone to have the ability to access and use information and digital content; communicate and collaborate through digital technologies; manage their digital identity; develop digital content; and use and protect their digital devices, personal data and privacy.

Work done on the Economic Impact of Basic Digital Skills and inclusion in the UK in 2015 examines this issue in detail, outlining the costs and the benefits for both individuals and the UK as a whole, of equipping everyone with Basic Digital Skills. Its definition of Basic Digital Skills is included in Box 1 below. Importantly, it concluded that 100% of the UK population needed Basic Digital Skills to future-proof the labour force for the inevitable expansion of technology in the workplace and in their daily lives.

Box 1: Components of Basic Digital Literacy Skills

An individual with Basic Digital Skills is expected to have the capabilities to undertake the following tasks:

- Manage information: having the skills to use a search engine to find information, search for deals on comparison websites, able to bookmark useful websites and services and store data on a device or in the cloud.
- Communicate: the individual is able to keep in touch with family and friends using emails, instant messaging, video calls and social media. This includes the ability for an individual to post comments on forums, connect with online communities and leave feedback e.g. on shopping websites and for service providers about purchases or experiences they've had.
- Transact: the ability to undertake financial transactions, such as completing a Universal Credit application, ordering shopping, booking travel, managing bank accounts, using digital government services and understanding how to buy and sell on the virtual marketplace.
- Problem-solve: The individual should be confident to solve problems using digital skills such as teaching themselves simple tasks using video lessons, using feedback from other internet users to solve a common problem and accessing support services e.g. 'live chat'.
- Create: having the skills to create basic digital content. For example, creating a social media post, drafting a text document, creating and sharing photo albums and providing feedback to online communities.

The economic impact of Basic Digital Skills and inclusion in the UK A report for Tinder Foundation and GO ON UK November 2015

6.2 Australia needs people to create technology

At the other end of the spectrum we need a skilled workforce that can 'create' not just 'use' technology. This capability applies across all industry sectors.

The focus on STEM – training in science, technology, engineering and mathematics (STEM) while not new, is crucial to building a 21st century knowledge based economy underpinned by data, digital technologies and innovation – key ingredients for growth. STEM education builds and encourages problem solving and critical reasoning skills. It is more than simply producing more engineers, technologists, scientists and mathematicians – although this is also necessary. The process of learning STEM, as important as the content itself, teaches students how to analyse problems and then work to correct and overcome them. It brings real world application and hands on experimentation to the learning process and instils creativity by encouraging students to see problems and solutions in new and different ways.

The ability to understand concepts across multiple disciplines will also be essential to solving many of today's global problems that are too complex to be solved by one specialised discipline.

6.3 Non-STEM skills are just as important

But even STEM skills will not be enough. Technical proficiency alone will not be sufficient.

While skills in STEM remain critical, the longer-term focus will move to a new mix of skills that combine workplace, applied knowledge, people and personal skills – with an emphasis on creativity, flexibility, tolerance of ambiguity, social intelligence and personal resilience and agility.

We know that even across our own membership of technology leaders, where STEM skills are a premium, businesses want more than hard technical skills.[41]

Enterprise skills such as complex and creative problem solving, innovative thinking, communication skills, teamwork and collaboration and an understanding of the business and industry context are what many of our own members are looking for from their hires.

This is consistent with analyst predictions that more technical and cognitive skills such as creativity, reasoning and complex problem solving, combined with social skills (influencing, persuasion, emotional intelligence and the ability to teach others) and processing skills (active listening and critical thinking) are becoming "core" across many industries.[42]

6.4 Transferring todays skills to tomorrow

Rather than completely and dramatically replacing existing occupations and job categories, technological disruptions are more likely to substitute specific tasks, resulting in changes to core skill sets.[43] While there will be exciting new opportunities, the jobs of tomorrow by and large, require us to prioritise and build on skills that are already in use today.

Building on existing research[44], AIIA has examined a range of current skills sets to see how they are likely to evolve to meet emerging new skill requirements. While there is much said in general terms about what is required for future jobs, our aim is to illustrate the extent to which new skills are an evolution of a range of existing skills and to provide a broad skills framework that individuals, businesses and educators can work towards.

Using the Australian Government Job Outlook data,(based on O*NET - the occupational information network analysis) we examined the current skill requirements for 10 middle to low skill occupations across 10 key industry sectors.[45] We chose a mix of industry sectors that are growing most and those experiencing the least growth. Within these sectors we looked at occupations we think are most likely to be impacted either because of automation, other technology or changes in demographic demands. Despite the diversity of sectors and jobs, several recurring skill sets rated as highly important across the board.

These include:

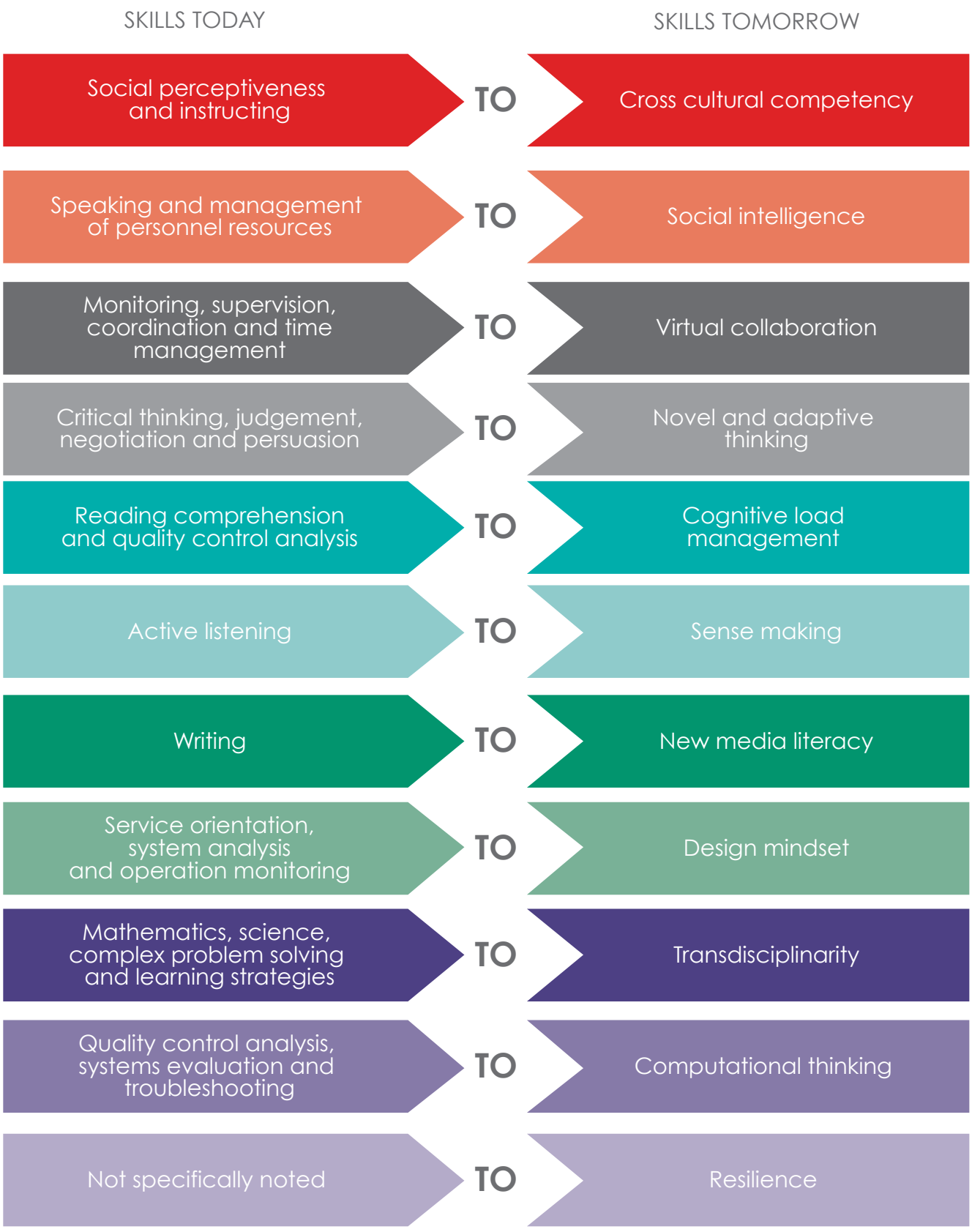
- Social perceptiveness and instructing
- Speaking and management of personnel resources
- Monitoring, supervision, coordination and time management
- Critical thinking, judgement, negotiation and persuasion
- Reading comprehension and quality control analysis
- Active listening
- Writing
- Service orientation, system analysis and operation monitoring
- Mathematics, Science, Complex problem solving and Learning strategies
- Quality control analysis, systems evaluation and troubleshooting

Looking at analysis done by the Institute for the Future (IFTF) on future skills, which identifies 11 specific skills[46] for the future (see Box 2) we map todays common skill requirements against those identified by the IFTF (Box 3).

Box 2: Skills Required for the Jobs of the Future

Personal Skills	**The ability to act as a striver and a team player**
Resilience	Highly resilient individuals maintain positive emotions and, in some cases, can actually thrive in the face of crises. Resilient people also tend to demonstrate more flexibility with change, more stability in demanding situations, and less aversion to risk than their non-resilient counterparts
People Skills	**The ability to be a team player**
Cross cultural competency	The ability to operate in different cultural settings. In a truly globally connected world, a worker's skill set could see them posted in any number of locations—they need to be able to operate in whatever environment they find themselves. This demands specific content, such as linguistic skills, but also adaptability to changing circumstances and an ability to sense and respond to new contexts.
Social intelligence	The ability to connect to others in a deep and direct way, to sense and stimulate reactions and desired interactions. Socially intelligent employees can quickly assess the emotions of those around them and adapt their words, tone and gestures accordingly. This has always been a key skill for workers who need to collaborate and build relationships of trust, but it is even more important as we collaborate with larger and more diverse groups of people in different settings
Virtual collaboration	The ability to work productively, drive engagement, and demonstrate presence as a member of a virtual team. As a leader of a virtual team, individuals need to develop strategies for engaging and motivating a dispersed group. We are learning that techniques borrowed from gaming are extremely effective in engaging large virtual communities. Ensuring that collaborative platforms include typical gaming features such as immediate feedback, clear objectives and a staged series of challenges can significantly drive participation and motivation.
Applied Knowledge	**The ability to logically analyse information**
Novel and adaptive thinking	Thinking and coming up with solutions and responses beyond that which is rote or rule-based. Tasks as different as writing a convincing legal argument, or creating a new dish out of set ingredients both require novel thinking and adaptability. These skills will be at a premium in the next decade, particularly as automation and offshoring continue.
Cognitive load management	The ability to discriminate and filter information for importance, and maximize cognitive functioning using a variety of tools and techniques. A world rich in information streams in multiple formats and from multiple devices brings the issue of cognitive overload to the fore. Organizations and workers will only be able to turn the massive influx of data into an advantage if they can learn to effectively filter and focus on what is important.
Sense making	The ability to determine the deeper meaning or significance of what is being expressed, i.e. skills that help us create unique insights critical to decision making. These higher level thinking skills cannot be machine codified.
Workplace Skills	**The ability to solve problems and make decisions**
New media literacy	The ability to critically assess and develop content that uses new media forms, and to leverage these media for persuasive communication. Communication tools that break away from the static slide approach will become commonplace, and with them expectations of worker ability to produce content using these new forms will rise.
Transdiciplinarity	Jobs that require skills in mathematics, science, complex problem solving and learning strategies will likely have a strong emphasis on transdiciplinarity in future. That is, literacy in and ability to understand concepts across multiple disciplines. Many of today's global problems are just too complex to be solved by one specialized discipline. The ideal worker with these strengths in the next decade is "T-shaped"—they bring deep understanding of at least one field, but have the capacity to converse in the language of a broader range of disciplines.
Computational thinking	The ability to translate vast amounts of data into abstract concepts and to understand data-based reasoning. As the amount of data that we have at our disposal increases, many more roles will require computational thinking skills in order to make sense of information

Box 3: Today's common skill requirements mapped against future skills for tomorrow's jobs



7. Need to be Proactive

There is no doubt that technological developments have and are still, effecting the labour market. To the extent that technology disrupts the workforce and some will lose out – the policy issues we face today are the same that have been faced and dealt with in the past.

Essentially these are:

- Ensuring everyone can participate in the workforce, notwithstanding how it is changing; and
- Facilitating the adjustment and employment of workers who are displaced due to technological change.

These translate to digital inclusion, managing those in transition and more fundamentally, skills, education and training.

To the extent that our modern industrial relations system underpins the quality, safety and stability of the workforce this is also an important area of focus.

How these issues are played out should not be left to chance. Rather than deal with problems after they reach a crisis, there is an opportunity for policy makers to anticipate and respond to issues to minimise negative or damaging impacts well in advance.

Initial thoughts on these issues are outlined below. These will be the focus of further discussion as we progress our Jobs for the Future series of thought leadership and events over the next 12 months.

7.1 Digital Inclusion

Without a minimum baseline of digital knowledge, skills and resources, citizens will have difficulty finding a job in the future. Studies have consistently found that equipping people with digital skills that enable them to participate effectively in the labour market, delivers real economic and social benefits. It reduces unemployment, drives productivity and growth and contributes to broader social cohesion.[48]

ICT and digital leaders intend to work proactively with governments and communities to increase awareness of technology developments on the horizon and to better understand and anticipate the wider social and economic impacts of these. Early identification of impediments to digital inclusion, particularly for some groups of individuals or communities, means active and practical strategies are developed to build Australia's digital literacy capabilities to prevent social and economic dislocation.

ACTION REQUIRED

Active and practical strategies are developed to build Australia's digital literacy capabilities to prevent social and economic dislocation.

7.2 Transitional Issues

While we are optimistic about the outlook for jobs of the future, there is no doubt that some jobs and people will be impacted more than others. For some this may involve simple re-skilling or up-skilling. For others, their jobs may change substantially and at worse, disappear. Providing opportunities for workers to re-skill and up-skill is critical to ensuring potentially disrupted workers are not displaced or worse, dislocated from the broader community.

Moreover, consistent with the findings of the Productivity Commission Report on Digital Disruption, the focus for government should be on assisting displaced workers not on industry protection or assistance.

Finally, more research needs to be done on the impacts of technology change on vulnerable sectors of the labour market such as older workers. Early intervention may lead to greater labour market participation down the line.

Failure to understand the potentially disruptive changes ahead will be a barrier to preparing workforces for the future. ICT and digital leaders can expertly inform the nature, timeframes and impacts of new technologies and with government and other industry leaders develop appropriate workforce transition and risk mitigation strategies.

ACTION REQUIRED

- Provide opportunities for workers to re-skill and up-skill to ensure potentially disrupted workers are not displaced or dislocated from the broader community.
- Identify and address needs of vulnerable sectors of the labour market.

7.3 Skills, Education and Training

Skilling up and reskilling our labour market will be one of the most critical factors in shaping the quality and resilience of our future workforce.
This has several components:

- Equipping young people today for the jobs of tomorrow;
- Developing a culture and framework for lifelong learning;
- Anticipating skill requirements and agile skill development frameworks.

Developing skills today for tomorrows jobs

To effectively participate in the workforce of the future, children today (and in the future) need to develop a more 'holistic' skills portfolio. This includes increased general STEM capabilities and, more importantly, creativity, reasoning and complex problem-solving skills, combined with social and cognitive processing skills.

Despite concern that school curriculums are already over full, these skills need to be incorporated sooner rather than later. The most effective and efficient way to do this is by integrating them in the learning experience of other specialist and mainstream skills. This requires more creative approaches to curriculum development and delivery combined with new classroom learning and student engagement techniques, changes to teacher professional learning and new education outcome measures. Rather than traditional listening and writing teaching methods, the focus needs to be on providing students with creative and 'doing' learning models that engage students in the learning process.

At the tertiary level improved alignment between graduate skills and work readiness and the needs of employers is required. This is one of the greatest areas of opportunity for industry to contribute to future skill development.

ACTION REQUIRED

- Encourage young people to develop more 'holistic' skills portfolios.
- Integrate jobs for tomorrow skills into mainstream learning experiences.
- Provide students with creative and 'doing' learning models.
- Investigate new skill acquisition and employment based learning pathways.

Work already done by AIIA, in collaboration with tertiary peers has identified options including:

- reciprocal exchange programs between university academics and industry;
- embedding industry practices in IT and engineering courses;
- universities and industry working together to define priority graduate attributes;
- implementation of 'for credit' work integrated learning at the national scale.

New skill acquisition models are also needed. For example, higher apprenticeship schemes aimed to meet the needs of advanced training outside the traditional university system and which provide an employment based learning path.

Discussion around STEM has generally focused on how the school and university sectors can help equip young people with the skills and knowledge necessary for the changing economy.

With increased expectations for more agile and flexible skill acquisition the role of the vocational education and training (VET) sector is increasingly important. The VET sector already has deep relationships with industry, expertise and experience in middle skill qualification development and typically provides course offerings that are shorter in duration and directed to specific skill requirements.

Workplace and Life Long Learning

In the context of our complex and fast paced digital economy, future demands for talent are changing faster than industry and educational institutions can keep pace with.

Research commissioned by AIIA shows that the majority (76%) of Australians think that the best ways workers can adapt to change is by keeping up to date with the changing technology in their industry, irrespective of the industry they are in.

Government and industry need to ensure that on-going learning structures and supporting systems are available to enable and empower workers to refresh their skills. This goes beyond mainstream curriculum development to ensuring more agile skill acquisition models aimed to support the re-skilling and up-skilling requirements of the future workforce. This is especially important for middle skill workers impacted by technology who need to keep pace with changing skill demands.

ACTION REQUIRED

More agile skill acquisition models aimed to support the re-skilling and up-skilling requirements of the future workforce, including lifelong learning approaches.

Again, the ICT industry has a key role in advising of emerging technology and informing the content and focus of these structures and programs.

The role of industry in anticipating and informing skills development

Reskilling and retraining efforts are unlikely to deliver the desired result unless their content anticipates impending change. Skills and educational content based only on today's needs will limit our ability to make investment decisions for the skills required for tomorrow. While in the past it has been sufficient to address this lag of skills to jobs over time, today people and businesses that do not keep pace with technological change are disadvantaged. This has broader impacts on our economy.

Industry has a key role in helping inform and prepare educators (specifically those that develop and deliver curriculum content) about how new technology and its application will demand new skill sets and how technology can be used to deliver more agile and flexible skills programs. For example: the use of predicative analysis techniques in the delivery of personalised learning; virtual and augmented reality tools that enable simulated working environments and conditions; and opportunities to undertake practical tasks and address in situ

ACTION REQUIRED

Develop new models of industry engagement with education and training institutions.

'real world' work tasks and problems, New models of industry engagement with education and training institutions are also required. Although industry already participates in a range of tertiary institution advisory roles, the contribution is typically bespoke and fragmented. There is clear opportunity to standardise and systematise the input of industry to ensure skills development at all levels of education are relevant in the context of emerging technology. While the VET system already has processes to support this, arrangements in the higher education are generally less systematised.

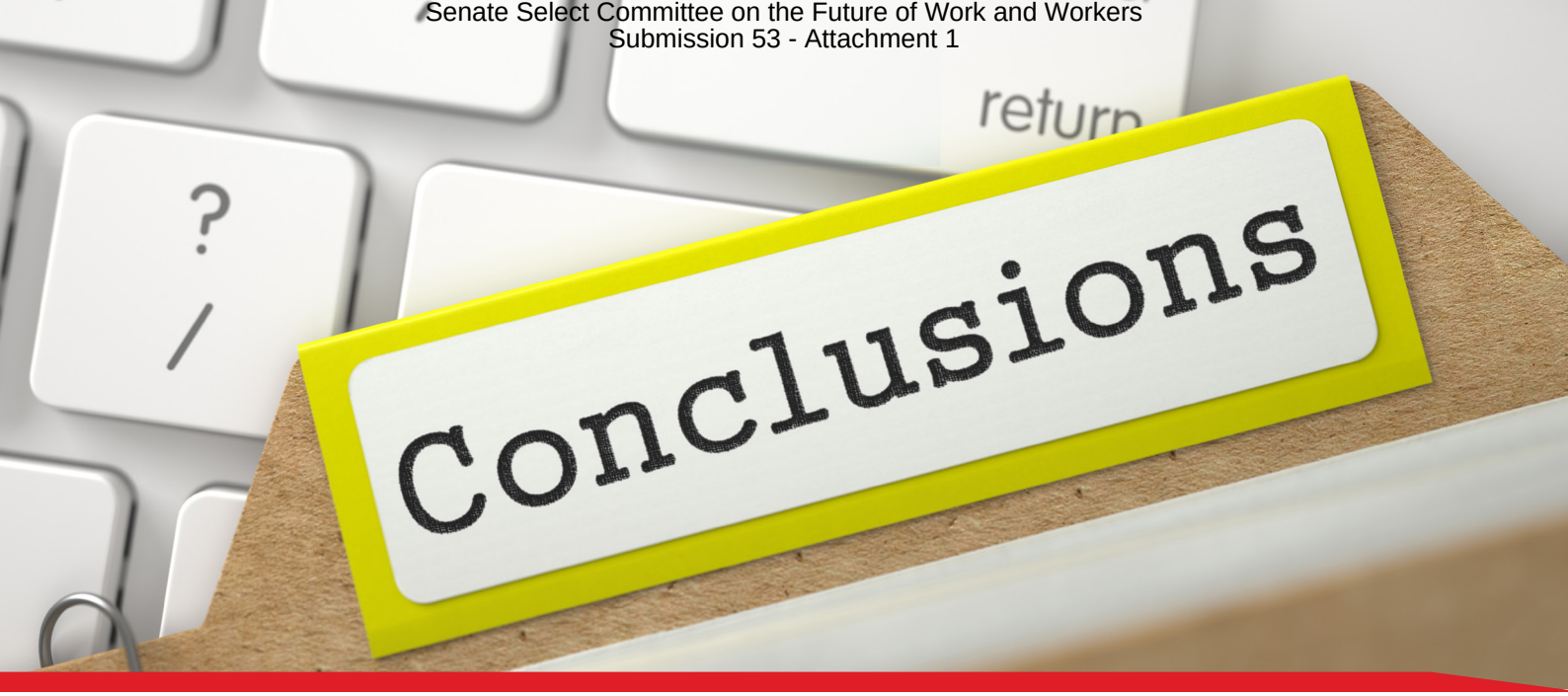
7.4 Industrial Relations

Our modern industrial relations system underpins the quality and stability of work and safety conditions enjoyed by many Australians. Technology is changing the way we work and for some, the work they do. The extent to which existing laws, regulations and policies are keeping pace with changing technology, work conditions and emerging workplace structures is unclear. It is very likely these will require adjustment.

Industry would like to work more closely with unions to support workers and workplaces better understand technological developments and their potential impacts. Rather than block technology, industry can work with unions and employers to help develop more appropriate and effective digital awareness, skills, and safety strategies. This is particularly important with the increased use of robots and automation in workplaces.

ACTION REQUIRED

Industry work more closely with unions to support workers and workplaces better understand technological developments and their potential impacts.

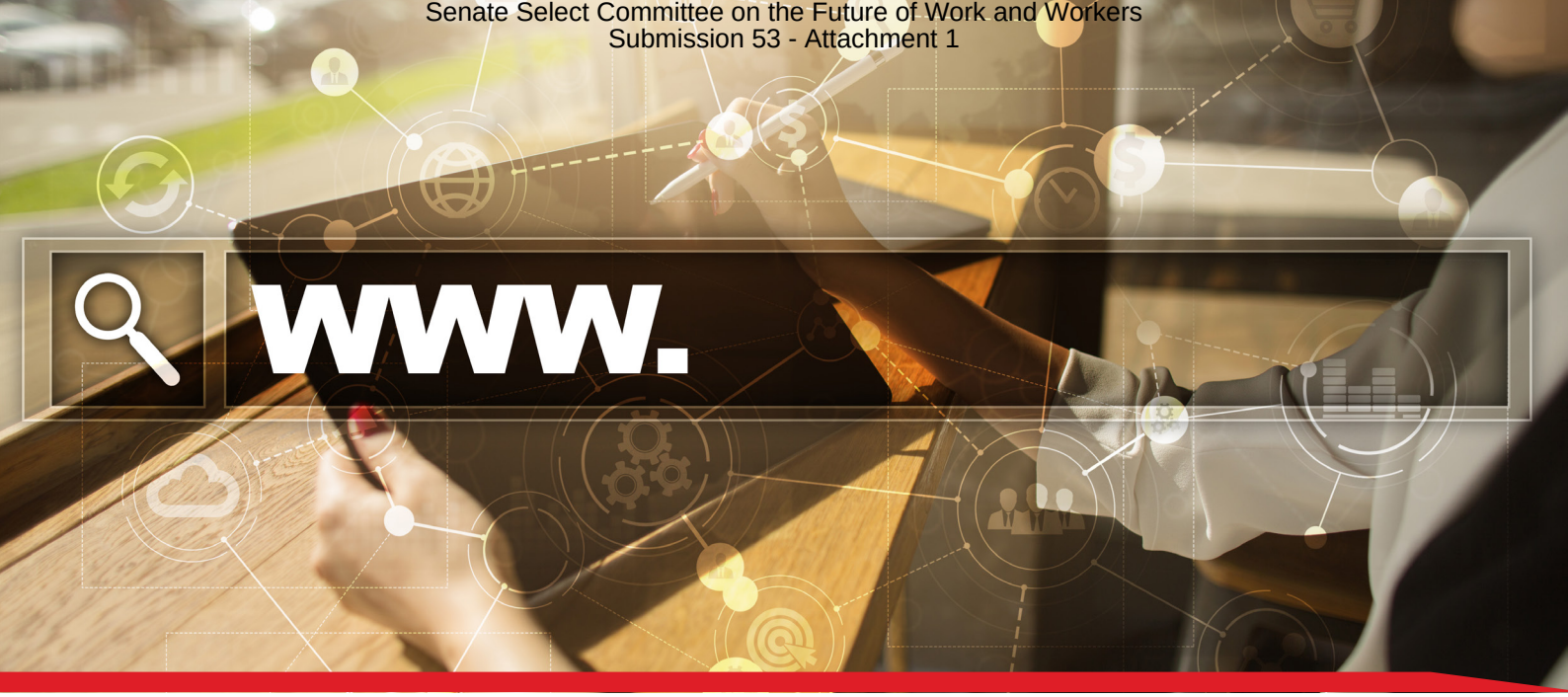


Conclusion

History has shown that despite our worse fears, technology and automation surprises us with new opportunities for productivity, growth and prosperity. While not everyone has benefited to the same extent by technological developments, overall citizens across the world have been empowered by the democratisation of information and improvements to living standards that information and communications technologies and now digital technologies deliver. Reflecting recent history, the advent of personal computers in the 1980s destroyed many jobs that involved routine and repetitive tasks but in return underpinned the growth of a global information technology industry that has itself spawned new industries and new jobs.

The notion that there's only a finite amount of work and that advances in technology reduces that notional limit have clearly proved to be unfounded. Changes in demographics and in our socio-economic and socio-political environment, coupled with the need for growth, the phenomenon that is competition and man's ingenuity, have combined over centuries to constantly evolve jobs and the nature of work and the labour market – mostly for the better.

Anticipating new opportunities, and the jobs that may emerge and the skills needed, positions us well to respond now to what lies ahead.



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