

McKinsey
& Company



Australia's automation opportunity

Reigniting productivity and inclusive income growth

March 2019

Australia's automation opportunity: Reigniting productivity and inclusive income growth

March 2019

Authors

Charlie Taylor

Jules Carrigan

Hassan Noura

Seckin Ungur

Jasper van Halder

Gurneet Singh Dandona

Preface

As Australia approaches three decades of uninterrupted economic growth, most of its citizens have a lot to celebrate. Our people are being paid more in real terms, and have seen a healthy rise in the value of their assets. We are now regularly found near the top of global income and wealth tables and—just as importantly—in the top ranks of liveable cities and quality of life measures. Our national wealth enables us to support those in need through universal health and welfare policies, and our natural wealth nourishes our economy and our psyche.

Still, too many of our people rightly feel that the long boom has been someone else's story. Even if employed, they worry about housing affordability, the vagaries of part-time work and their family's future. When they hear about automation technologies like artificial intelligence or robotics, they understandably see a threat rather than an opportunity. It is hard to be enthusiastic about the next wave of disruption when the last wave left you feeling vulnerable.

That these automation technologies are coming to Australia is certain. For the nation, that should be a good thing. They can reignite our income growth, and help us navigate the headwinds of an ageing population. If we can embrace automation in the national interest, businesses can develop new services and products, boost productivity and create new and better-paying jobs, keeping employment levels high and creating the national wealth that can promote social inclusion.

Our challenge is to embrace automation not only for the benefit of 'the nation', but also for those who will need to shift their occupations and maybe even their homes. The scale up of automation across the economy will be disruptive, just as other technology adoptions have been disruptive in the past. Firms that can leverage these technologies and use them to innovate will thrive; others will not. More people will be affected than one might think: not only those who perform routine manual activities, but also those in predictable, data-heavy analytical areas like engineering, accounting and computing. People who can acquire new skills will flourish in their existing roles and in roles yet to be defined; others will find it much harder. Governments and other institutions who manage this transition poorly could see increased inequality and risk public backlash and political instability.

We need to act now. Australia has lost its late 20th century reform momentum and is falling behind on innovation, digitisation and productivity compared to the rest of the world. Complacency and the instinct to protect the status quo, combined with an ageing population, put the economy at further risk. The longer we delay action, the more painful the consequences will be.

Many individual people and businesses will prosper regardless of economic conditions and policy settings. However, public economic policy is all about sharing the gains so that everyone can have the opportunity to benefit. Political and economic consensus among a broad range of stakeholders is a must. If Australia is to capture the promise of automation, it needs clear-headed debate and action from those of us who can make a difference to the broader population—policymakers, business leaders and learning institutions. This report aims to contribute to the evidence and analysis that will inform these efforts.

This report presents research conducted by McKinsey Australia in collaboration with the McKinsey Global Institute (McKinsey's business and economics research arm). It builds on previous McKinsey Australia research into productivity and competitiveness in the country—including *Beyond the boom* (2012) and *Compete to Prosper* (2014)¹—and leverages the latest

¹ This paper builds on our previous major economy-wide reports: *Compete to prosper: Improving Australia's global competitiveness* (2014), which highlighted the risk of a pervasive lack of sector competitiveness for future prosperity in an age of globalisation; and *Beyond the boom: Australia's productivity imperative* (2012), which explained the potentially fragile growth outlook if productivity is not addressed.

methodologies and in-depth research on automation developed by the McKinsey Global Institute over the last three years.²

Our research is also informed by other work on the impact of automation on Australia. In 2015, the Committee for Economic Development of Australia (CEDA) released a report titled *Australia's Future Workforce*, which looked at the implications of 'the next wave of the industrial revolution' for our businesses, in particular the impact of digital disruption and the policy levers available for worker and business opportunities. Google and AlphaBeta's 2017 report, *The Automation Advantage*, noted that automation could add \$2.2 trillion to the Australian economy over 15 years by raising productivity and creating jobs that are safer and more satisfying, as long as there is a strong policy framework to protect vulnerable workers. They followed up in January 2019 with a report titled *Future Skills*, highlighting the need for dramatic investment in education, training and lifelong learning to prepare Australians for the automation age. That work built on the Business Council of Australia's 2018 report, *Future-Proof*, which proposed a redesign of Australia's post-secondary education and skills system.

We add several components to this valuable body of knowledge by:

- Examining how technology adoption, productivity and competitiveness have historically supported incomes and prosperity in Australia, and can again in the future
- Estimating—down to the local government area, and by sector and occupation—which jobs are vulnerable to disruption because of automation, as well as the potential upside in terms of increased productivity, economic and income growth
- Considering the skill and qualification shifts required in the workforce and among tertiary students to meet future labour market demands
- Estimating the potential impact of automation on unemployment and income inequality
- Sharing our views on what it will take for both the private and public sectors to capture the opportunities from automation, while ensuring that the resulting benefits are broadly shared

We hope this work contributes to a rich discussion on how to harness the benefits of new technologies for the welfare of all Australians.

John Lydon, managing partner of McKinsey Australia and New Zealand, and the partners of McKinsey Australia sponsored this research. Charlie Taylor and Jules Carrigan, the leaders of the Australian Public Sector Practice, oversaw the work, along with associate partners Hassan Noura, Seckin Ungur and Jasper van Halder. The leadership team was supported by engagement managers Alice Hudson and Bart Woord. Gurneet Singh Dandona, an automation specialist with the McKinsey Global Institute, led the research and analytics work related to automation in Australia. The core team also included Caroline Wong, David Premraj, Guenièvre Lasalarié, Joshua Chew, Joshua Geron, Lucy Harris, Patricia Walsh, Sev Thomassian and Vanshika Bagdy.

We are grateful for contributions and assistance from colleagues at the McKinsey Global Institute, especially Badri Gopalakrishnan, Jeffrey Condon, Jonathan Woetzel, Krzysztof Kwiatkowski and Michael Chui, as well as other McKinsey colleagues, including Angus Dawson, Andrew Grant and David Pralong.

² The McKinsey Global Institute has been studying the impact of automation over the last three years and has published a number of papers on the topic, including: *A future that works: Automation, employment and productivity (2017)*; *Artificial intelligence: The next digital frontier? (2017)*; *Jobs lost, jobs gained: Workforce transitions in a time of automation (2017)*; *Skill shift: Automation and the future of the workforce (2018)*; *Applying artificial intelligence for social good (2018)*; and *Solving the productivity puzzle: The role of demand and the promise of digitisation (2018)*.

We would like to thank our advisory committee—Alison Deans, Catherine Livingstone AO, Daniel Mulino, Daniel Petre and Amit Singh—who challenged our thinking and provided valuable feedback and guidance throughout. We are also grateful to the many leaders in both the private and public sectors with whom we tested our findings and who provided valuable feedback.

The report was edited by Emma Ruckley, Joanna Pachner and Josh Dowse, with further support from Lisa Renaud, Liza Cornelius and Peter Gumbel. The report was designed by producers Joanne Loughlin, Lisa Maconie and Therese Khoury.

McKinsey Australia's mission is to help businesses and policy leaders understand the forces transforming the Australian economy and prepare for the next wave of growth. Our work is independent and has not been commissioned or sponsored in any way by any business, government or other institution. While we are grateful for all the input we have received, the report and views expressed here are ours alone.

John Lydon

Managing Partner of McKinsey Australia and New Zealand

Charlie Taylor

Senior Partner, Australia Public Sector Practice

March 2019

Contents

Preface	2
In brief	6
Executive summary	8
1. Australia needs to boost productivity to extend its boom	10
2. The automation opportunity	13
3. The challenges to employment, skills and inclusion	15
4. A national agenda for automation and inclusion	18
Is the long boom in income growth at an end?	20
Three decades of growth from determined reforms	21
The benefits of growth have been relatively widespread	25
As the boom weakened, growth became less inclusive	29
Australia needs to return to sustainable, productivity-driven growth to reignite broad income growth	35
Australia's automation opportunity	38
The automation wave is here, holding enormous promise	39
Workplace activity will be automated at differing speeds	41
Automation can help reignite income growth by boosting productivity	46
The challenges to employment, skills and inclusion	54
Total job demand will be resilient, although with much churn	55
Job demand will vary by sector, occupation and region	61
Different skills will be needed, and at a higher level	69
Without a strong societal response, automation could widen inequality	76
A national agenda for automation and inclusion	82
A. Accelerate automation both nationally and at the organisational level	84
B. Promote inclusion by supporting workers through job and skill transitions	94
Appendix	106
Appendix 1: McKinsey Global Institute methodologies	107
Appendix 2: Income inequality methodology	110
Appendix 3: Skills gap methodology	111

In brief

Powerful new automation technologies such as machine learning, artificial intelligence (AI) and advanced robotics have already started to transform the Australian economy and are set to reach scale in the decades ahead. These technologies present an enormous opportunity to restore momentum to the Australian economy and extend its 30-year boom in an inclusive way. However, the potential scale and distributional impacts of this disruption need to be carefully managed. This research examines how automation may affect Australia's economy (under slow, mid-point and fast rates of adoption), and what policymakers and business leaders can do to both secure the benefits and navigate the challenges. The key findings are summarised below.

- Automation technologies offer the promise of better customer and citizen outcomes, new business ventures and more efficient operations. We estimate that between 25 and 46 percent of current work activities in Australia could be automated by 2030, helping to drive a renaissance in productivity, income and economic growth. If seized, this opportunity could add \$1.1 trillion to \$4 trillion to the economy over the next 15 years, providing every Australian with \$4,000 to \$15,000 in additional income per year by 2030. Achieving these benefits depends on ensuring displaced workers can get new jobs.
- Automation technologies will disrupt workforces across the economy. We estimate that 3.5 million to 6.5 million full-time equivalent positions could be affected, with 1.8 million to 5.0 million workers needing to change professions. At a mid-point pace of adoption, disruption by industry could range from 16 percent of jobs in the education sector up to 33 percent of jobs in transport. Across regions, the impact could vary from 21 percent in city centres dominated by professional services to over 30 percent in mining regions like the Pilbara. The economy will adjust, however, and new jobs will flow from the higher productivity that automation generates, as well as other trends including rising consumer incomes, greater health spending on ageing and infrastructure investment.
- While some jobs will be lost, and others created, all jobs will change. As automation technologies take over more routine, predictable and physical activities, the mix of skills required in all jobs will shift, and there may be more opportunities for women with children, older workers and people with a disability. People at work will spend over 60 percent more time using technological skills and over 40 percent more time using social and emotional skills. Demand will increase for workers in unpredictable and interactive roles such as nurses, care workers and salespeople, but will fall for workers doing more automatable activities such as radiologists, mechanics, legal research assistants and those in accounts processing.
- Left to its own devices, automation could have significant distribution impacts. During the peak of the transition, increased job churn could see Australia's unemployment rate temporarily spike by up to 2.5 percent (for example, from 5 to 7.5 percent). Without retraining for vulnerable workers, especially administrative and manual workers and those in vulnerable regions, income inequality could widen by up to 30 percent.
- With foresight and a commitment to act, Australia can capture the opportunity offered by automation, manage the risks and ensure the gains are broadly shared. The national effort could include essential competition reform and strong mechanisms to coordinate action. Companies and public agencies could refresh their strategies with ambitious customer- and citizen-centric targets that could only be achieved with automation, then build the skills and culture they need to meet them. Educators can lead efforts to foster lifelong learning of relevant skills through accessible, modular courses. Finally, companies could benefit from taking farsighted steps to assist displaced workers, complementing renewed government efforts to protect the most vulnerable and promote inclusive income growth.

Australia's automation opportunity

Our scenarios for midpoint to rapid automation adoption highlight significant upsides



50-150%

Increase in average annual productivity growth compared to baseline



\$4,000-\$15,000

Additional annual income per Australian by 2030



\$170-\$600 billion

Additional annual GDP by 2030

Potential workforce displacement and transitional risks



25-46%

Share of existing workforce activities that could be automated by 2030, under our midpoint to rapid automation adoption scenarios



+27%

Increase in income inequality without additional retraining programs, under our midpoint automation adoption scenario



+0.3-1.2 ppt

Increase in unemployment rate without additional transitional support programs, under our midpoint automation adoption scenario

Workforce transitions

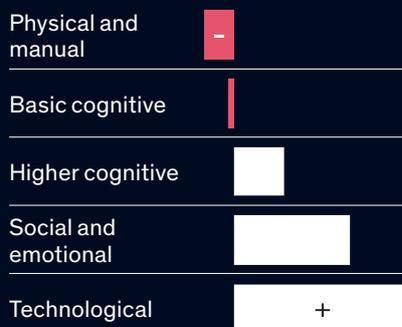
Our scenarios for automation and labour demand also highlight challenges for workers

Switching occupations...

1.8-5 million

Number of people who may need to switch occupational categories by 2030, under our midpoint to rapid automation adoption scenarios

Demanding new skills...



Changing education requirements...

High school or less



Certificate/
Diploma



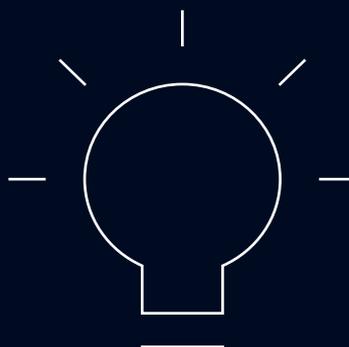
University or advanced



Ten ideas for policy makers, employers and educators

A. Governments and employers should accelerate automation both nationally and at the organisational level

1. Jump-starting national competition agenda
2. Create national mechanisms to coordinate change
3. Accelerate automation at the organisational level
4. Build the organisation of the future



B. Governments, employers and educators should promote inclusion by supporting workers through job and skill transitions

5. Invest in worker retraining
6. Support displaced workers prepare for new roles
7. Better align course offerings with needs
8. Establish 'lifetime learning accounts'
9. Invest in individual transitional support
10. Optimise re-employment services

Executive summary

A century ago, few things said ‘the world is changing’ louder than a horseless buggy. Today’s horseless buggy is a driverless car, but robo-taxis are just one of infinite automations that will change people’s lives, combining robotics, machine learning and artificial intelligence (AI). That prospect may seem both exciting and terrifying, but it is fast becoming a reality in Australia and elsewhere.

Automation is coming at an interesting time for Australia, which is now approaching three decades of uninterrupted economic growth. While the benefits have been shared relatively widely and there has been a lot to celebrate, many Australians have recently started to feel that they are missing out. In some ways, they are right: the last decade has not been as impressive as the first two decades of the boom, delivering both lower economic and income growth, and fewer benefits to Australian households.

It is perhaps natural that people who are feeling anxious about their economic futures are not thrilled about the prospect of another wave of technological change. However, automation is not the harbinger of robot armies and mass unemployment. While it may seem counter intuitive, automation holds great promise for Australia and could help to rekindle the kind of economic growth that delivers higher living standards and more choices for everyone. Of course, automation will inevitably create challenges, but Australia has in the past confronted similar challenges head on and found ways to maximise opportunities to build sustainable and inclusive growth for all.

This report sets out why and how Australia must push for the win-win scenario of inclusive growth (top-right scenario, Exhibit 1) by pursuing actions that both accelerate automation adoption *and* share its benefits:

- Australia needs to boost productivity to rekindle the kind of sustainable economic growth that spreads income growth across the population, especially given the long-term headwinds of an ageing population. Without a renaissance in productivity, Australia risks a permanent future of lower growth, and reduced resources to invest in creating more opportunities for all its citizens.
- Automation could provide just the fuel Australia needs to turbocharge productivity, with the potential to boost productivity growth by 50 to 155 percent relative to a base scenario, depending on pace of adoption. This could result in a 20 to 70 percent increase in gross domestic product (GDP) growth, and a 60 to 190 percent increase in per capita growth.
- The scale of this opportunity is considerable: automation could add around \$1.2 trillion to the Australian economy by 2030 and give each Australian additional income of \$4,000 per year. A bold push to rapidly automate could more than triple these benefits to \$4 trillion and \$15,000 respectively.³
- However, automation will change the nature and mix of Australia’s jobs, posing skills and equity challenges across sectors, occupations and regions. Without a concerted effort to support displaced workers to retrain and re-enter the workforce, unemployment could rise by up to 2.5 percent and income inequality could widen by up to 30 percent.
- Capturing the potential upside of automation and positive outcomes for workers will not magically happen on its own. To overcome the risks and benefit from the opportunities, Australia needs the twin national efforts of accelerating automation while ensuring social inclusion, with national mechanisms for policy and coordination.

³ Assumes that all displaced workers re-join labour market at productivity levels equal to or higher than previous job.

Automation holds great promise for Australia and could help to rekindle the kind of economic growth that delivers higher living standards and more choices for everyone. Of course, automation will inevitably create challenges, but Australia has in the past confronted similar challenges head on and found ways to maximise opportunities to build sustainable and inclusive growth for all.

Pick a box

Scenarios for potential outcomes of automation, by pace of adoption and effectiveness of policies to share gains



The alternatives are not appealing: either firms race ahead and automate, leaving workers behind (top-left scenario); or Australia tries—in vain—to hold back the unstoppable tide of automation (bottom-left scenario), potentially while also fighting over a shrinking pie (bottom-right scenario).

Faced with these alternatives, it is imperative that Australia taps into the collaborative, bipartisan and reformist spirit that launched its economic boom, so that it can continue to reap the rewards. Society must recognise that automation is inevitable and actively steer its course, rather than choosing fear and resistance.

To help prepare Australia for the next wave of change, McKinsey Australia has looked at what the country has done to successfully navigate past structural changes and to ensure that benefits were fairly shared (Chapter 1); how automation could positively impact Australia (Chapter 2), as well as the potential challenges (Chapter 3); and finally, what the country could do to prosper in the age of automation (Chapter 4). The key findings from these chapters are summarised below.

1. Australia needs to boost productivity to extend its boom

Australia won't generate the widespread benefits and rising incomes that it enjoyed from 1992 to 2007 unless it can accelerate its flagging productivity growth.

Australia's impressive economic boom delivered widespread benefits

Australia has enjoyed a 27-year streak of uninterrupted economic growth, skilfully navigating a series of global crises while undertaking significant structural reforms: opening up its economy, increasing labour market flexibility, transitioning to a service-based economy and embracing the digital revolution. The results have been the envy of the world, prompting *The Economist* magazine to proclaim Australia the world's 'most successful rich economy' in 2018.⁴ Australia now boasts the highest median income and wealth in the G20 (a group of the world's major industrialised economies) and the highest human development levels, and it is home to three of the world's ten most liveable cities.⁵

⁴ *Aussie rules*, *The Economist*, October 27, 2018.

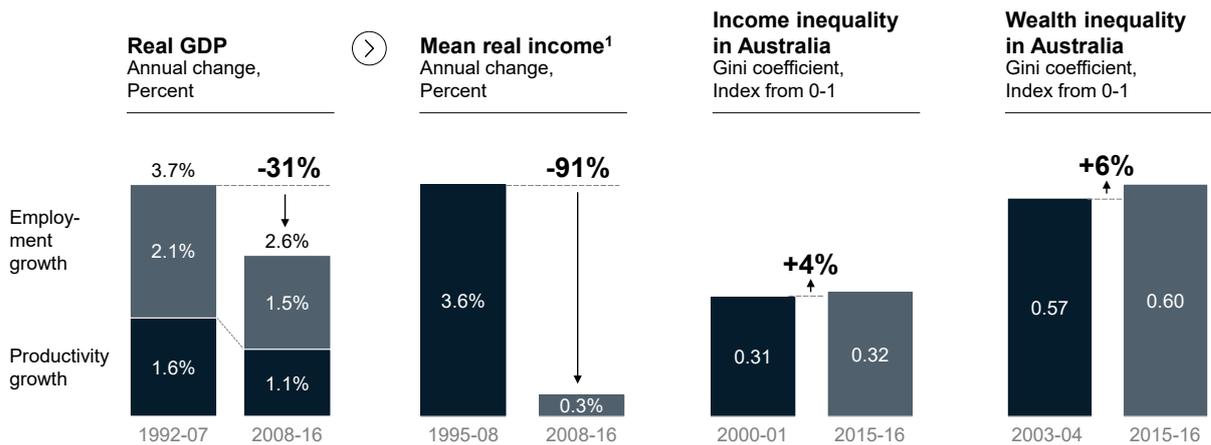
⁵ *The Global Liveability Index 2018*, *The Economist*.

For most of Australia's boom, the benefits of economic success were distributed relatively widely. Between 1995 and 2016, the great majority of Australians—regardless of income quintile—enjoyed an average annual rise in income of around 2.4 percent, resulting in an extraordinary two-thirds increase in income levels over that two-decade period. This income growth, combined with progressive government policies, allowed Australia to avoid the sharpest gaps between 'haves' and 'have-nots' that have plagued many other advanced economies in recent decades. Despite a recent slight uptick, both income and wealth inequality in Australia are at or below the average for advanced economies, and well below levels in the United States.

However, as the boom weakened, growth became slower and less inclusive

While the macro story of the last three decades is overwhelmingly positive, the most recent decade has been less impressive, with slower growth fuelled by less inclusive drivers. This shift in gears has produced smaller and less equitable gains. Since the Global Financial Crisis (GFC), GDP and productivity growth have fallen by a third to 2.6 percent and 1.1 percent per year, respectively (Exhibit 2). This slowdown occurred across nearly every industry, and sectors employing around half of all Australian workers saw little or no productivity growth at all. With productivity on the wane, the engines of growth have tilted to less sustainable drivers such as the terms of trade boom (fuelled by China), rising household debt and strong population growth.

Exhibit 2
Shifting down a gear



¹ Equivalised disposable household income; data only available from the 1994-95 financial year. Not available for the 2016-17 financial year
Note: All growth rates are compound average growth rates (CAGR)
Source: ABS National Accounts (Catalogue 5206) and Household Income and Wealth (Catalogue 6523)

The impact on Australians has been painful, with almost no meaningful increase in average real incomes in almost a decade. Income growth has essentially collapsed, inching ahead at just 0.3 percent a year (Exhibit 2). This sharp slowdown has coincided with a slight uptick in income inequality. Wealth inequality has increased too, driven by the long housing boom (notwithstanding the recent cooling in prices), exacerbating inequalities between existing homeowners and those who are increasingly priced out of the housing market. These trends have left many Australians feeling like they have missed out on the boom years.



To reignite inclusive growth, Australia needs to accelerate productivity

Productivity and wages have historically moved in tandem with one another in Australia (Exhibit 3). Worryingly, both have declined and the two are now diverging, raising concerns about the fairness of how benefits from growth are being shared. Since 2008, productivity growth has run at three to four times the rate of wage growth, suggesting that businesses have invested their smaller productivity gains elsewhere. This decoupling has occurred in the past and eventually readjusted, so it isn't yet clear whether the current break is a structural shift or simply a short-term phenomenon. However, the closer these two measures track, the more inclusive and sustainable a nation's economic growth.

Exhibit 3

Separation or divorce?

Historical correlation of productivity and wage indicators in Australia¹

Index, 1992=100



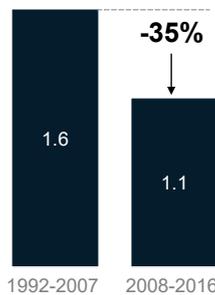
Note: Numbers may not sum due to rounding
¹ Real compensation per hour calculated using CPI

Source: OECD

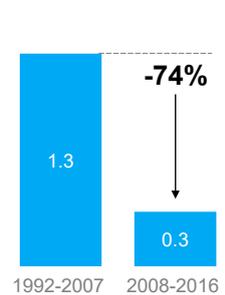
Growth in indicators

Annual change (CAGR), Percent

Labour productivity



Labour compensation per hour



To reignite income growth for Australian households, the country must re-fire its productivity engine *and* ensure that any gains translate into wage gains. If it fails in this task, we estimate that Australia's economic growth could decline to an average of just 2.4 percent through to 2030, and that per capita GDP growth could stagnate at the current low of 0.9 percent.

2. The automation opportunity

Automation is an inevitability that holds enormous promise for Australia. But that does not mean that its benefits are inevitable. The extent to which it can boost productivity and incomes depends on how fast Australia chooses to enter the automation age.

The automation wave is on its way, with enormous promise

Automation technologies—advanced robotics, machine learning and AI—have the potential to make revolutionary changes to the workplace. For example, AI-driven algorithms can already recognise faces, personalise product recommendations, automate customer service, coordinate supply chains, detect fraud, schedule asset maintenance, make hiring decisions, analyse financial risk, create online content and interpret X-rays. Much more growth and competitive reshuffling is still to come. Globally, the McKinsey Global Institute has found that AI alone may deliver US\$13 trillion in additional economic activity by 2030—about 16 percent more than it would achieve otherwise.

A significant share of workplace activity could be automated

The McKinsey Global Institute has mapped automation technologies against more than 2,000 specific work activities across 800 occupations and examined the global implications. This research also examined multiple factors that would affect the pace and extent of automation, resulting in three scenarios for automation potential (i.e. what can technically be automated, because the technology exists) and automation adoption (i.e. what we believe will be automated, taking into consideration financial, regulatory, and political and social constraints). These three scenarios are: (1) a late (or slow) scenario; (2) an early (or fast) scenario; and (3) a mid-point scenario, which is the average of the late and early scenarios. For early adoption to happen, technologies and solutions would need to be developed at an accelerated speed, requiring both the public and private sectors to invest significantly in research and development (R&D), technology development and technology deployment. That would require investment in developing the technologies themselves, and in digitally enabled infrastructure. Likely barriers to adoption would also need to be overcome quickly, requiring a high degree of support and consensus across society.

McKinsey Australia has applied these methodologies to examine the impact for Australia. We found that 63 percent of work activities have the potential to be automated by 2030 in the mid-point scenario, and 81 percent in the early scenario. Factoring in potential barriers to adoption, we estimate that 25 percent of work activities will be automated by 2030 in the mid-point scenario (about 40 percent of the total potential) and 46 percent in the early scenario (about 60 percent of the potential).

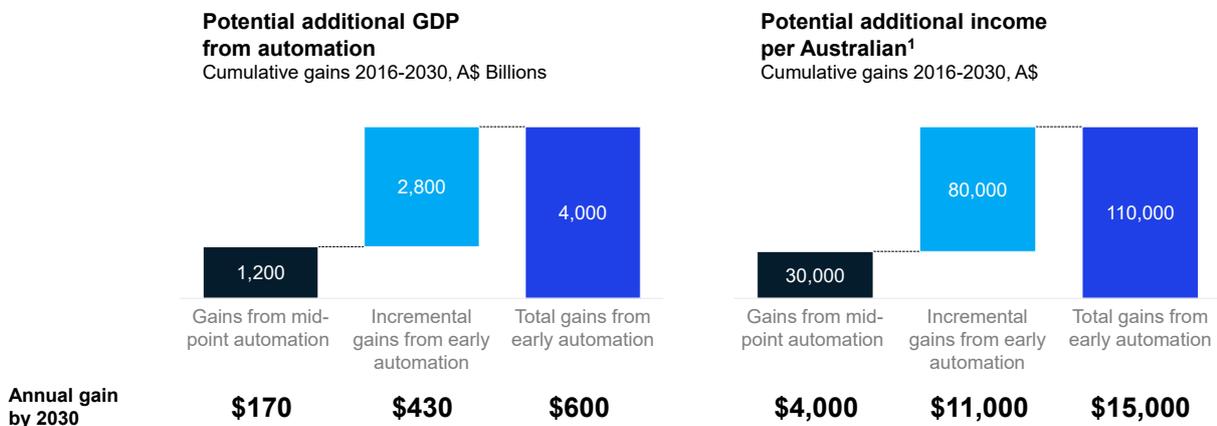
Three-quarters of Australia's automation opportunity will be found in nine sectors. Six are among the largest employers in the economy and have highly automatable activities: retail, administrative and government, construction, manufacturing, accommodation and food services, and transport and warehousing. Three more sectors—healthcare, professional services and education—will experience significant automation simply due to their size and diversity of work activities. Notably, three of the nine sectors—administration and government, healthcare and education—are heavily dominated by the public sector, making public agencies critical players in capturing automation opportunities.

Automation can help reignite income growth by boosting productivity

By lifting productivity and incomes, mid-point automation could add around \$1.2 trillion to the Australian economy by 2030 and give each Australian additional income of \$30,000 over that period (Exhibit 4). A bold push to rapidly automate could more than triple the benefits to \$4 trillion and \$110,000 respectively. In annual terms, this could increase incomes for Australians by \$4,000 to \$15,000 per year by 2030 (7 to 26 percent more than otherwise).

Exhibit 4

The automation opportunity



Note: Numbers may not sum due to rounding
¹ Equalised disposable household income

Source: ABS National Accounts (Catalogue 5206) and Household Income and Wealth (Catalogue 6523) data, McKinsey Global Institute analysis

By adopting automation at the mid-point rate, Australia could boost annual productivity growth to around its pre-GFC rate of 1.6 percent; rapid adoption could boost it to 2.7 percent (almost two times the pre-GFC rate). This could increase annual GDP growth to between 2.9 and 4.1 percent (depending on speed of adoption) and accelerate per capita income growth from 0.9 percent to 1.4–2.5 percent. In some tradeable sectors, such as manufacturing, rapid adoption offers the opportunity to increase productivity levels and potentially catch up to competitors. In domestic sectors, such as retail, rapid automation could allow firms to overtake US productivity levels, potentially enabling significant wage increases for workers.

Against the long-term headwinds of an ageing population, the threats of declining growth in China, rising global protectionism and the recent housing market downturn, automation is an opportunity that Australia cannot afford to ignore.

Capturing these benefits of automation will, however, require substantial investment in assets, automation of business processes and workforce capability building by organisations across the private and public sectors. We estimate that it could require additional cumulative investment of around \$800 billion by 2030 in the mid-point scenario (in real terms), and around \$2.7 trillion in the rapid adoption scenario—about 11 to 39 percent more than would be required otherwise. This equates to additional annual investment of between \$60 billion and \$300 billion, on average, in the period to 2030 depending on the pace of automation.

3. The challenges to employment, skills and inclusion

Automation does not come without its challenges; there is no denying that it will displace jobs, and disrupt workplaces and some vulnerable communities. However, the extent of this change is neither unprecedented nor unmanageable, and the benefits will be lasting.

Total job demand will be resilient, though with much churn

The 25 and 46 percent automation adoption rates under the mid-point and early scenarios translate to around 3.5 million or 6.5 million full-time equivalent positions displaced over the next decade, respectively. These levels of displacement are not unprecedented: they equate to a simple average annual displacement rate of around 1.8 percent in the mid-point scenario (not dissimilar to recent historical rates of displacement due to technology and economic change) and 3.3 percent in the rapid scenario (roughly 40 percent higher than recent trends). At the same time, moreover, population growth, rising consumer incomes, growing healthcare needs from an ageing population, and higher energy and infrastructure investment will continue to create jobs. Once automation kicks in, it will have second-round positive impacts on income and consumption, creating a virtuous loop. These trends will help to absorb displaced workers and return the economy to close to full employment.

While the very long-term (50- to 100-year) impacts of automation are hard to fathom, the economy should adjust and stabilise over the next decade or so. However, there is no doubt that displaced workers will find this period challenging. Some may be able to find similar jobs, but between half and 80 percent may need to retrain and transition to completely new occupations in order to find work, depending on the pace of automation.

The immediate challenge is to minimise long-term unemployment for individuals transitioning between jobs and occupations by maintaining labour market flexibility and stepping up support for displaced workers. If Australia's historically high re-employment rate for unemployed people holds, automation may have a relatively small impact on the unemployment rate, causing a temporary rise to between 5.3 and 5.7 percent (Exhibit 5). However, if the re-employment rate falls, the overall unemployment rate could rise as high as 6.2 percent in the mid-point scenario (1.2 percent higher than otherwise) and 7.3 percent in the rapid adoption scenario (2.2 percent higher than otherwise).

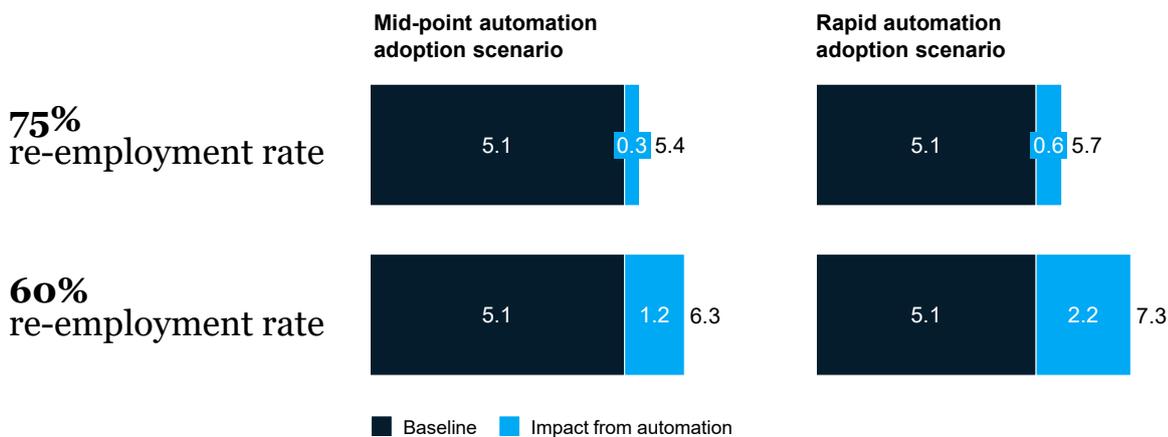
Job demand will vary by sector, occupation and region

Existing jobs will see varying shifts in supply and demand. While across the nation about 25 percent of jobs will be affected in the mid-point scenario, this could range from lows of 16 percent in the education sector to highs of 29 percent in manufacturing. Even within sectors, there will be variation across occupations. In the health sector, for example, there will be more demand for doctors and nurses but lower demand for radiologists. In the retail sector, there may be greater demand for customer service staff but lower demand for checkout staff.

Exhibit 5

Peak unemployment

Scenarios for peak impact on unemployment by automation adoption and re-employment rate¹ within one year
Percent in 2025

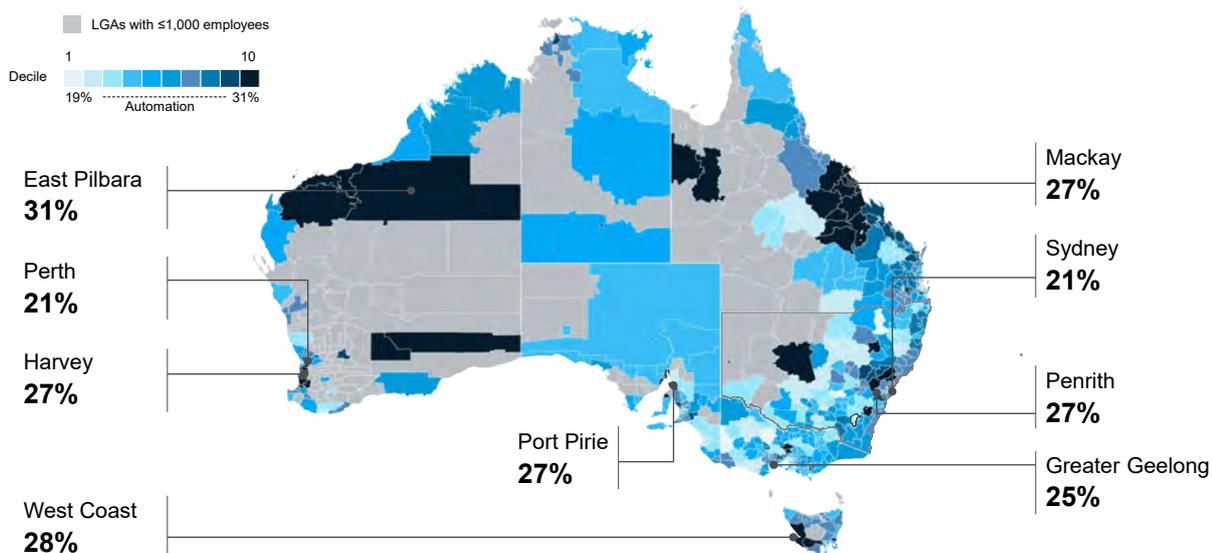


¹ Over long term, 75% of unemployed persons in Australia have been re-employed within one year. The lowest rates recorded are around 60% during the recessions of the early 1980s and 1990s
Source: ABS Labour Force (Catalogue 6202), December 2018; McKinsey Global Institute Global Growth Model

Exhibit 6

Regional blues

Mid-point automation adoption by 2030, by local government area (LGA)



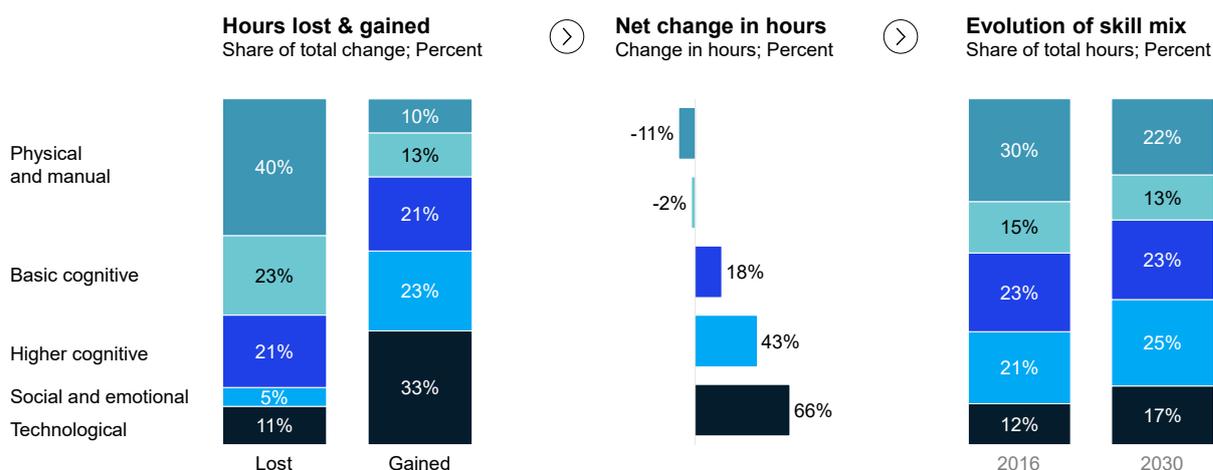
In addition, while our modelling predicts that the rate of automation will be relatively uniform across Australian states and territories, there will be significant variation across local areas and communities (Exhibit 6). Job displacement could range from lows of about 21 percent in the inner cities to highs of about 31 percent in some outer suburban and remote areas, where jobs are concentrated in vulnerable sectors like mining, transport and construction.

Different skills will be needed, and at a higher level

Automation will also lead to a shift in the demand for skills across the economy, requiring everyone to upskill and retrain (Exhibit 7). Four types of work activities will see an increase in demand: working with machines (technology skills), applying specialised expertise (higher cognitive skills), interacting with stakeholders (social skills), and managing, teaching and developing people (emotional skills). In our mid-point scenario, workers will spend 66 percent more time using technology, and 43 percent more time in personal interactions that require social and emotional skills. In contrast, the need for people to perform physical and routine

Skills evolution

Change in hours worked by skill category, 2016-30 (step-up labour demand, mid-point automation)



Note: Based on difference between hours worked per skill in 2016 and modelled hours worked in 2030 in step-up scenario and mid-point automation adoption

Source: McKinsey Global Institute workforce skills model, McKinsey Global Institute analysis

tasks will shrink. Again, the skills shift will vary by industry. In transport, for example, demand for vehicle drivers will fall sharply, but automated fleets will be directed by people who can engage with monitoring technology, recognise issues, and work with stakeholders and their teams to resolve them.

Over time, automation could exacerbate current mismatches between future graduates' skills and labour market needs. For example, there may be an oversupply of vocational education and training (VET) graduates with entry-grade engineering or business skills (which are highly susceptible to automation). At the same time, Australia could face a shortage of 600,000 university graduates by 2030 in health, education and information technology (IT), including highly trained postgraduate engineers who know how to develop and work with new technology. Within the graduate body, students are already moving towards the health, science and education disciplines, all of which are areas of need. Accelerating these trends could minimise future labour market mismatches.

Without a strong societal response, automation could widen inequality

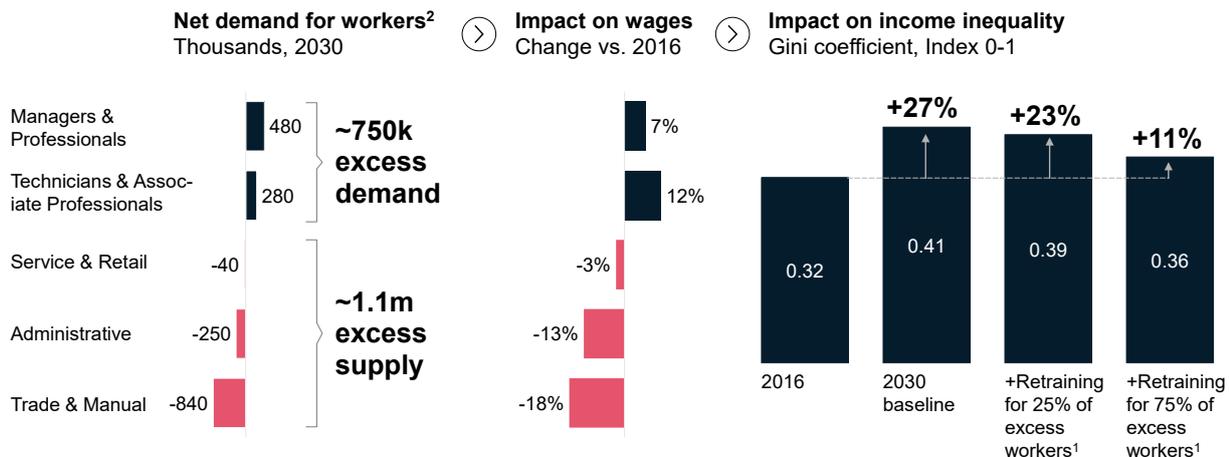
By global standards, Australia has moderate levels of income inequality. However, there are legitimate concerns that automation may increase those levels, as wages will tend to favour the more skilled. Subject to retraining efforts, the economy may need about 750,000 more professionals, managers, technicians and associate professionals by 2030, and may have a surplus of around 1.1 million trade, manual and administrative workers (Exhibit 8). These supply-and-demand forces could lead to a divergence in pay cheques, potentially leading to a 7–12 percent increase in wages for those with in-demand skills, and a 13–18 percent decline for those with over-supplied skills.

The extent to which these market forces result in higher income inequality will depend upon how much Australia steps up its efforts to retrain and redeploy its surplus service, administrative and manual workers. Without retraining, Australia's Gini coefficient of income inequality may rise by as much as 27 percent to 0.41, on par with the United States today. If three-quarters of surplus workers were retrained, the Gini coefficient would rise to just 0.36 (11 percent); if they were all upskilled, the co-efficient would not change at all.

The need for retraining underscores the risks for older workers, who may not be prepared, willing or able to upskill. Perhaps the greatest risk lies in outer suburban and regional communities, where sectors with greater potential for automation are concentrated. People living in these areas may have fewer local employment options and face a number of barriers to re-employment, particularly if they have already experienced waves of layoffs.

Divergence or convergence?

Scenarios for impact of automation on income inequality, by retraining scenario for workers in excess supply,¹ 2016-30 (mid-point adoption scenario, step-up labour demand)



¹ Workers in excess supply (e.g. trade and manual workers) are retrained to fill vacancies in technician and associate professional jobs, while technicians and associate professionals are retrained to fill vacancies in manager and professional jobs
² Demand for workers minus supply of workers

Source: MGI Global Trade Analysis Project (GTAP) general equilibrium model

4. A national agenda for automation and inclusion

Automation could provide a major boost to Australia's productivity and national prosperity. While the country has the necessary foundations to seize this opportunity, the challenge lies in accelerating the pace of automation adoption while simultaneously working to ensure inclusive growth. Australia's successful history of structural reform should help in managing this transition, but it will require collaboration across the Australian economy by governments, employers and education providers. We offer ten ideas for navigating the twin challenges of accelerating automation and ensuring inclusive income growth for consideration as part of this collaborative national effort.

A. Accelerate automation both nationally and at the organisational level

Governments

1. **Incentivise automation adoption in the private sector by jump-starting the national competition agenda.** The 2015 Harper Review and the Productivity Commission have made recommendations for improving Australia's competition policies and institutions to reverse its stalled reform momentum. Bold political leadership and a broad public mandate will be critical to implementing these recommendations and accelerating the pace of reform.
2. **Create national and regional coordination mechanisms to drive reform and maximise the productivity and inclusion benefits of automation.** The automation challenge needs systematic and wide-reaching engagement, and only the government has the resources and political mandate to coordinate across the economy. New mechanisms may be needed to provide a credible fact base on automation, forge consensus, and integrate implementation across government. There is also a place for regional mechanisms to coordinate national strategies at that level.

Private and public employers

3. **Accelerate automation at the organisational level as part of a long-term strategy, with ambitious targets that only the latest technologies can deliver.** The opportunities of automation apply equally to the private and public sectors. Organisations in both sectors could accelerate investments in automation technology, setting ambitious targets anchored in long-term strategies.

4. **Build the organisation of the future with the right size, shape and skills to deliver an automation strategy.** Private companies and public agencies will need to build organisations with the right size, shape and skills to deliver their automation strategies. This requires a gap analysis of current and future skill needs, and a comprehensive and well-executed strategic workforce plan to close those gaps.

B. Promote inclusion by supporting workers through job and skill transitions

Private and public employers

5. **Mitigate the impact of automation on the workforce by investing significantly in worker retraining and building an agile and resilient culture.** Organisations will not be able to hire all the skills they will need in the future. Instead, they will need to equip existing staff with the skills they need for new roles—for example, by investing significantly in worker retraining and upskilling, and creating an agile organisational culture that can adopt and adapt to technology.
6. **Support displaced workers beyond the organisation.** Employers could take steps to prepare workers for new careers, improving morale among continuing staff and attracting new staff with in-demand skills, funding and partnerships.

Education providers and governments

7. **Better align course offerings to student and employer needs.** Courses offered for working students could benefit from two changes: greater flexibility in the structure and timing of courses, and closer alignment with the mix of skills that workers at all levels will need. For these changes to happen, new funding models would need to link funding to student outcomes rather than intentions.
8. **Establish 'lifetime learning accounts' for adults of all ages.** Such accounts—active in Singapore and France, and under consideration in the United States—could support agile reskilling for adults.

Governments

9. **Invest in individual support rather than regional or sectoral plans.** It will be tempting to pursue sectoral or regional plans. A better use of public funds may be to offer targeted assistance that matches workers' individual profiles.
10. **Optimise re-employment incentives and capacity, and pilot social welfare innovations as needed.** Tweaks can always be made to ensure that existing unemployment and welfare systems provide appropriate incentives and capacity for workers to reskill and find better jobs. Governments may also consider piloting new ideas such as wage insurance to determine their effect in Australian conditions.

Automation is coming. The question is, what can Australia do to get the best possible outcomes for everyone?

Australia has managed this type of transition before, and it can do it again. When its economy has been under stress in the past, Australia has impressed the world with its will and capacity for effective solutions. However, the opportunities and challenges of automation are not something that a government, a single firm or a single individual can navigate alone. Australia needs a clear national strategy, the right skills and effective collaboration at all levels, as well as the determination to take action when needed.

The challenge is clear, but so is the prize. The timely and rapid adoption of automation can restore Australia's economic lustre, make its economy and workplaces more inclusive, create the necessary wealth for higher income growth—and perhaps even usher in a new and even brighter era of inclusive Australian prosperity.



Is the long boom in income growth at an end?

Australia is experiencing one of its longest stretches of prosperity, comparable to the period from the 1940s to the 1970s. For almost three decades, the Australian economy has grown, and real incomes have risen. For most Australians, this has been a time to celebrate.

Many experts now fear that the boom is running out of steam, leaving Australia to face a future with lower growth as its population ages. Even worse, too many Australians feel that they have not benefitted from the boom. This raises an important question: What is needed both to extend the boom and to restore broader economic confidence?

This chapter argues that the answer is to increase productivity back to levels not seen since the early 2000s in order to underpin the economic growth needed to generate widespread and inclusive prosperity.

- Australia's long boom (since 1992) is a truly impressive case study of sound economic reform leading to economic success, which has funded progressive social policies to deliver inclusive growth and an enviable quality of life.
- For the first two decades of the boom, economic growth was powered by productivity gains and delivered widespread benefits and income gains.
- However, since the Global Financial Crisis (GFC) in 2007–08, headline growth in gross domestic product (GDP) has declined and now rests on less sustainable foundations, producing almost no household income growth and exposing inequalities.
- Before the boom runs out, Australia needs to re-boot productivity—the main driver of quality growth—in order to extend the boom and deliver higher incomes for all.

Chapter 2 suggests that automation holds the promise to do just that.

Three decades of growth from determined reforms

Australia was one of the world's most open trading economies until the 1900s, when the recession of the 1890s triggered a string of protectionist policies that persisted for almost a century. Prior to the 1980s, Australia's economy was inward-focused and heavily regulated. The Australian dollar was pegged to the British pound, tariffs shielded domestic industries from global competition, and industrial tribunals had significant power to set wages across whole sectors. The government controlled capital flows, barred foreign banks from establishing footholds in the country, and set pricing and output levels for industries ranging from dairy to retail. Governments also owned monopoly corporations in telecommunications, post, power, water and gas utilities, as well as the country's biggest airline and bank. Regulators even controlled the size and interest rates of loans that banks could offer.⁶

Yet for all those faults, Australia's economy performed as well as any from the 1940s all the way through to the 1970s. Income growth wasn't high, but neither were inflation or house prices. A single middle-class wage was more than enough to finance a family of five, a car and a house in the rapidly expanding suburbs. Australia became known as 'the Lucky Country' because its economic fortune was a gift of natural resources, but for all that good fortune the country was wasting glorious opportunities.⁷

All this came to a shuddering halt with the global oil shocks of 1973 and then 1979, which led to the dismal 'stagnation' of high unemployment and high inflation in Australia and elsewhere. Australia made it through the 1970s, but only just. It fell to later governments to start the work of overhauling the Australian economy so that it could compete and prosper in a rapidly globalising world.

⁶ *Australia's experience with economic reform*, Australian Government, The Treasury, October 2018.

⁷ This term comes from the title of Donald Horne's book on Australia and its culture (*The Lucky Country*, Penguin, 1964). It was widely adopted soon afterwards for more optimistic reasons.

Opening the economy for the first time since World War 1

In 1980, former Singaporean prime minister Lee Kuan Ywe famously warned that Australia was destined to become the ‘poor white trash’ of Asia if it didn’t open up its economy.⁸ Australia rose to the challenge, and the transformation seen in the decades since has become the wonder of the world.

Australia successfully navigated three decades of structural reform, opening up its economy, increasing labour market flexibility, transitioning to a service-based economy and embracing the digital revolution.

The first major reform was to float the Australian dollar in 1983. In quick succession, the government reformed consumer and anti-trust laws to boost competition, reached an ‘accord’ between business and unions to increase labour-market flexibility while safeguarding the working wage, started to ratchet down tariffs and drove plans to encourage industries to embrace globalisation (Exhibit 9).⁹ Since then, Australia has signed 11 free trade agreements, including agreements with both the United States and China; become an enthusiastic member of four regional economic partnerships; and recently joined the 11-nation Comprehensive and Progressive Agreement for Trans-Pacific Partnership. Its major publicly owned corporations were floated on the Australian Stock Exchange to help boost efficiency and competition (including the Commonwealth Bank in 1991, Qantas in 1993 and Telstra in 1997). Meanwhile, moves to deregulate the labour market in the late 1980s and 1990s have made the workforce more flexible.

Exhibit 9

Opening up

Reduction in barriers to foreign trade

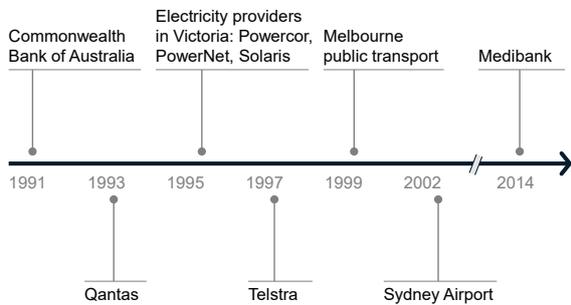
Average tariff rates, Percent of value



Source: ABS 6321, ABS 5206, ABS 5368

Liberalisation of the domestic economy

Timeline of major government privatisations



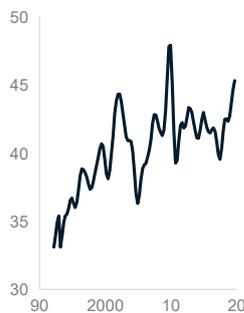
⁸ *The poor white trash of Asia: A phrase that changed an economy*, Australian Financial Review, March 2015.

⁹ We focus on the period 1992–2018 for our contextual analysis because this follows Australia’s ‘long boom’ from the end of the 1991 recession to the present day. Where we have deviated from this time period, it is due to data constraints.

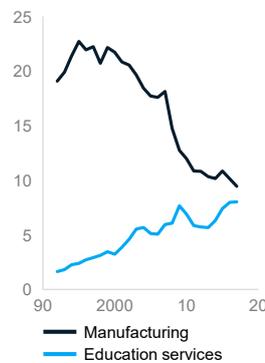
These policy shifts were intended to open Australia's economy while at the same time ending its reliance on primary exports, and they largely succeeded (Exhibit 10). Australia's trade intensity (the ratio of trade to GDP) increased from around 30 percent in the early 1990s to just under 45 percent by 2017 (Exhibit 10). While mining continues to dominate Australia's exports and commodities still account for eight of its top ten exports, services dominate the overall economy. Education is now Australia's third largest export, with the number of international students attending Australian schools and universities rising nearly eight-fold between 1994 and 2015. Employment has shifted towards the service sectors: manufacturing jobs have fallen while professional services and healthcare employment are 2.5 times their previous share.¹⁰

Exhibit 10
Keep on changing

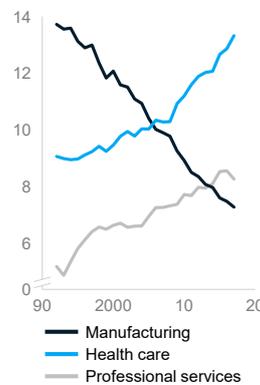
Increase in trade intensity
 Total value of imports and exports as percent GDP



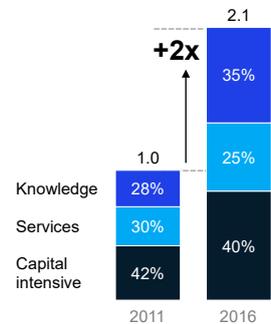
Changing export mix
 Percent of total exports



Changing employment mix
 Percent of total employment



Digitisation of Australian industries
 Australian Digitisation Index by industry group



Source: ABS 5368, ABS 6291, ABS 5206, ABS 6321; DFAT Composition of Trade, Australia (COT) TRIEC; McKinsey Digital Australia report

As the economy modernised and tilted to the service sector, work became accessible to a broader spectrum of Australians (Exhibit 11), increasing labour force participation from 63 to 66 percent in the three decades to 2018. Much of this gain was due to women entering the workforce in large numbers for the first time since World War 2, prompted by a wave of feminism in the 1970s. For example, until 1966, women in Australia had to resign from the public service when they were married. Women made up just 29 percent of tertiary students in 1970, but this had risen to 55 percent by 2000,¹¹ rightfully raising women's expectations and workforce participation from 52 to 60 percent by 2018. As a result of this shift, and other employer and employee preferences, part-time work has become more common, rising 10 percentage points since 1990 to now represent nearly one-third of employment. That increase may reflect both the empowerment of individuals to pursue their own working preferences and the disempowerment of being unable to find stable, full-time work.¹² Nonetheless, there is no doubting that increased labour market flexibility contributed to the sustained decline in unemployment during the boom.

¹⁰ More recently, growing investment in technologies more than doubled Australia's level of digitisation between 2011 and 2016. *Digital Australia: Seizing opportunities from the fourth industrial revolution*, McKinsey & Company, 2017.
¹¹ Selected higher education statistics – time series data (1949–2000, Table 1), Australian Government, Department of Education and Training.
¹² *Analysis of wage growth*, Australian Government, The Treasury, November 2017.

Upsides of flexibility

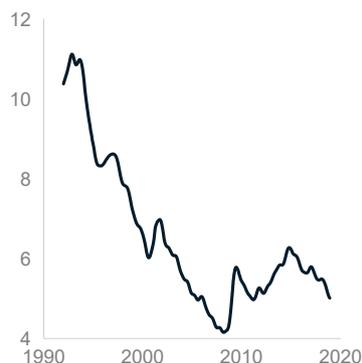
Participation rate
Percent of population¹



Part-time employment rate
Percent of total employed persons



Unemployment rate
Percent of total labour force



¹ Percentage of the civilian population aged 15 years and over

Note: All data presented is 'trend' data

Source: ABS 6202.0 - Labour Force, Australia, Dec 2018

2x

Income growth in Australia has been faster than in peer economies.

These extensive structural reforms have paid off amply (after a transitional 'recession we had to have' in 1991–92),¹³ allowing Australia to enjoy a record-breaking 27-year streak of uninterrupted economic growth. Increasingly buffered by trade with China, Australia was only minimally affected by the Asian crash of 1997 and was able to negotiate a safe path through the 2008 GFC by stimulating consumer demand and guaranteeing the financial system. Between 1992 and 2016, Australia managed to outperform its peers on almost every key economic and social metric (Exhibit 12). Over those 25 years, Australian GDP grew by 3.3 percent per year—almost 60 percent faster than the average of its advanced economy peers in the G20. Unemployment averaged 6.5 percent over the period, just slightly lower than Australia's peer average. As a result, average disposable incomes increased by 3.3 percent annually—almost double the rate of Australia's peer average. By 2016, Australia had achieved the second highest level of GDP per capita in the G20 (with the United States coming in first), at around US\$46,000 (roughly AU\$70,000).¹⁴ Moreover, given its significantly lower inequality, Australia overtook the United States on *median* adult income, taking the top spot in the G20.¹⁵ Australia also ranked number one in the G20—and in the world—on median adult wealth in 2018, with *median* wealth of US\$191,450 per adult (roughly AU\$270,000), beating out even Switzerland (US\$183,340).¹⁶

Australia has been described as the world's most successful rich economy. It boasts the highest median income and median wealth in the G20, as well as the highest human development levels, and it is home to three of the world's ten most liveable cities.

75%

Australia's net debt is lower than in peer economies.

Just as impressively, and contrary to popular opinion in the country itself, Australia delivered these outcomes without racking up high levels of government debt. Although debt increased after the GFC, Australia's net government debt stood at just 19 percent of GDP at the end of 2016, fully 75 percent below the average for other advanced G20 economies. Australia has also excelled in broader measures of well-being. For example, Australia is ranked number one in the G20 (and third globally, behind only Norway and Switzerland) in the United Nations' overall measure of human development and boasts three of the world's ten most liveable cities.¹⁷ This impressive track record led *The Economist* to laud Australia as the world's 'most successful rich economy' in a special October 2018 report.¹⁸

¹³ Treasurer Paul Keating's defiant phrase as the economy was driven into recession by 17 percent interest rates.

¹⁴ World Economic Outlook Database, International Monetary Fund (IMF), October 2018. Gross domestic product per capita, constant prices measured in purchasing power parity; 2011 international dollar.

¹⁵ Income distribution and poverty tables, median disposable income (current prices), OECD, 2016.

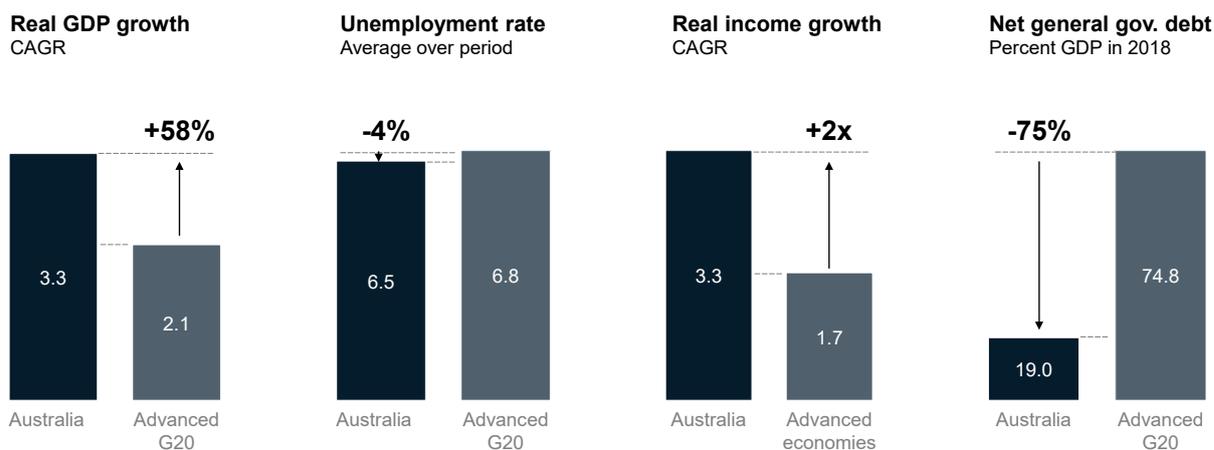
¹⁶ *Global Wealth Report 2018*, Credit Suisse.

¹⁷ *The Global Liveability Index 2018*, The Economist.

¹⁸ Aussie rules, *The Economist*, October 27, 2018.

Flying kangaroo

Comparison of Australia to its advanced G20 economy peers¹, 1992-2018



¹ Advanced G20 countries according to IMF are: Australia, Canada, France, Germany, Italy, Japan, Korea, United Kingdom, United States. Advanced G20 average is simple average for all countries excluding Australia

Source: IMF World Economic Outlook Database (October 2018), Oxford Economics, World Bank

The benefits of growth have been relatively widespread

Inequality of outcomes is inherent in any market economy; people make different choices and, despite the best efforts of progressive governments, have different opportunities. However, recognising that markets can produce harsh outcomes for many in society (if left to their own devices), most advanced market economies also introduce wage, tax and transfer policies to help prevent unacceptable levels of inequality.

Despite this long-standing norm of trying to moderate, but not eliminate, market outcomes, inequality has risen around the world in recent decades, raising concerns and anxiety, especially in the wake of the GFC. Previous research by the McKinsey Global Institute (McKinsey's private business and economics research arm) found that about two-thirds of households in 25 advanced economies were in segments of the income distribution that experienced flat or falling incomes between 2005 and 2014.¹⁹ Key drivers of this stagnation in real incomes included the recession that followed the GFC, persistently weak demand, smaller households with fewer working-age adults, lower investment returns and business incomes, and a lower share of GDP flowing to wages. The combination of these trends has left hundreds of millions of households feeling that they simply can't get ahead.

Australia is no stranger to these debates and concerns; from its convict settlements to its compulsory voting, Australia has tried to be an egalitarian immigrant country, to which people have come with the expectation that a reasonable income can convert into a high standard of living. This sentiment was reflected in the famed 1908 Harvester judgement, in which the Commonwealth Conciliation and Arbitration Commission determined that a 'fair and reasonable wage' for manual workers was seven shillings a day, enough to provide for the basic needs of a family of five. Multiple government policies have since defended the right to a 'fair go'—a fair and reasonable wage and the chance to get ahead—amid public wariness of too wide a gap between rich and poor.

¹⁹ *Poorer than their parents: A new perspective on income inequality*, McKinsey Global Institute, July 2016.



60%

The median Australian experienced an increase in income over the last two decades.

It is therefore a matter of national culture and interest to test whether the prosperity of the economic boom has been fairly shared, and whether the global trend of rising inequality has arrived on Australia's shores. Despite the undoubted stress of many Australian families and communities (discussed in more detail below), the macro-level data suggests that income growth has been shared surprisingly equally across income groups, as measured by income quintiles. Between 1995 and 2016, every quintile enjoyed an average annual rise in real income of between 2.2 and 2.6 percent (Exhibit 13). While Australia and the United States have experienced similar average income growth, Australian *median* incomes have risen four times faster than in the United States due to their more even distribution.²⁰ This sustained growth over two decades lifted the real annual income of the typical Australian by around 60 percent in total, from roughly \$28,000 per year in 1994–95 to \$45,000 in 2015–16.²¹

Policies to promote inclusive prosperity enabled all income groups in Australia to benefit from the economic boom, allowing the country to avoid the sharp divide between 'haves' and 'have-nots' that arose in many other advanced economies.

As a result of this widely shared income growth, income inequality in Australia has ticked up only slightly since the start of the boom, from 0.30 to 0.32 (about 7 percent), as measured by the Gini coefficient. Most of this increase occurred during the trade boom between 2000 and 2008, and much of it reversed immediately after the GFC. Despite this recent uptick, income inequality in Australia stands exactly at the average for all countries in the Organisation for Economic Co-operation and Development (OECD; an intergovernmental forum that aims to improve economic and social well-being): lower than in the United States, the United Kingdom and New Zealand, but higher than in some European economies with more generous welfare states.²²

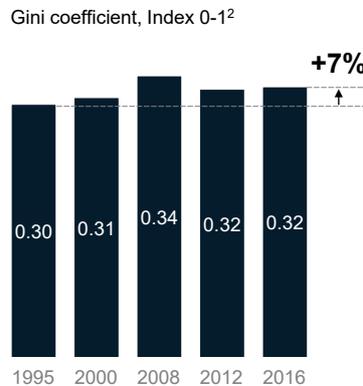
Exhibit 13

Some for you, some for me

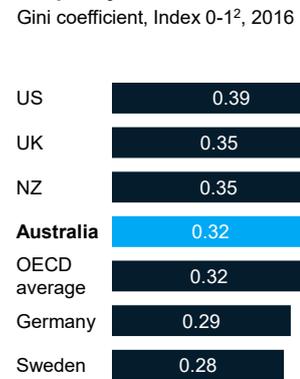
Income growth in Australia by income quintile¹ CAGR, 1994-95 to 2015-16



Income inequality in Australia Gini coefficient, Index 0-1²



Global income inequality Gini coefficient, Index 0-1², 2016



¹ Equalised disposable household income
² A higher Gini coefficient denotes higher inequality, a lower Gini coefficient denotes lower inequality

Source: OECD Economic Statistics; ABS 65230 Household Income and Wealth, Australia: Summary of Results, 2015-16

²⁰ *Aussie rules*, The Economist, October 27, 2018.

²¹ *Household Income and Wealth, Australia: Summary of Results*, ABS 65230, 2015–16. Note: Equalised disposable household income.

²² The recent Productivity Commission review of inequality came to similar conclusions. *Rising inequality? A stocktake of the evidence*, Australian Productivity Commission, August 2018.

This variation in inequality across countries hints at the scope for government policies to help promote inclusive growth. Australia has a significantly higher national minimum wage than the United States, for example, at around \$18.93 per hour in 2018 (compared to US\$7.25 per hour in the United States, unchanged since 2009).²³ Moreover, recent decisions by Australia's Fair Work Commission to award significant pay increases to social and community sector workers²⁴ have done much to ensure that the benefits of growth have been shared with the lowest income quintile.

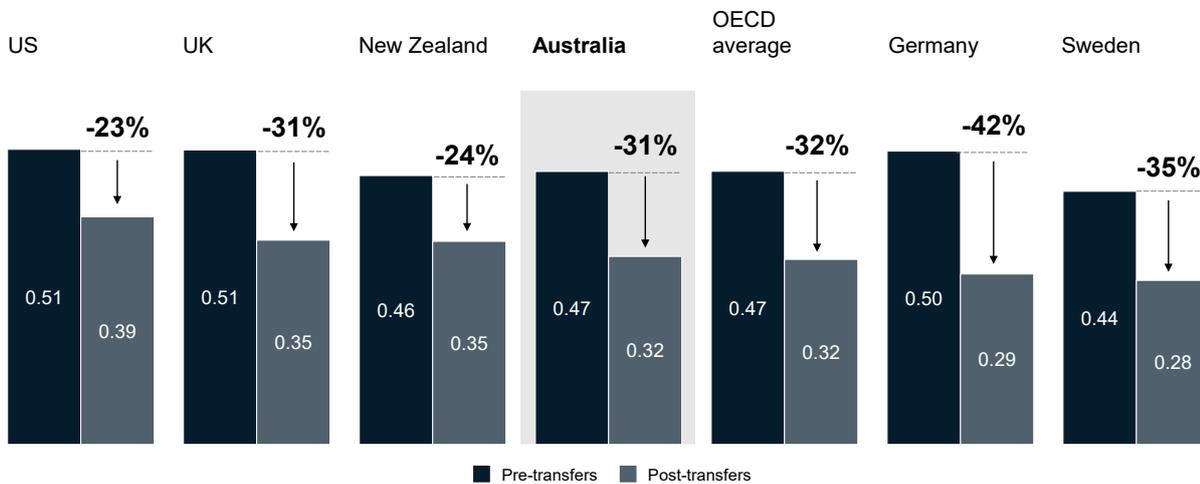
More broadly, Australia's tax and transfer policies reduce income inequality by around a third, relative to what it would be if market forces were left to their own devices (Exhibit 14). This level of redistribution hovers around the OECD average: some countries such as Germany redistribute more (around 42 percent), while others such as the United States (23 percent) and New Zealand (24 percent) redistribute less.

Australia's healthy economy has also supported strong jobs growth and social policies that allow Australians to enjoy, on average, a generous quality of life. Australia has found a broadly supported balance of socially progressive and economically rational policies. Progressive policies and investments are found in Australia's universal healthcare and education systems, broad childcare subsidies, unemployment and pension benefits, and progressive taxation system. Australia has therefore avoided the sharpest differences between 'haves' and 'have-nots', as well as the hollowing out of the middle class that afflicts some other advanced economies.

Exhibit 14

Helping hand

Income Gini coefficient, pre- and post-taxes and transfers, 2016



Source: OECD Statistics, Dataset: Income Distribution and Poverty

²³ FairWork Australia and the US Department of Labour. In the United States, the federal minimum wage for covered non-exempt employees is \$7.25 per hour, effective July 24, 2009.

²⁴ The Equal Remuneration Order (ERO) made by the Fair Work Commission (2012, with full implementation by 2020), which applies to social and community services industries.

As the boom weakened, growth became less inclusive

While the macro story of the last three decades is an overwhelmingly positive one, a closer look at the last decade reveals a less rosy picture.

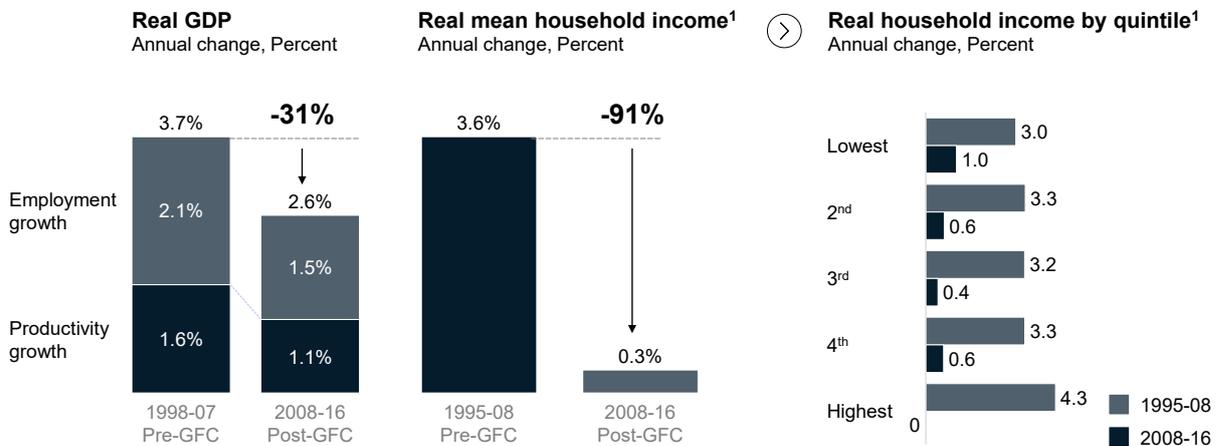
Australia's long boom extends across the 2007–08 GFC, but both its pace and nature changed after the GFC. Growth indicators declined, with average GDP growth falling by about a third, from 3.7 percent between 1992 and 2007 to 2.6 percent between 2008 and 2016. During the same period, productivity growth declined from 1.6 percent to 1.1 percent (Exhibit 15). While these don't resemble the runaway figures from the height of the boom, they are far from disastrous in global and historical terms.

Any debate over inequality, however, is sharpened when income growth itself starts to slow. This is what Australians are now experiencing, much like their counterparts in other advanced economies. In the decade since the GFC, the average Australian has seen almost no meaningful increase in their real income. After growing at 3.6 percent per year between 1995 and 2008 (and as high as 5 percent during the mid-2000s), mean incomes have inched ahead at just 0.3 percent a year since the GFC (Exhibit 15).²⁵ Although the incomes of Australia's highest earners have slowed the most, the financial pressure is perhaps most felt among the lowest tier of earners, who have the least discretionary spend and the least ability to draw on accumulated wealth reserves.

The fact that income stagnation is a global concern provides little comfort to those Australians who feel they haven't experienced the benefits of the long economic boom, as some recent surveys have highlighted.²⁶ Perhaps unsurprisingly, they have not been persuaded by the statements of politicians or market commentators celebrating almost three decades of GDP growth.

Exhibit 15

Shifting gears and stalling



¹ Household income is equivalised

Note: All growth rates are compound average growth rates (CAGR)

Source: ABS 65230 Household Income and Wealth, Australia: Summary of Results, 2015–16

²⁵ This slowdown does not appear to have been caused by a temporary blip during the financial crisis. In all but the highest income group, income growth was slower in the period after 2011 than the period from 2008 to 2011.

²⁶ For example, *Community pulse 2018: The economic disconnect*, Committee for Economic Development of Australia (CEDA). This report found that only 5 percent of respondents in a national 2018 poll of community attitudes towards growth stated that they had personally gained during the 26 years of uninterrupted growth. About 40 percent said they had gained 'a little' and 44 percent reported not benefitting at all. Moreover, almost one-third find it difficult to live on their current incomes. Importantly, some 79 percent of the respondents felt that the gap between the richest and poorest Australians had become unacceptable.

The 'quality' of growth weakened after the GFC

Not only did the pace of Australia's growth weaken after the GFC, its quality also declined, with the drivers of growth shifting away from productivity and towards less sustainable and more externally driven factors.

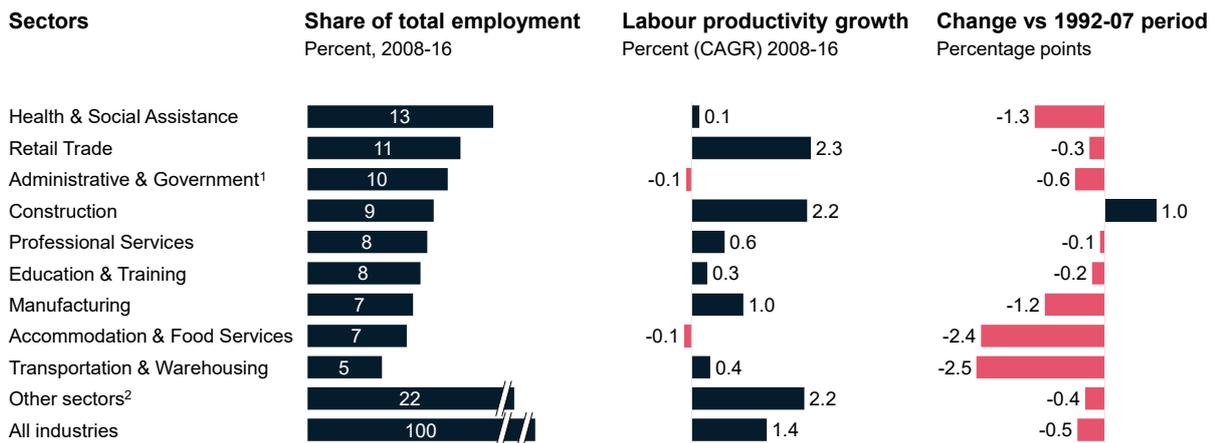
The third decade of the boom had been less impressive than the first two, with slower growth fueled by less sustainable, less inclusive drivers. This shift has produced smaller and less equitable benefits for Australian households.

Although Australia did extremely well throughout the GFC, changes to global and domestic economies meant that Australia couldn't simply resume its previous path. The GFC experience, followed by a continuing global downturn, led to a dampening of risk appetites and investment in business, and falling productivity.

In Australia, the slowdown in productivity occurred across nearly every industry, with only one sector—construction—experiencing an increase in productivity growth after the GFC (Exhibit 16). Moreover, sectors employing around half of all Australian workers saw little or no productivity growth at all. This included sectors with heavy government involvement (such as health and social services, administration and government, and education and training), as well as some privately dominated sectors such as accommodation and food services, transport and professional services.

Exhibit 16

All slow down



¹ Administrative & Government is composed of private and public administrative functions. ~70% of employment in is in public administration, with ~30% in general administrative and support functions
² Includes nine other sectors which each individually account for <5% of total employment

Source: ABS catalogues 5204, ABS 6291

Instead of productivity-driven growth, economic growth has been driven by a set of less sustainable factors since 2008, which are less likely to boost overall income and more likely to favour subsets of the population. These primary drivers include a once-in-a-generation peak in Australia's terms of trade, wealth-enabled or debt-driven consumer spending, and strong population growth.

As a consequence of these changing drivers, growth has become less inclusive—that is, less beneficial to ordinary Australian households. Before the GFC, strong economic growth went hand in hand with strong income growth. This was high-quality, productivity-fuelled growth, built on a strong economic foundation. This growth generated enough income to be shared reasonably evenly among the population, with businesses able to reward both investors and workers, and wages largely tracking productivity. After the GFC, however, economic growth became increasingly decoupled from income growth.

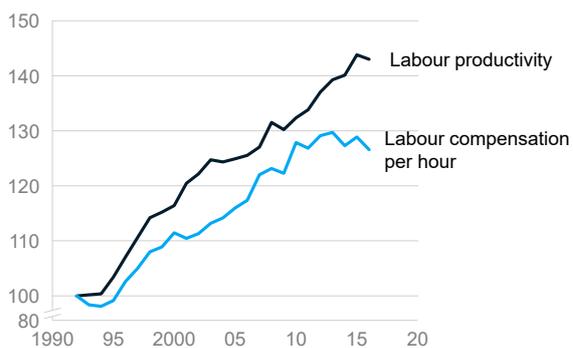
Productivity and wages have historically moved in tandem with one another in Australia. Worryingly, both have declined and the two are now diverging, raising concerns about the fairness of how benefits from growth are being shared.

In addition, productivity and wage growth, which have historically moved in tandem with one another, have recently decoupled as well. Growth in labour productivity enables businesses to sustainably fund wage growth as their output per worker rises, so the two have been closely correlated over the long term (Exhibit 17).²⁷ Since 2008, however, productivity growth has run at three to four times the rate of wage growth, suggesting that businesses have applied their smaller productivity gains elsewhere. This decoupling has occurred in the past and eventually readjusted, so it isn't yet clear whether the current break is a structural shift or simply a short-term phenomenon. However, the closer these two measures track, the more sustainable a nation's economic growth. An essential part of preparing for automation is ensuring that gains are distributed broadly and fairly, so a return to growth has to be a return to inclusive growth.

Exhibit 17

Separation or divorce?

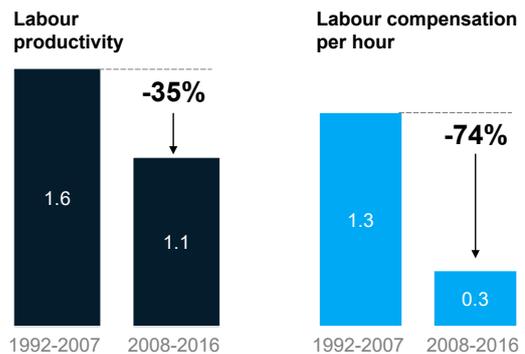
Historical correlation of productivity and wage indicators in Australia¹
Index, 1992=100



¹ Real compensation per hour calculated using CPI
Note: Numbers may not sum due to rounding

Source: OECD

Growth in indicators
Annual change (CAGR), Percent



²⁷ In the short term, labour productivity and compensation per hour may decouple due to economic cycles, such as when unemployment is high or during a skills shortage, but this is generally a temporary phenomenon. In Australia, labour's share of income has remained relatively stable since the early 1990s. Structural factors also affect wage growth relative to productivity, such as award regulations and industrial relations. For a discussion, see: *Analysis of wage growth*, Australian Government, The Treasury, November 2017.



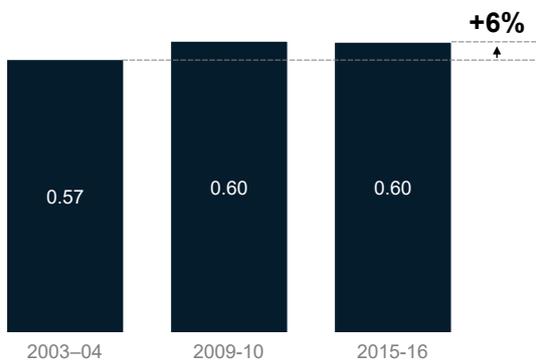
Wealth inequality from the housing boom has also driven anxiety

The picture for Australian households becomes even more complicated if one widens the scope of inequality beyond just income to include other factors such as wealth, which measures the total value of a household's assets such as houses, shares and superannuation. As in all countries, wealth inequality in Australia is higher than income equality. Although Australia has the eighth most equal distribution of wealth among 28 OECD countries, its wealth inequality has increased.²⁸ The Gini Index for wealth inequality rose by 6 percent during the boom's peak between 2000 and 2008, from around 0.57 to 0.60, where it has remained (Exhibit 18). Moreover, increases in net worth over this period have been concentrated among the wealthier half of the population.

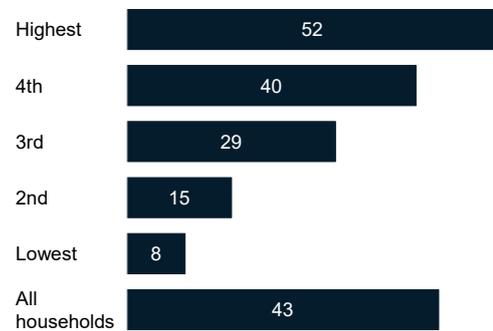
Exhibit 18

For richer and poorer

Wealth inequality in Australia
Gini coefficient, 0-1



Growth in real equalised net worth by quintile
Total change, 2003-04 to 2015-16



Source: ABS 65230 Household Income and Wealth, Australia: Summary of Results, 2015-16

2.5x

Australia's household debt to income ratio increased over the last two decades.

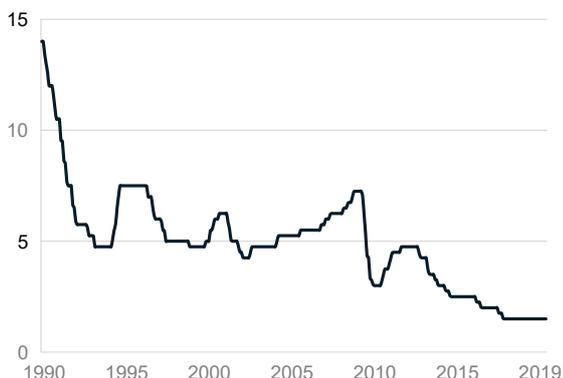
In its review of inequality, the Productivity Commission found that real wealth increases over the last 15 years have been driven by housing assets and superannuation.²⁹ Even as income growth stalled, households leveraged themselves to record levels to buy up property, increasing the level of household debt by roughly 2.5 times, from around 70 percent of income in 1992 to around 180 percent by the end of 2016 (and almost 190 percent by the end of 2018) (Exhibit 19). This spending spree was fuelled by record-low interest rates, the 'safe-haven' and tax-effective investment in residential housing, and the resulting surge in house prices. Those who could afford to own a home were able to spend large parts of their rising equity or leverage their home to invest in more houses or the stock market, leading to an uptick in wealth (as opposed to income) inequality.

²⁸ *Rising inequality? A stocktake of the evidence*, Productivity Commission, August 2018.

²⁹ *Rising inequality? A stocktake of the evidence*, Productivity Commission, August 2018.

Rocket fuel

RBA cash rate target
Monthly average, Percent



Source: Reserve Bank of Australia data, 2019

Household debt as share of annualised disposable income
Percent



That same dynamic locked out those who did not own a home from either buying one or drawing on its equity. First-home buyers, young adults and low-income groups were disproportionately affected and increasingly struggled to break into the housing market, while existing homeowners and investors, older baby boomers and retirees were buoyed by the rising value of their homes and investment properties. Non-owners have felt increasingly aggrieved, particularly younger renters who fear that they will never attain the ‘great Australian dream’ of a freestanding home. Despite a real-estate correction over the past year (which by early 2019 had yet to fully play out), renters on low incomes in the nation’s largest cities can pay almost half their earnings in rent. Up until the recent correction, soaring house prices made housing affordability a pressing national issue.³⁰

Pockets of disadvantage persisted despite the boom

These income and wealth trends become even more urgent when one examines wider socio-economic data and significant events, which have left some communities particularly affected. For example, communities that once depended on the now shuttered auto manufacturing industry (Geelong and Greater Dandenong in Victoria, and Port Adelaide in South Australia), steel industry (Whyalla in South Australia) and even mining (Ravensthorpe in Western Australia, where BHP Billiton built and then closed a town of around 3,000 people in 2009) would probably not relate to the broader picture of economic progress described above.³¹

Moreover, any advances that Indigenous communities have made over the last three decades have not been sufficient to include those communities in the mainstream of Australian prosperity. Even after a decade of improvement, Australia’s Indigenous population continues to suffer persistently below-average outcomes on all economic, social and personal health metrics. In education, for example, Year 9 Aboriginal and Torres Strait Islander students are 22 points less likely to attain minimum reading standards, and 13 points less likely to attain minimum numeracy standards, compared to their non-Indigenous peers. In health, child mortality is almost 50 percent higher for Indigenous children than for non-Indigenous children—even in the best-performing state, New South Wales.³²

³⁰ ISPOS Issues Monitor, December 2017.

³¹ For example: *Mining job losses escalate as BHP Billiton cuts 6000*, The Australian, 21 January 2009.

³² *Closing the gap*, Australian Government, Department of Prime Minister and Cabinet, 2018.

Finally, welfare advocates suggest that 40 percent of Australian workers are seeking more paid work,³³ and that the proportion of people in Australia living below the poverty line (half of the median disposable income) has stubbornly remained at around 13 percent for most of this century.³⁴

Nationwide discussions about wealth and income inequality in Australia are far from the populist anger seen in other countries, but they are starting to stretch the social fabric. This tension has been heightened by widely publicised data on the negligible rates of corporate tax paid by multinational corporations, and in particular by the dismaying evidence of the 2018 hearings and 2019 report of the Royal Commission into Misconduct in the Banking, Superannuation and Financial Services Industry. Constructive action is needed more than ever to increase real productivity and incomes in an inclusive way.

Australia needs to return to sustainable, productivity-driven growth to reignite broad income growth

Before the boom runs out, Australia needs to re-boot productivity—the main driver of quality growth—in order to extend the boom and deliver higher incomes for all Australians.

Over the coming decades, the Australian economy will face increasing headwinds from an ageing population, which will permanently lower population and employment growth. More immediately, the International Monetary Fund (IMF) has recently highlighted the downside risks for the economy from declining growth in China, Australia's largest trading partner, and from rising global protectionism—not to mention the recent housing market downturn, which has yet to fully play out.³⁵

Productivity is 'one of the few certain ways of raising living standards in the 2020s'. Without it, Australia could face a future of slower and less inclusive growth.

Nonetheless, Australia should do everything it possibly can to extend the boom and, in particular, reverse the recent stalling of household income growth. As the decline in household income growth is correlated with productivity, a key part of the solution is to re-fire our productivity engine, with support from labour participation (see Box 1). The Productivity Commission's recent comprehensive economic review called productivity-boosting reforms 'one of the few certain ways of raising living standards in the 2020s'.³⁶ It is equally important to ensure that any productivity gains then translate into income gains.

³³ *Excessive hours and unpaid overtime: 2018 update*, The Australia Institute, 2018.

³⁴ *Poverty in Australia 2018*, Australian Council of Social Services and the University of New South Wales.

³⁵ Australia: Staff Concluding Statement of the 2018 Article IV Consultation Mission, *Completing the Rebalancing after the End of the Mining Investment Boom*, November 19, 2018.

³⁶ *Shifting the dial: 5 year productivity review*, Productivity Commission, August 2017.

Box 1: Labour force participation supports productivity to deliver higher incomes

Given the challenges in increasing productivity, Australia must focus on its other engine of income growth: labour force participation. More people working means more production and services, more people earning wages in every household and more people buying. Australia's current participation rate of 65 percent is a little higher than the United States and the United Kingdom (each at 63 percent). However, if Australia could match New Zealand's 71 percent participation rate, the country could raise its annual GDP by roughly \$140 billion.¹

Two demographic headwinds may make it harder to fire up the participation engine: Australia's ageing population, and the country's ongoing debate about whether to lower the rate of immigration. Although low by developed world standards, Australia's median age of 37.6 is rising by one month every year.² The immigration program targets working-age people, and the average age of immigrants is just 26—well below the national median of 37.³ Ageing and lower immigration would reduce the number of available workers relative to the total population. By 2030, there may be just three working-age people for every two dependents, not four as there is now.⁴

Assuming no change in immigration settings, the clearest opportunity to raise Australia's participation rate is to focus on the three groups whose participation lags behind global counterparts: women with children, workers over the age of 65 and people with disability. Currently, workforce participation among Australian women is 3 percent lower than the OECD average of 66 percent, and a full 20 percent below the rate for Swedish women with children. Older workers' participation rate in Australia is 13 percent, compared to a 15 percent average among OECD countries and 37 percent in Iceland (which leads the OECD in aged worker participation). Meanwhile, Australians with a disability have just half the rate of workforce participation of those with no disability, compared to 70 percent for OECD countries that are among the top eight on this metric.⁵ Based on these numbers alone, Australia will not reach its participation targets without engaging with these three groups. To ensure equitable opportunity for all, Australia must also take steps to increase the participation of two overlapping groups with notoriously high unemployment rates: regional youth and Indigenous Australians.

¹ Labour force statistics, OECD, 2017.

² Australian demographic statistics (3101.0), Australian Bureau of Statistics (ABS), June 2018.

³ Australian demographic statistics (3101.0), ABS, June 2018 and June 2017.

⁴ Intergenerational Report, Australian Government, The Treasury, 2017.

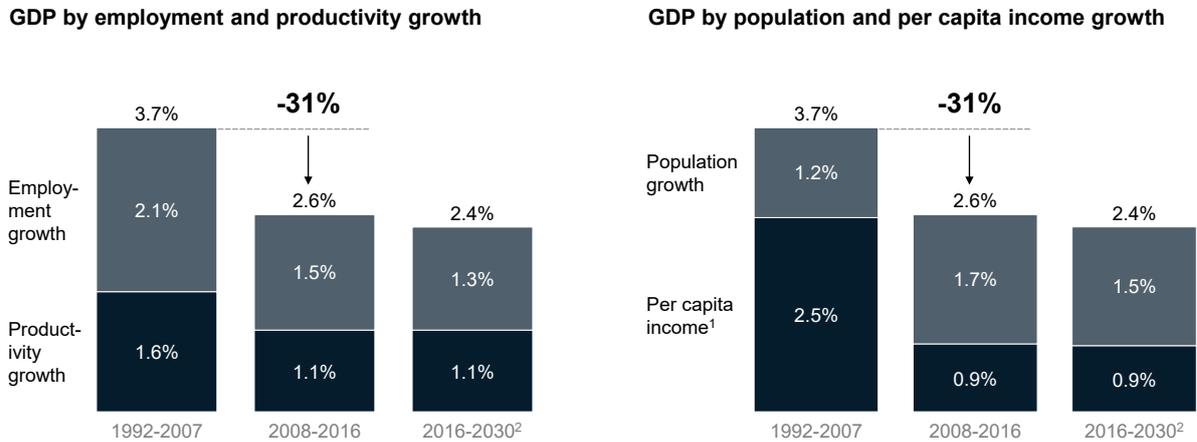
⁵ Labour force statistics, OECD, 2017.

If Australia does not lift productivity growth, the country's economic growth could continue to drift down to average 2.4 percent per year through to 2030 as ageing reduces population and employment growth (Exhibit 20). The result could be a continued stagnation of per capita GDP growth at the current low of 0.9 percent, and another decade of strain on the social fabric.³⁷

Exhibit 20

Down and downer?

Decomposition of GDP growth, historical and projected; Annual change (CAGR), Percent



¹ Per capita income refers to GDP per person, and aims to measure how much output has grown on a like-for-like basis once population growth is excluded
² At 2008-2016 productivity growth rates
 Note: Numbers may not sum due to rounding
 Source: 2015 Intergenerational Report – Australian Treasury, ABS, ONET, World Bank, ABS, BLS, Oxford Economics, McKinsey Global Institute analysis

One immediate way for Australia to reignite productivity growth is to catch up with the rest of the world in capturing the full benefits of the third industrial revolution: digitisation.³⁸ A key reason for the country's lagging productivity is its relatively slow adoption of technology. Across the economy, Australia's digital output is estimated at 28 percent of GDP, behind the United States at 33 percent and the United Kingdom at 30 percent.³⁹ Again, there are sectoral exceptions, such as mining, agriculture and finance. But even after Australian companies doubled their level of digitisation over the past five years, some sectors—notably manufacturing, construction and other asset-intensive industries—materially lag behind their international peers. Happily, this is something that Australia has the power to change.

At the same time, the fourth industrial revolution of automation has already begun.⁴⁰ As the next chapter will outline, this revolution holds the promise of even greater productivity benefits.

After leading the developed world in GDP and income growth for almost three decades, Australia has hit some economic speed bumps. With doubts over income growth and equality, the country needs to boost productivity to get back on track. The next chapter suggests that automation—though not without risk—holds the promise to do just that.

³⁷ McKinsey Global Institute analysis.
³⁸ The Third Industrial Revolution, or the Digital Revolution, refers to the advancement of technology from analog electronic and mechanical devices to the digital technology available today. The era started during the 1980s and is ongoing. Advancements during the Third Industrial Revolution include the personal computer, the internet, and information and communications technology (ICT). Source: *What is the fourth industrial revolution?*, World Economic Forum, 2016.
³⁹ Digital output estimates the GDP value created by measuring the digital skills, technologies and accelerators in all sectors of the economy. *Digital disruption: The growth multiplier*. Accenture.
⁴⁰ The Fourth Industrial Revolution builds on the Digital Revolution, representing new ways in which technology becomes embedded within societies and even the human body. The Fourth Industrial Revolution is marked by emerging technology breakthroughs in a number of fields, including robotics, artificial intelligence, nanotechnology, quantum computing, biotechnology, The Internet of Things (IoT), decentralised consensus, 3D printing and autonomous vehicles. Source: *What is the fourth industrial revolution?*, World Economic Forum, 2016.



Australia's automation opportunity

'In the new technology [era], machines and automated processes will do the routine and mechanical work. Human resources will be released and available for new activities beyond those that are required for mere subsistence.' This prediction sounds like it could have run in this morning's newspaper. In fact, it comes from a 1966 US Government report and mirrors John Maynard Keynes' prediction in 1930 that in a century's time everyone would be working 15-hour weeks.⁴¹

⁴¹ *Economic prospects for our grandchildren*, John Maynard Keynes, 1930.

Automation is not a new phenomenon; technological innovation has been reshaping work and economies for millennia. But digital and mobile technologies have accelerated the pace of these transformations, making many routine activities vastly more efficient and less labour-intensive than they were just 20 years ago. Automation technologies—which span advanced robotics, machine learning and AI—have the potential to change workplaces on an even greater scale. Globally, the McKinsey Global Institute has found that AI alone may deliver the equivalent of US\$13 trillion in additional economic activity by 2030, about 16 percent more than would otherwise be achieved.⁴²

This additional wealth is added because machines can outperform humans in many areas, which has implications both for jobs and for the future of work. This report will explore these issues, but it's important to first discuss how that additional wealth is created and what it could offer. It will then be up to businesses, politicians, communities and individuals to ensure that the additional wealth translates to a better, more equitable quality of life.

This chapter discusses the following findings:

- Automation is accelerating globally. Its benefits are driving revolutionary change from the warehouse to the mine to the hospital, and are promising to crack long-standing challenges in fields such as medical research and environmental science.
- On average, up to 25–46 percent of the activities that make up current jobs in Australia could be automated by 2030 (out of a total potential of 63–81 percent).
- Depending on Australia's pace of adoption, this automation could drive up productivity growth from 1.1 percent currently to 1.6–2.7 percent, and boost annual per capita income growth from 0.9 percent to 1.4–2.5 percent.

With these benefits in mind, Chapter 3 looks to the transitional challenges that await.

The automation wave is here, holding enormous promise

Digital technologies have appeared in accelerating waves, from the first computers through to the latest smartphones and cloud banks. Of these, automation appears to be the most revolutionary phase yet. With the potential to develop at an even faster pace than today, it will increase the amount people can produce, the way they work and the industries in which they work.

In the past, computers completed the rigidly defined tasks for which they were programmed. Now, machines can guide themselves by setting a strategy for learning and using past data to understand future patterns, all without being reprogrammed. This AI is already used to recognise faces, personalise product recommendations, automate customer service, coordinate supply chains, detect fraud, schedule asset maintenance, make hiring decisions, analyse financial risk, create online content and interpret X-rays. Machines have not yet redefined what it means to 'think', but they are starting to do things that once only humans could do, and to do it better. Games such as chess and Go were once considered the ultimate challenges; even the fastest computers couldn't spin through the possibilities quickly enough to beat an intuitive grand master. Now, programs simply learn from their 'opponents'—thousands of them in a second—to tilt the playing board in their favour.⁴³

The McKinsey Global Institute has mapped the capabilities of this 'deep learning' against more than 2,000 specific work activities across 800 occupations and all sectors to identify a wealth of practical applications. For example, AI-driven algorithms can look ahead to optimise logistics, or schedule maintenance to reduce downtime and operating costs while extending the life of capital assets such as cargo planes. Consumer industries will tend to see more AI marketing applications because frequent digital interactions with customers generate larger data sets—the food for AI systems.⁴⁴

⁴² Notes from the *AI frontier: Modelling the impact of AI on the world economy*, McKinsey Global Institute, 2018.

⁴³ For a useful overview of AI technologies and use cases, see the following McKinsey Global Institute publications: *The age of analytics: Competing in a data-driven world*, December 2016; and *What's now and next in analytics, AI, and automation*, May 2017.

⁴⁴ Notes from the *AI frontier: Applications and value of deep learning*, McKinsey Global Institute, April 2018.

Some jobs will be lost to automation, others will be created, and almost all will be transformed. Fewer than 10 percent of occupations could be fully automated and eliminated outright. However, about a third of component activities in 60 percent of jobs could be automated.

AI or machine learning can then be combined with cyber-connected objects (the Internet of Things, or IoT) and robotics to create an integrated cyber-physical world. These technologies have already arrived in Australia. The country's two major supermarkets, for example, are investing heavily in these technologies: Coles to the tune of \$950 million and Woolworths to the tune of \$560 million, so far. Coles' CEO, Steven Cain, believes cyber-integrated stores and warehouses would 'provide a safer working environment for our team members, lower supply chain costs, enhance our overall business competitiveness and make life easier for our customers by having the right offer in the right location'.⁴⁵ AI can also be combined with machine dexterity to create the robots first imagined in fiction, such as care robots for those with limited personal mobility and autonomous vehicles or 'robo-taxis'.

For organisations investing in automation technologies, the benefits run well beyond reducing labour costs (which is often more a by-product than an objective). These technologies can optimise how industrial plants use energy and raw materials, or help managers coordinate large, complex construction projects more seamlessly. AI can also lead to entirely new offerings. Amazon's recommendation engine and the Alexa home virtual assistant give consumers an expanded range of choices, often leading to higher quality products at lower prices. In fact, the unquantifiable upside of automation for Australia lies in its impact on diversity of choice and increased convenience. As consumer demands change and new markets are created, innovators can increase exports of automation-era products and services. In previous decades, Australia has lost production and routine jobs to low-cost countries, replacing them with higher-value jobs. The automation era will create more collaborative and cognitive jobs that involve more complex interactions and judgement⁴⁶—if Australia can help its workforce to develop these skills.

Today, AI is where digital technologies were 15 years ago; much more growth and competitive reshuffling is still to come. Australian companies that remain wedded to their traditional business models and operations may pay a heavy price. Public agencies will also need to release their highly cognitive workforce from more routine activities and allow them to meet the rising service expectations of their citizen customers. A fourth and more powerful economic revolution awaits.⁴⁷

Workplace activity will be automated at differing speeds

Our workplaces may be unrecognisable in the decades ahead as automation technologies gain momentum. But it will not be a simple story of robots replacing people. Some jobs will be lost, and others will be created, and almost all will be transformed. The impact will be similar to previous waves of structural change in some ways, but more profound because of the skill shifts required. The only question is how long the transition will take.

Some jobs will be lost to automation, others will be created, and almost all will be transformed. Fewer than 10 percent of occupations could be fully automated and eliminated outright. However, about a third of component activities in 60 percent of jobs could be automated.

Up to 63–81 percent of work activities could potentially be automated by 2030

The first step in considering how this could all play out is to understand what current technologies can do and where human labour will remain valuable. For example, machines will take on predictable physical activities and data collection and processing, but they will do less of the work that involves higher cognitive skills, digital expertise and personal interactions. (A machine can already lay bricks to build a house perfectly to plan within 24 hours, but it cannot plan where those bricks should go, either on site or across markets.)⁴⁸

⁴⁵ *Coles to spend almost \$1 billion to get two 'game changing' sheds*, Sydney Morning Herald, January 24, 2019.

⁴⁶ *Compete to prosper: Improving Australia's global competitiveness*, McKinsey & Company, July 2014.

⁴⁷ The first industrial revolution prompted the 18th century shift from rural to urban societies. The second industrial revolution, which took place in the lead up to World War 1, saw the twin breakthroughs of electricity and the internal combustion engine. The third industrial revolution is the first digital revolution, which took place from the 1980s onwards, with the emergence of the personal computer, the internet and related technologies. See: *The fourth industrial revolution: What it means and how to respond*, World Economic Forum, 2018.

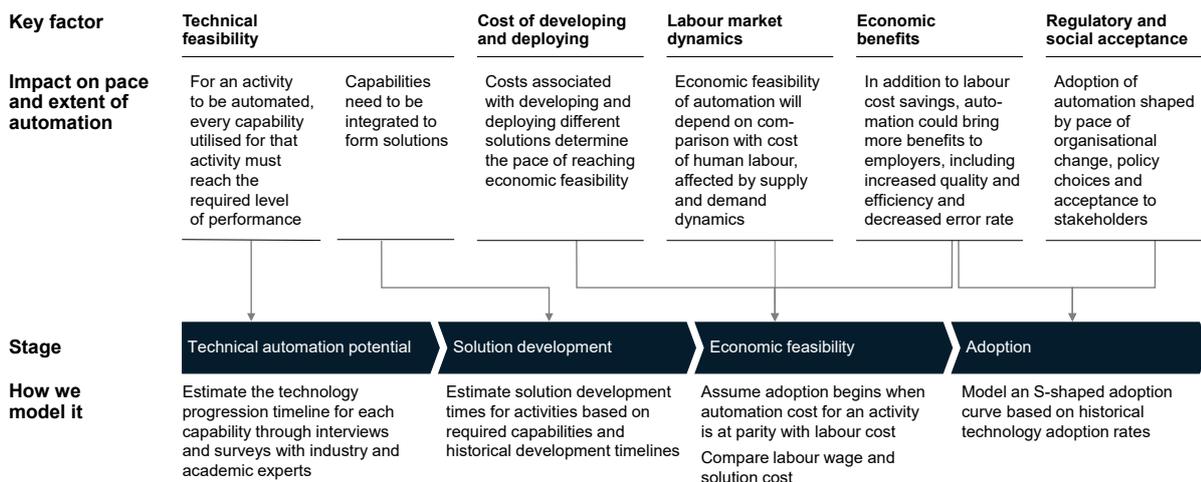
⁴⁸ The Fastbricks Hadrian-X.

Previous research by the McKinsey Global Institute examined more than 2,000 work activities in more than 800 occupations globally, estimating both the time spent on them and the feasibility of automating them, using existing technologies only. It found fewer than 10 percent of occupations could be fully automated and eliminated outright. However, it also found that in 60 percent of jobs, about a third of their component activities could be automated.⁴⁹ This means that companies would need fewer workers as jobs are combined, redefined and enhanced.⁵⁰

Research by the McKinsey Global Institute also examined five factors over four stages that would affect the pace and extent of automation (Exhibit 21), resulting in three scenarios for automation potential and adoption: a late (or slow) scenario; an early (or fast) scenario; and a mid-point scenario, which is the average of the late and early scenarios. For early adoption to happen, technologies and solutions would need to be developed at an accelerated speed, requiring both the public and private sectors to invest significantly in research and development (R&D), technology development and technology deployment. That would require investment in developing the technologies themselves, and in digitally enabled infrastructure to support automation. The likely barriers to adoption (social, political, organisational) would also need to be overcome quickly, which would likely require a high degree of support and consensus across society.

Exhibit 21

How automation works



Note: Economic benefits affect both when adoption will begin and its pace. For determining economic feasibility, we assume that decision-makers discount the uncertain benefits of initial labour cost savings by roughly the same amount as they believe the (also uncertain) non-labour cost-related benefits will be captured

Source: McKinsey Global Institute analysis

⁴⁹ *A future that works: Automation, employment, and productivity*, McKinsey Global Institute, January 2017; and *Jobs lost, jobs gained: Workforce transitions in a time of automation*, McKinsey Global Institute, December 2017.

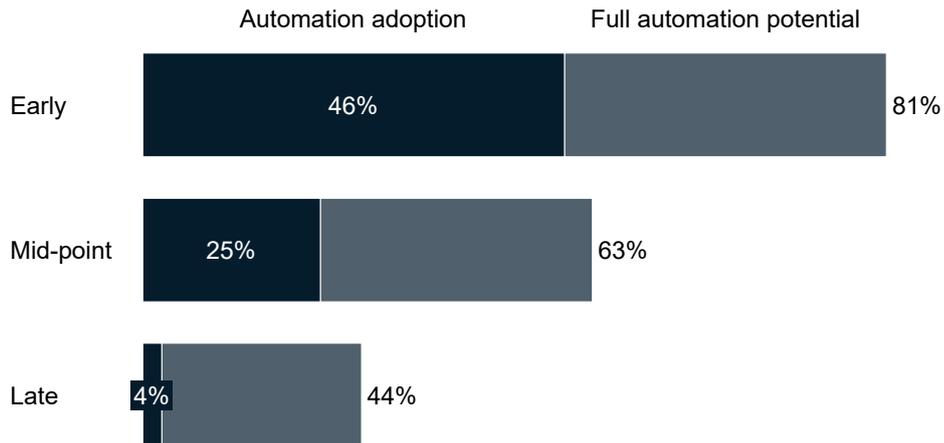
⁵⁰ As a baseline for discussion, we directly map percentages of activities within an occupation that can potentially be automated to the percentage of jobs within that occupation that could be lost.

For this report, the McKinsey Global Institute methodology was applied to the Australian economy. The results suggest that 44 percent of existing workforce activities could already be automated using today's technologies. This is roughly on par with the United States, but lower than the global average due to Australia's service-heavy and relatively highly skilled workforce.⁵¹ The results also suggest that the automation potential rate could rise to 63 percent by 2030 in the mid-point scenario, and to as high as 81 percent in the early (or fast) scenario (Exhibit 22).

Exhibit 22

Potential versus adoption

Scenarios for automation potential and adoption for Australia by 2030; Percent of time spent on work activities



Source: McKinsey Global Institute (MGI)

44 percent of current work activities could already be automated using existing technologies. This potential rate of automation could rise to 63–81 percent by 2030.

⁵¹ Specialised work refers to work that requires personal interactions or the application of specialist skills that are highly sensitive to changing stimuli (i.e. not routinised), are cross-functional or require significant creativity. For example, teaching, nursing and sales are considered specialised work occupations.

In practice, 25–46 percent of workplace activities could be automated by 2030

Although it may be technically feasible for organisations to automate a wide range of activities, they will not do so overnight, and they may not automate every possible activity. Deciding what degree of automation to adopt is complex, because of the need to factor in the investment cost requirement for the systems and the transition, the relative cost of labour, the strength of the business case, customer acceptance and industry regulations. If retail stores automate the checkout process, for instance, they may choose to eliminate some checkout staff, but they could also opt to redeploy their checkout staff to help customers with questions about products, delivering a better customer experience. Likewise, as call centres introduce more automation technologies, employees may only be needed to handle difficult customer service questions. These shifts will not necessarily lead to workforce reductions. When Australian banks began introducing ATMs, for example, the number of tellers at each branch dropped but the total number increased because banks could operate branches with fewer employees, allowing them to expand into marginally profitable locations for the first time.

Our mid-point scenario estimates that less than half of the total automation potential will be realised by 2030. Activities that together account for 25 percent of the hours put in by Australia's workforce today would be handled by machines. However, this share could be as high as 46 percent in a fast or early adoption scenario.

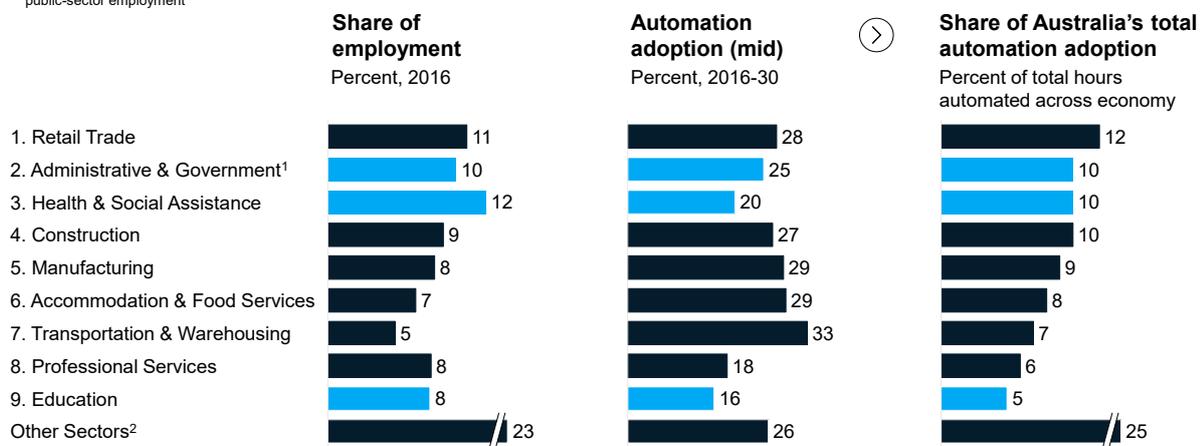
Compared to other countries, Australia could adopt automation relatively quickly because it has relatively high minimum wages by global standards, even for routine work, which makes it attractive for organisations to automate part or all of those jobs. The only countries more likely to automate faster in the global McKinsey Global Institute study were Japan (28 percent in the mid-point scenario) and Germany (26 percent), due to their industry-heavy economies and, in the case of Japan, a rapidly ageing and shrinking workforce.

Not surprisingly, three-quarters of the automation opportunity is found in the six sectors that are among the largest employers in the economy and are highly susceptible to automated activities: retail, administration and government, construction, manufacturing, accommodation and food services, and logistics (Exhibit 23). Three more sectors—healthcare, professional services and education—will experience significant automation simply due to their size and diversity of activities. Notably, three of the biggest employers—administration and government, healthcare and education—also fall within the public sector, making our public agencies critical players in capturing the automation opportunity.

Exhibit 23

Biggest automators

■ Sectors with high share of public-sector employment



¹ 'Administrative & Government' is composed of private and public administrative functions. Around 70% of employment is in public administration, with around 30% in general administrative and support functions
² Includes nine other sectors which each individually account for <5% of total employment

Source: McKinsey Global Institute analysis



Automation can help reignite income growth by boosting productivity

As outlined in Chapter 1, Australia needs to increase its productivity and competitiveness if it is to resume the faster and more widespread income growth of the long boom's early decades. Automation offers that opportunity. Here, we estimate the extent to which automation can increase productivity. However, in order to increase incomes, Australia will also need to increase its competitiveness, both in domestically focused sectors that employ the bulk of workers, and in internationally tradeable sectors where automating faster than competitors could become a key determinant of success. Both thrusts will require a national effort.

There are also two less obvious ways in which automation may add to national productivity and incomes: opening up more jobs to more people, thereby boosting workforce participation; and improving the energy, health and safety of those in employment by freeing them from the routine and physical elements of their jobs.

Automation can reignite income growth through competitiveness

Boosting productivity is hard without technological advances, but new automation technologies may be tailor-made for the job. They are related to all four levers that an economy can pull to boost its productivity: investing in capital assets, investing in human capital, boosting competition and entrepreneurship, and investing in innovation and technology. Australia could have strategies for all four of these levers, each incorporating the promise of automation. These innovative technologies are specifically designed to increase quality and output with greater efficiency, create incentives for greater cognitive and collaborative human skills, and create opportunities for entrepreneurs to take on incumbents.

If embraced, automation and the return of displaced workers to equal or more productive jobs could have significant positive impacts on the Australian economy over the coming decade. Compared to a baseline scenario of historical growth, we estimate that automation could support productivity growth of 1.6 percent between 2016 and 2030 in a mid-point adoption scenario (around the pre-GFC rate), and that rapid adoption could boost it to as much as 2.7 percent (more than double the baseline rate) (Exhibit 24). This productivity surge could increase annual GDP growth to 2.9 percent in the mid-point scenario (about a fifth higher than the baseline scenario), or 4.1 percent if automation is rapidly adopted (about 70 percent higher than the baseline). This, in turn, could help to accelerate per capita income growth from its recent low level of around 0.9 percent per year to 1.4 percent in the mid-point scenario (60 percent above the baseline) and almost 2.5 percent per year in the rapid scenario (almost three times the baseline).

To put these numbers in context, our estimates suggest that automation could lift the value of Australia's annual economic activity or GDP by around \$170 billion by 2030 in the mid-point adoption scenario, and by around \$600 billion in the rapid adoption scenario—about 7 to 25 percent more than would be achieved otherwise (Exhibit 24). For ordinary Australians, it could increase incomes by \$4,000 to \$15,000 per year, about 7 to 26 percent more than would otherwise be achieved.⁵² Over 15 years, these numbers add up: automation could cumulatively add \$1.2 trillion to \$4 trillion to the Australian economy by 2030, and give each Australian additional income of \$30,000 to \$110,000 over the same period. Comparing the two scenarios, rapid automation offers almost triple the benefits. In other words, the additional value of pursuing rapid automation (rather than the mid-point adoption rate) could be worth \$3 trillion to the economy over 15 years, and about \$80,000 for each Australian household. If Australia shuns automation, it needs to be aware that it is forgoing these potential upsides as well.

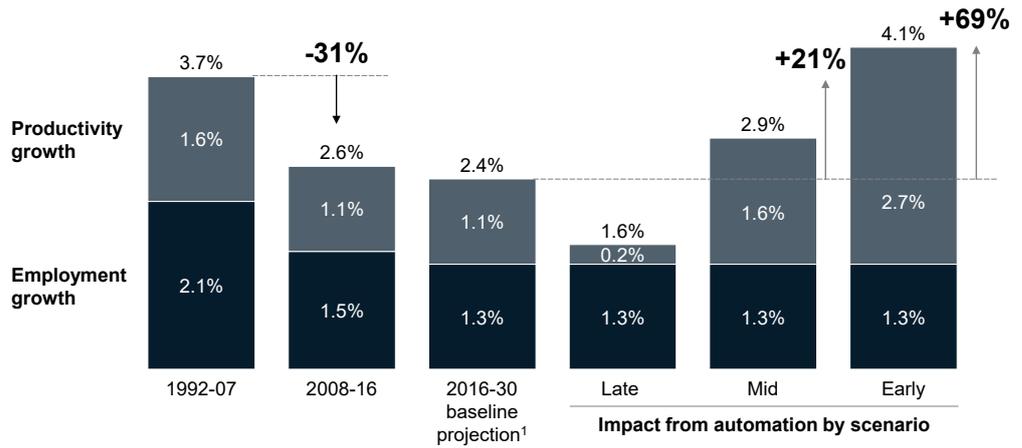
A large blue '2x' icon indicating a doubling of productivity growth.

Rapid automation could lead to an increase in productivity growth.

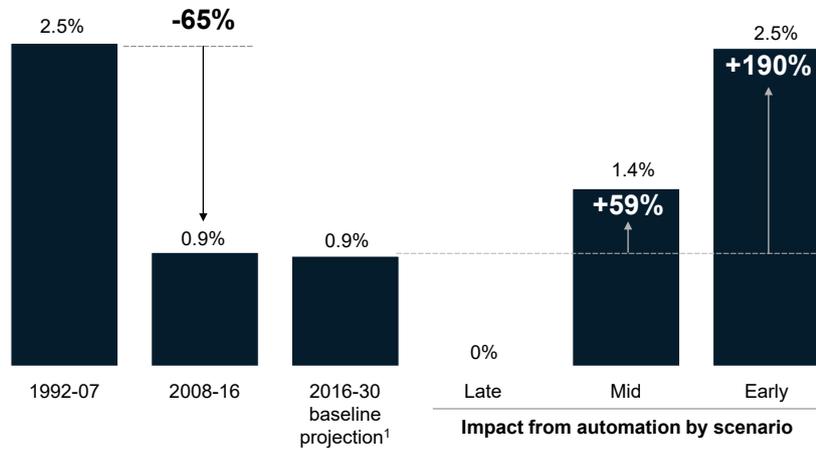
⁵² To give a better estimate of the impact of automation on households, we have applied the estimated growth in GDP per capita to equalised disposable household income. The equivalent increase for GDP per capita is \$6,000 to \$20,000 per year. The two concepts are closely correlated, but not perfectly. If more of the benefits of automation accrue to profits than wages, the gap between per capita income and household income could widen.

The automation opportunity

Impact on GDP growth (CAGR) by employment and productivity, Percent



Impact on GDP per capita growth, Percent



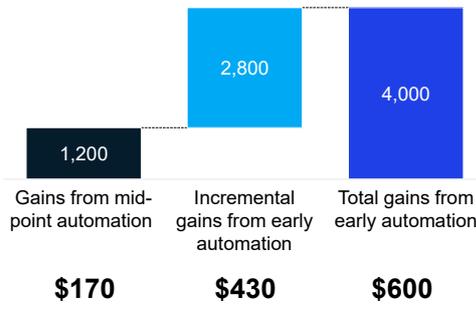
¹ At 2008-16 productivity growth rates and taking employment and population projections from Treasury's 2015 Intergenerational Report. Note: Numbers may not sum due to rounding. Model assumes displaced labour re-joins the economy and is at least as productive as in 2016

Source: 2015 Intergenerational Report – Australian Treasury, ABS, ONET, World Bank, ABS, BLS, Oxford Economics, McKinsey Global Institute analysis

Impact on GDP and incomes, \$

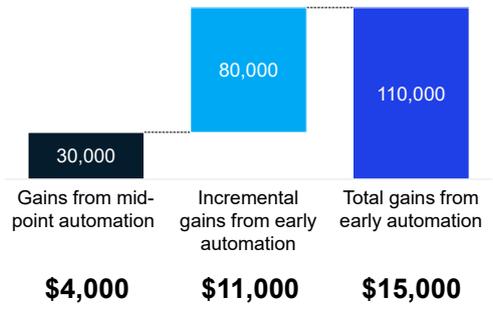
Potential additional GDP from automation

Cumulative gains 2016-2030, A\$ Billions



Potential additional income per Australian¹

Cumulative gains 2016-2030, A\$



¹ Equalised disposable household income. Note: Numbers may not sum due to rounding

Source: ABS National Accounts (Catalogue 5206) and Household Income and Wealth (Catalogue 6523) data, McKinsey Global Institute analysis

By lifting productivity and incomes, mid-point automation could add around \$1.2 trillion to the Australian economy by 2030 and give each Australian additional income of \$4,000 per year by 2030. A bold push to rapidly automate could more than triple these benefits to \$4 trillion and \$15,000, respectively.

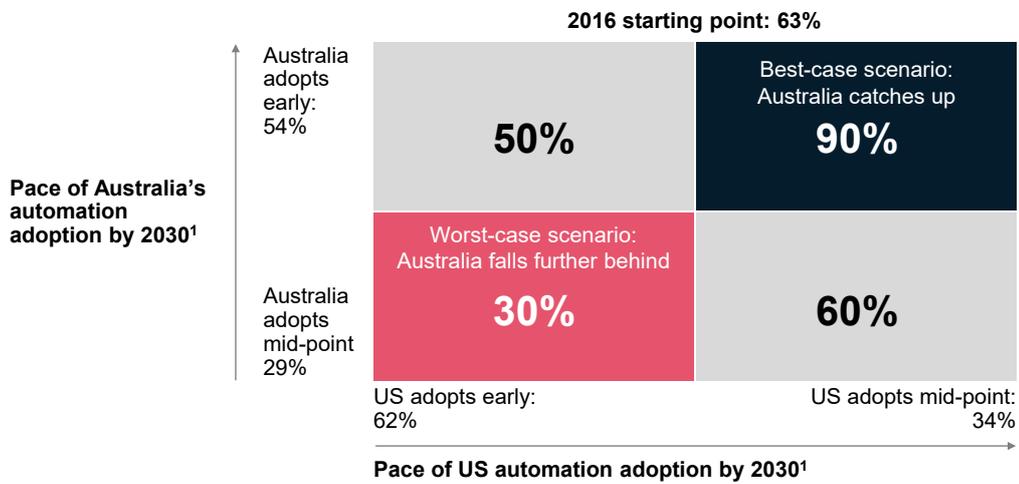
In some sectors, automation offers the opportunity not only to increase productivity levels, but also to potentially catch up to competitors. This is particularly important for Australia's more trade-exposed sectors. In manufacturing, for example, Australia's labour productivity is only 63 percent of the US equivalent (Exhibit 25), making it hard for Australia to compete. Faster adoption of automation could allow Australian manufacturers to close that gap to just 10 percent. Slower adoption, meanwhile, risks seeing the country's relative manufacturing productivity plunge to just one-third of the US level.

In the retail sector (a large employer in Australia), labour productivity lags behind the United States by about 10 percent. If Australian retailers adopt automation faster than their US counterparts, their productivity could overtake that of the United States, giving businesses more leeway to raise wages. Conversely, a worst-case slow adoption could see their productivity fall to just 60 percent of the US level (Exhibit 26).

Exhibit 25

Time to catch up

Australian manufacturing labour productivity, as a share of US level

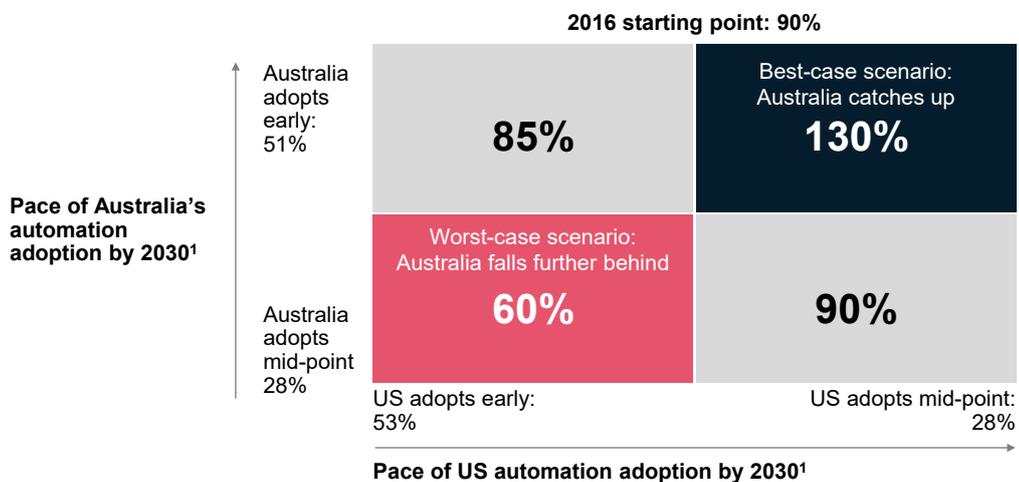


¹ New occupations that currently do not exist added. Jobs gained are calculated for mid-point automation adoption
 Note: The sectoral competitiveness estimates only include labour substitution effect from automation. Labour productivity is calculated keeping output level constant with remaining labour
 Source: McKinsey Global Institute analysis

Exhibit 26

Time to overtake

Australian retail labour productivity, as a share of US level



¹ New occupations that currently do not exist added. Jobs gained are calculated for mid-point automation adoption
 Note: The sectoral competitiveness estimates only include labour substitution effect from automation. Labour productivity is calculated keeping output level constant with remaining labour
 Source: McKinsey Global Institute analysis

Capturing the benefits of automation will require substantial investment

Capturing the benefits of automation (in terms of both GDP and income uplift) will require substantial investment in automation technologies by organisations across the private and public sectors. An integrated investment approach will also be needed to ensure sound ROI and to link the right investments in assets with end-to-end digitisation and automation of business processes, supported by a digitally enabled and empowered labour force.⁵³

To grow their economies, countries must continually make investments. Australia itself has invested a total of \$7.1 trillion over the past 27 years of uninterrupted economic growth (from 1992 to 2016, in real terms), equivalent to an average of \$300 billion per year or 27 percent of cumulative GDP over this period.⁵⁴ Approximately 80 percent of this investment was undertaken by the private sector, and the remainder by governments and public corporations. About half this investment went into new machinery and equipment as well as the development of new intellectual property.

In recent years, total investment across the Australian economy has been around \$400 billion per year, and some of this investment is already going towards automation. Recently, for example, Rio Tinto invested around US\$1 billion to automate the operation of its 1,700 km heavy-haul rail network in the Pilbara region of Western Australia.⁵⁵ As discussed earlier in this chapter, Australia's two retail giants have also recently announced \$1.5 billion investments over the next five to six years in a number of automated distribution centres.

To help illustrate the potential scale of the investment required on automation over the next decade, we developed scenarios based on the historical relationship between investment and GDP in Australia.⁵⁶ Australia's capital-output ratio—the total value of the stock of property, infrastructure, machinery and equipment, computer software and intellectual property over the total value of annual GDP—has been remarkably constant at around three since the 1970s, and averaged 3.2 over the past decade.⁵⁷ This relatively constant relationship is also observed in other countries, where this ratio is typically between two and three.⁵⁸

If we take this ratio as a proxy and assume that it remains constant,⁵⁹ we estimate that capturing the benefits of automation could require additional cumulative investment of around \$800 billion by 2030 in the mid-point scenario (in real terms), and around \$2.7 trillion in the rapid adoption scenario—about 11 to 39 percent more than would be required otherwise. This equates to additional annual investment of between \$60 billion and \$200 billion, on average, in the period to 2030 depending on the pace of automation. Some of this investment may already be budgeted for by the private and public sector, but others will require the development of new investment strategies. There is likely to be a time lag between companies' investments in automation and the productivity and performance impact. The sooner Australia starts making these investments, the sooner it can enjoy the benefits.

⁵³ For details on what this investment could look like across sectors, see *Digital Australia: Seizing the opportunity from the fourth industrial revolution*, Digital McKinsey, March 2017.

⁵⁴ *Gross Fixed Capital Formation, 5206.0* Australian National Accounts, ABS, September 2018.

⁵⁵ *Rio Tinto completes automation of Pilbara rail network*, International Railway Journal, December 2018.

⁵⁶ To understand the link between investment and growth, it is necessary to look at the capital-output ratio. Using this ratio, it is possible to roughly calculate how much investment an economy would need to support growth: for example, each percentage point of additional GDP growth requires additional investment of 3 percentage points of GDP, if the capital-output ratio is to be held constant at a constant 300 percent. In addition to investment for growth, countries—like companies—must maintain their current capital stock as it depreciates. Economists estimate a depreciation rate of around 5 percent annually for physical capital, which suggests that an annual investment of roughly 14 percent of GDP is required to renew assets as they become obsolete or unproductive. Putting these two figures together provides a rough estimate of what a country's investment requirements will be.

⁵⁷ *End-year net capital stock: Current prices, 5206.0* Australian National Accounts: National Income, Expenditure and Product, ABS September 2018, Australia Bureau of Statistics.

⁵⁸ *Farewell to cheap capital? The implications of long-term shifts in saving and investment*, MGI, December 2010.

⁵⁹ This is an illustrative scenario given considerable uncertainty about how capital heavy an automated economy will be, and what the evolution of prices for automation equipment and software will be.



Automation could also create (perhaps unexpected) opportunities for the three groups that are currently under-represented in the workforce: women with children, workers over the age of 65 and people with a disability.

Automation can also boost workforce participation

Automation could also create (perhaps unexpected) opportunities for the three groups that are currently under-represented in the workforce: women with children, workers over the age of 65 and people with a disability. This is because automation technologies can remove the need for physical strength and dexterity in many activities, and at the same time enable more flexible working arrangements.

Automation shifts the relative importance of skills away from manual dexterity and strength, and towards interpersonal and technological skills. As more manual activities become automated, jobs that were previously closed to people with a disability and seniors may become open to them. Tokyo is home to a café of robot waiters, controlled remotely by people with severe physical disabilities working from home. Technologies that perform real-time voice-to-text or language translation can also broaden service-sector opportunities. As the manufacturing, natural resources and logistics sectors increasingly rely on robots, positions will open up to people with physical limitations to direct that automation.

Greater flexibility around work hours and location may also flow from automation, creating more opportunities for working parents and others. Remote working would allow the easier accommodation of medical appointments or family schedules, for example, and reduce commutes at peak hour. On oil rigs, automated equipment is already being operated from centralised control rooms, requiring far less travel time to reach site locations.

As automation favours cognitive, social and emotional skills over brawn, Australia may well see not only greater labour force participation, but also more inclusive workplaces. However, the skills people need at work will continue to evolve, and at pace, necessitating lifelong learning attitudes and institutions, not just an initial injection of knowledge. Both new and displaced workers will need to learn new skills that fill a skills gap.

Automation may boost fulfilment, energy and safety at work

Automation has important implications for the quality of jobs, beyond the obvious benefit of eliminating many dangerous and dirty activities. By freeing employees from lower-value routine and manual activities, automation may allow people more time to use their specialised skills rather than their eyes and hands alone. For example, lawyers can now use machine-learning systems to review documents during discovery—an often mind-numbing activity for junior lawyers, and an expensive one for their clients. In the healthcare sector, nurses may undertake more routine medical activities and observations. Automated systems should also lead to faster and more accurate diagnoses, freeing up doctors and nurses to spend more time with patients (see Box 2). These systems may also free up hospital budgets to employ more ‘front line’ staff to support patients.

AI and automation hold vast potential to improve Australia’s productivity, by making its work systems more efficient and its jobs more engaging, and by opening up more of its jobs to more people. These improvements in turn hold the promise of a major uplift in national wealth and higher living standards for Australians. However, there is no denying the potential for automation to cause disruption, both in individual workplaces and across the economy. Chapter 3 considers these challenges, and how Australia could achieve the sweet spot of increased employment, job value, workplace skills and inclusion.

Box 2: Automated disease diagnoses are not artificial at all

AI capabilities—particularly computer vision, natural language processing and structured deep learning—will have far-reaching implications for health, hunger, education, security and justice, and equality and inclusion.¹ In health, for example, AI-enabled wearable devices can detect potential early signs of diabetes with 85 percent accuracy. This may make diagnosis much more affordable for the governments of the more than 400 million people affected by the disease. Similarly, a disease-detection AI system developed by researchers at the University of Heidelberg and Stanford University uses natural images of skin lesions to determine if they are cancerous, with more accuracy than professional dermatologists.

¹ *Applying artificial intelligence for social good*, McKinsey Global Institute, November 2018.



The challenges to employment, skills and inclusion

While automation holds the promise of economic and social benefits across Australia, individual workers and communities will still find it a challenging transition. In the period through to 2030, automation could displace between 3.5 million and 6.5 million positions (distinct from workers). While the economy will adjust and affected workers will find new jobs or transition to new occupations, the nature of existing jobs will change, and new jobs will appear.

Some sectors will benefit from all this change, but many in regional areas will find employment in traditional sectors hollowing out, leaving a lack of ready options. As physical and routine jobs are taken up by machines, organisations will be looking for people with digital, problem-solving and collaboration skills. They may struggle to find them, leading to a possible widening of income gaps, and underlining the need for more relevant skills training across the board.

This chapter discusses the following challenges:

- The impact of automation on total job demand and employment (with a sector and regional overview)
- The impact of automation on skills demand, including the type and level of skills that will need to be developed through formal education and lifelong learning
- The potential inequalities that may affect individual Australians, across skill levels, regions and age groups

These are serious challenges, but policymakers must avoid the trap of seeing automation only as a threat. Automation is an inevitability, and the advantages of actively steering its course far outweigh the benefits of resisting change. Slowing down the pace of automation might reduce short-term disruption to the labour market, but it may also lead to a decline in global competitiveness, productivity and income growth that could be hard to reverse as other countries get ahead.

Slowing down the pace of automation might reduce short-term disruption to the labour market, but it may also lead to a decline in global competitiveness, productivity and income growth that could be hard to reverse as other countries get ahead.

Multiple sectors would need to be engaged to make the transition to automation a success, but only the government has the mandate and opportunity to coordinate resources across the economy and gain support for fairly distributing the macro-benefits of automation. Chapter 4 outlines a national agenda for navigating these challenges.

Total job demand will be resilient, although with much churn

Historically, major economic changes have both destroyed and created jobs. The industrial revolution reduced the agricultural workforce but generated countless new jobs in manufacturing, just as the decline in manufacturing in advanced economies led to a boom in service industry jobs. There is every reason to think that a similar process will unfold with the automation revolution, with effects felt across all sectors and regions. The impact of this revolution on jobs, and how quickly this impact will be felt, remain less clear.

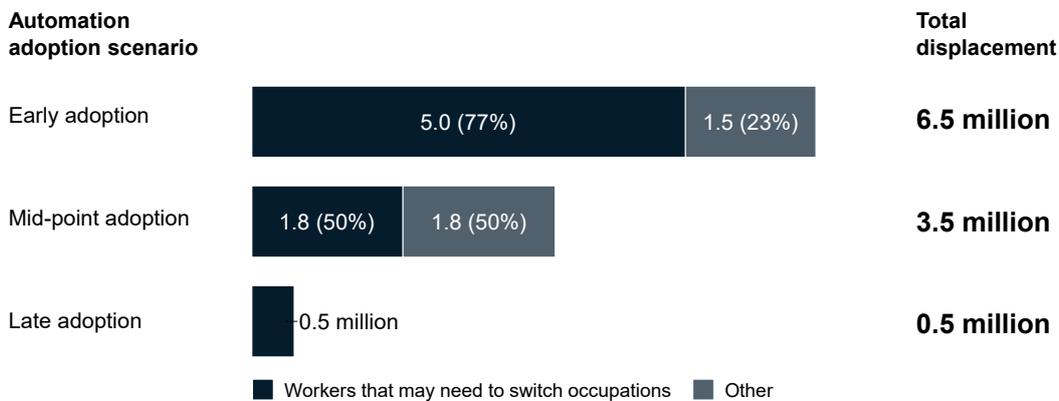
Overall employment levels will be stable but with potentially higher churn

Multiple studies have attempted to project the impact of these historic system changes on employment levels. While most focus on the jobs at risk, this report looks at work *activities*. Every job is made up of constituent activities, each of which may have different technical potential for automation. A retail salesperson, for example, may spend time ringing up sales (an activity that is easily automated) but may also interact with customers (an activity that is not easily automated).

As discussed in Chapter 2, activities accounting for a quarter of the hours put in by Australia's workforce could be handled by machines by 2030 in a mid-point adoption scenario. This could be as high as 46 percent in an early adoption scenario. In these scenarios, up to 3.5 million and 6.5 million full-time equivalent positions, respectively, could be displaced in the decade through to 2030 (Exhibit 27).

New jobs, new professions

Scenarios for total number of full-time equivalent (FTEs) positions displaced due to automation and estimates for number of workers who may have to shift occupational categories to find work by respective automation scenarios and trendline labour demand scenario; Millions, 2016-30



Note: Estimated impact is the static impact before economic adjustment begins to return labour market to equilibrium. Numbers may not sum due to rounding
 Source: MGI Automation Model March 2018, Jobs Lost Jobs Gained December 2017; McKinsey Global Institute (MGI)

However, this is only the displacement part of the picture, and the first step in the process of economic adjustment. Demographic and economic trends such as population growth, rising consumer incomes and growing healthcare needs, as well as ongoing (and potentially increased) investment in areas such as infrastructure and transitions towards cleaner energy, will continue to create jobs in the economy and help to absorb displaced workers. At the same time, new technologies will create entirely new jobs that don't exist today. For example, we estimate that seven key trends alone could create around 4 million new jobs by 2030 in a mid-point labour demand scenario.⁶⁰ This would be more than enough to offset the 3.5 million jobs lost to automation in the mid-point scenario, even before the second round of impacts (indeed, the infinite virtuous cycle) of higher productivity from automation kicks in, leading to higher incomes and consumption.

There is no doubt that workers who are displaced will find this period challenging. Some may be able to find similar jobs in other companies or sectors, but between half to 80 percent (depending on the pace of automation) may need to retrain and transition to completely new occupations in order to find work.

While the impacts of automation over the next 50 to 100 years are hard to fathom, the economy is likely to return to full employment in the medium term (i.e. by 2030), as it has always done following structural shocks. However, there is no doubt that workers who are displaced will find this period challenging. Some may be able to find similar jobs in other companies or sectors, but many will need to retrain and transition to completely new occupations in order to find work. We estimate that around one-half of the workers displaced in the mid-point scenario will need to switch occupations to find a job (Exhibit 27). In a rapid adoption scenario, where the share of activities automated in individual jobs is much higher, this figure could reach almost 80 percent.

**1.8-
5.0Mn**

workers may need to change occupations by 2030.

⁶⁰ The seven key trends are: (1) rising incomes; (2) spending on ageing healthcare; (3) education spending; (4) spending on technology; (5) investment in real estate and construction; (6) investment in infrastructure; and (7) energy transitions. Of the 4 million jobs, about 2.5 million come from trendline growth in the seven trends; about 0.5 million come from choices, mostly by governments, to step up investments in infrastructure and new sources of energy, and to convert some currently unpaid work into paid positions; and about 1 million jobs are entirely new and will be created by new technologies, including automation itself. For more details on the McKinsey Global Institute methodology, see the Technical Appendix.

Unemployment rates could rise during the transition

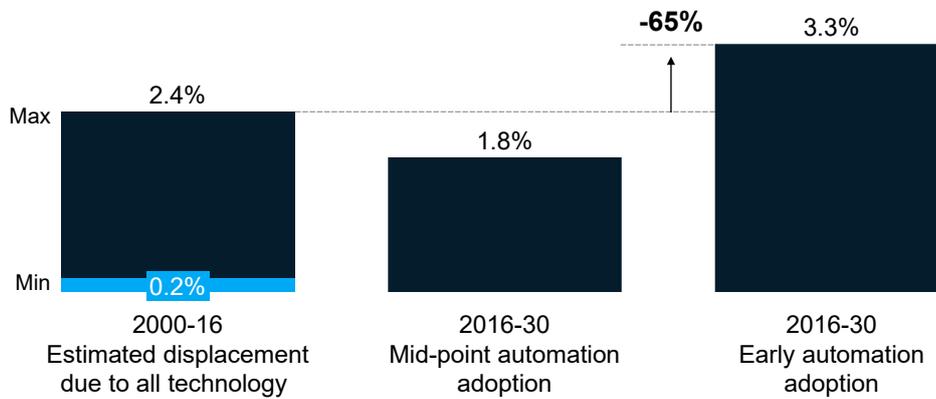
While the impact of automation could be offset by broader job growth over the coming decade, Australia may experience a bump in unemployment during the transition, particularly if there is insufficient transition and retraining support.

Between 2000 and 2016, around 18 percent of Australian workers changed jobs every year on average, mostly for voluntary reasons, but an estimated 2.4 percent of all workers were displaced or retrenched in any given year due to technological and economic changes (Exhibit 28, see Box 3 for details). In the years ahead, this annual rate of displacement from technology may be similar in a mid-point automation adoption scenario, but it could increase by almost 40 percent to 3.3 percent in an early adoption scenario.

Exhibit 28

Faster than before?

Scenarios for rate of displacement due to technology or automation, by automation adoption;
Percent of FTEs displaced, average per annum over period



Note: Numbers may not sum due to rounding

Source: ABS Labour Statistics 2018, ABS Retrenchment and Redundancy survey 2001, MGI research

Box 3: Will the pace of change be different than in the past?

An important question is whether automation's pace of change will be faster than in prior waves of technological advancement. Research suggests that in Australia, the pace of change due to automation and related technologies—measured by the degree of annual job displacement or churn—may be on par with what the country has been experiencing since the year 2000, although this would speed up in a rapid automation adoption scenario.¹

Only at first glance does the prospect of automation appear gloomy. Our mid-point scenario for Australia estimates 25 percent job displacement by 2030 due solely to automation (an average of 2 percent per year). This is not far from the 30 percent of jobs that disappeared within 15 years during the decline of agriculture in Germany or the exodus of manufacturing from the United States.² Furthermore, through the continuing boom years of 2000–16, Australia averaged 3 percent job displacement or redundancy a year—significantly higher than our forecast rate of automation displacement.³ This raises another important question: how much of our historical job displacement rate has been due to technology adoption?

While there is a paucity of data on this topic, it is likely that a large share of Australia's past displacement rate has been due to technology adoption. In a 2001 survey of displaced workers conducted by the Australian Bureau of Statistics (ABS), 5 percent self-identified as having been displaced directly by technology, and three-quarters cited a broad range of economic and management factors. (The remainder cited other reasons, including poor health and underperformance.⁴) Economic factors—for example, an economic downturn or increased competition—are themselves often indirectly related to technological progress. Firms make workers redundant in order to reduce costs, and then re-invest in new technologies and more efficient technology-enabled management practices.

It is therefore possible that up to 80 percent of Australia's past redundancies have been directly or indirectly related to technology adoption. Since 2000, this would imply a maximum annual displacement rate due to technology of around 2.4 percent, which is slightly higher than the displacement rate in the mid-point scenario. Only if automation technologies are adopted rapidly will the annual displacement rate rise to 3.3 percent—almost 40 percent higher than Australia's job displacement rate throughout the boom years. However, the challenge may be greater because of the scale and nature of the reskilling effort needed for new positions. While someone with manual skills may have found it relatively easy to transition into a job requiring basic cognitive skills, they may find it much harder to move from a job that requires basic cognitive skills to one that requires complex cognitive or socio-emotional skills.

¹ Displaced is defined as: employees who were retrenched or laid off, including no work available, made redundant, employer went out of business or dismissed; and self-employed people whose business closed down for economic reasons.

² *Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages*, McKinsey Global Institute 2017.

³ Participation, job search, and mobility statistics (6226.0), ABS, 2018.

⁴ Retrenchment and Redundancy Survey (6266.0), ABS, 2001.

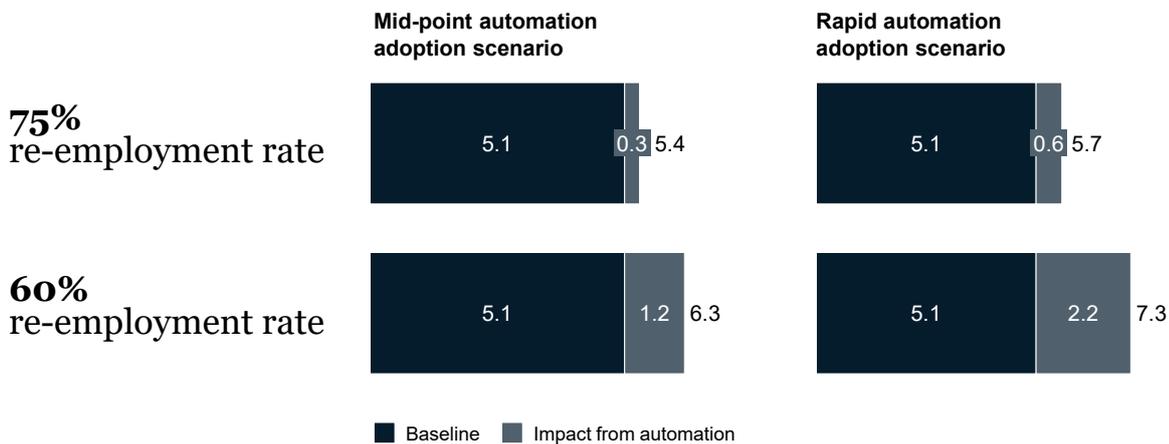


A relatively high number of displaced workers does carry the risk of higher fluctuation in the unemployment rate. The challenge here is to minimise long-term unemployment for individuals, which has devastating consequences for affected households and for society as a whole.⁶¹ Historically, almost three-quarters of unemployed Australians have been able to find new jobs within a year—a rate that is well above the OECD average and approaching that of the United States.⁶² If this historical re-employment percentage holds, automation could have a relatively small impact on the unemployment rate, potentially causing it to rise to between 5.3 and 5.7 percent (0.3 to 0.6 percentage points above the long-term projection), depending on the speed of automation adoption (Exhibit 29). However, if policy decisions or automation itself structurally lower the rate of re-employment (for example, because it is harder to teach higher cognitive and technological skills than it is to teach manual and basic cognitive skills), the result could be worse. For example, if the re-employment rate falls to around 60 percent (Australia’s historical low during recessions), it could bump the overall unemployment rate as high as 6.2 percent in the mid-point scenario (1.2 percentage points higher than otherwise) and 7.3 percent in the rapid adoption scenario (2.2 percentage points higher than otherwise).

Exhibit 29

Peak unemployment

Scenarios for peak impact on unemployment by automation adoption and re-employment rate¹ within one year
Percent in 2025



¹ Over long term, 75% of unemployed persons in Australia have been re-employed within one year. The lowest rates recorded are around 60% during the recessions of the early 1980s and 1990s
Source: ABS Labour Force (Catalogue 6202), December 2018; McKinsey Global Institute Global Growth Model

Moreover, the challenge will not simply be to get displaced workers back into any job, but ideally a better, more productive and higher paying job. Encouragingly, an OECD study on labour market displacement in Australia found that a fifth of displaced workers upgrade their skills when they switch to a new job or occupation, and almost 50 percent obtain a wage increase of 10 percent or more. On the downside, almost half of displaced workers downgrade their skills and 30 percent experience a wage cut of 10 percent or more. In the age of automation, Australia will need to step up its efforts to significantly improve these odds.⁶³

While automation won't lead to mass unemployment, there could be a bump in the unemployment rate during the transition. The challenge will be to minimise long-term unemployment for individuals, which has devastating consequences for affected households and for society as a whole.

⁶¹ Natural rate of unemployment is the share of people who are temporarily unemployed due to job changes that occur in any healthy economy. In Australia, this rate has been estimated at around 5 percent.
⁶² That rate peaked at 85 percent but has declined since the financial crisis (as in most advanced economies) to stabilise at around 75 percent. If a recession hits, however, the re-employment rate could drop to between 62 and 64 percent.
⁶³ *Back to Work (Australia): Improving the Re-employment Prospects of Displaced Workers*, OECD, 2016.

Job demand will vary by sector, occupation and region

In the wake of automation, many new jobs that cannot possibly be predicted now will be common by 2030. However, for the most part, changes will be seen in the jobs and sectors that Australians are familiar with, and these changes will be far from uniform.

New jobs will be added to those we are already familiar with

Most of the 4 million jobs that could be created by 2030 in the 'step-up' labour demand scenario (discussed above) would come from new sources of demand and the faster economic growth that accompanies higher productivity. Yet almost a million jobs could be in entirely new roles that don't currently exist. This isn't surprising; a third of the new jobs created in the United States in the past 25 years didn't exist at the start of that period, and 70 percent of these were linked to technology.⁶⁴ Just as it would have been impossible to imagine web developers and social media marketers 50 years ago, it may be hard to envision today the new types of digital specialists of tomorrow who will work to keep autonomous systems running with optimal efficiency. For example, the market for edge computing experts and 3D printing engineers will grow. Other new jobs will focus on helping people live in an automated world: fitness commitment counsellors will be needed to combat the effects of increasingly sedentary work lives, and virtual data brokers will help individuals to keep their personal information safe and accessible.⁶⁵

While many tend to focus on the potential job losses from automation, we estimate that almost a million jobs could be created by 2030 in entirely new roles that don't currently exist.

Some sectors and professions will be more disrupted than others

Across the economy, the industries that are likely to experience the greatest disruption will be retail, administration and government, health and social assistance, construction, manufacturing, and accommodation and food services (Exhibit 30). This suggests that these sectors may need to modernise. For example, previous McKinsey research noted that the digital maturity of Australia's retail sector lags behind that of its international peers, particularly when it comes to reaching and influencing customers through digital channels.⁶⁶ Retail may lose around 430,000 at-risk jobs (28 percent of total jobs), but it could add around 600,000 jobs, many of which may be very different to roles today. For instance, most retail growth would occur in sales and customer service and in training and development occupations, while the majority of the net losses would occur in production, installation and construction-related occupations, such as operating packaging machines. Similar shifts would be found in manufacturing (340,000 jobs at risk, with 270,000 new jobs likely) and accommodation and food services (290,000 jobs at risk, with 260,000 new jobs likely).

Overall, job displacement will be highest in administrative or generalist occupations that involve predictable physical activities or repetitive data collection and processing. Receptionists, research and legal assistants, and payroll and data entry workers, for example, are highly vulnerable. Demand will hold steadier for occupations that require personal interactions or the application of specialist or technological skills, such as teaching, nursing, sales and computer programming (Exhibit 31).

For the most part, however, automation will not remove the need for particular sectors or occupations altogether. The greater impact will be the need to rebalance the type and level of skills needed across sectors and occupations (discussed later in this chapter).

⁶⁴ Jeffrey Lin, 'Technological adaptation, cities, and new work', *Review of Economics and Statistics*, Volume 93, No. 2, 2011.

⁶⁵ For more, see: *Jobs of the future: A guide to getting—and staying—employed over the next 10 years*, Centre for the Future of Work, 2017.

⁶⁶ *Digital Australia: Seizing the opportunity from the fourth industrial revolution*, Digital McKinsey, March 2017.

Exhibit 30

Jobs lost, jobs gained

Mid-point automation adoption scenario and step-up labour demand scenario, 2016–30

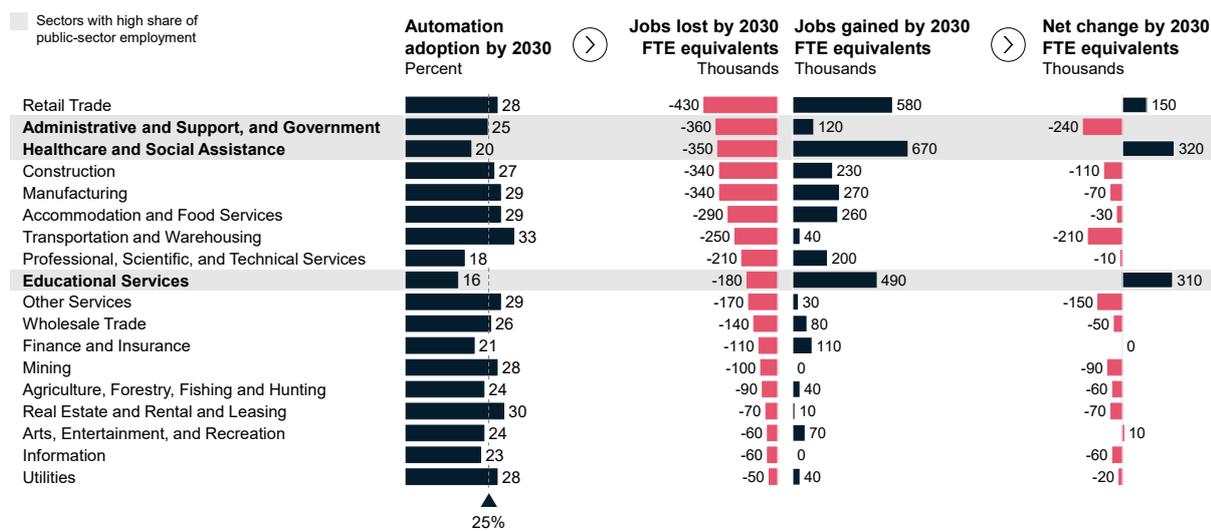


Exhibit 31

Hot professions

Projected net change in jobs by occupation type (step-up labour demand, mid-point automation);¹

Thousands, 2016-30

Occupation Type	2016	Percent of jobs	
		2016	2030
Care providers (Surgeons, nurses)	610	10	12
Educators (Teachers)	570	5	8
Professionals (Lawyers, business specialists)	340	11	12
Managers and executives (CEOs, sales managers)	350	11	12
Customer interaction (Retail sales, bartenders)	330	11	12
Other jobs—unpredictable environments (Farmworkers, firefighters)	210	10	10
Technology professionals (Web developers, IT)	90	2	2
Creatives (Authors, designers)	70	3	3
Builders (Construction workers, electricians)	40	7	6
Office support (Payroll clerks, data entry)	-120	15	12
Other jobs—predictable environments (Machinists, cooks)	-380	16	11

¹ Mid-point of earliest and latest automation adoption in the 'step-up' scenario (i.e. high job growth)
 Note: Does not include new occupations created by automation. Numbers may not sum due to rounding

Source: MGI Automation Model March 2018, Jobs Lost Jobs Gained December 2017; McKinsey Global Institute analysis

While many tend to focus on the potential job losses from automation, we estimate that almost a million jobs could be created by 2030 in entirely new roles that don't currently exist.



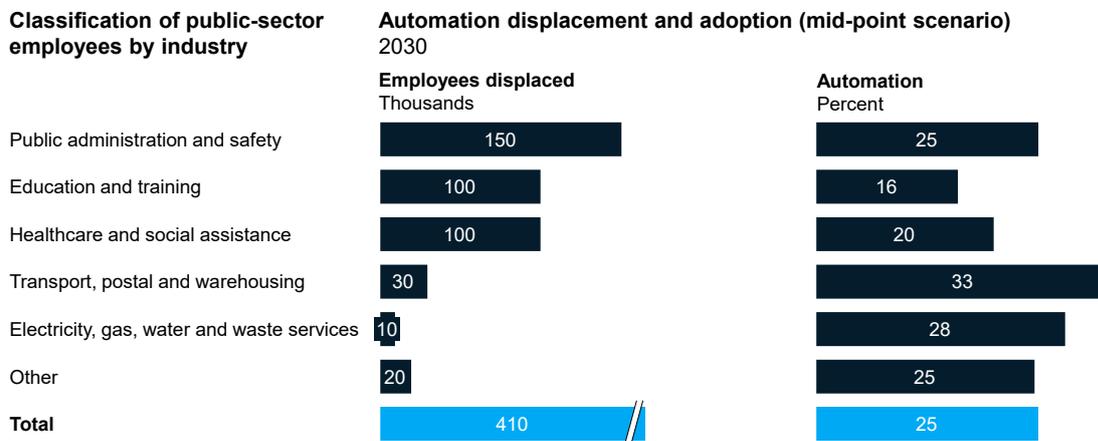
The public sector will have additional challenges

The public sector, which currently employs about one in five Australian workers, will likely find the shift to automation particularly challenging.⁶⁷ Job security and limited flexibility is often written into workforce contracts, and public agency missions are more complex than raising profits and lowering costs. Without forward planning, the public sector runs the risk of locking in higher cost structures and missing out on the opportunities offered by new technologies to better serve citizens. Around 400,000 jobs could be displaced in the public sector over the next decade and do more with less.

In our mid-point scenario, automation could progressively displace around 20 percent of public-sector positions in Australia over the decade to 2030, covering both civil servants and large, publicly funded health and education workforces (Exhibit 32). As in the private sector, the displaced jobs will largely be replaced by higher demand for other jobs and by entirely new jobs, as the economy creates around 500,000 new publicly funded jobs over the same period. For example, there may be 240,000 new front-line jobs in education, to compensate for about 100,000 displaced jobs. Many of these new jobs will be for instructional coordinators who develop curricula and content—a specialist role requiring knowledge of the education system and job market, as well as strong cognitive and managerial skills. In healthcare and social assistance, there may be around 100,000 displaced jobs, but in healthcare alone about 190,000 new jobs may be created, many of them for nurses and medical specialists. In raw numbers, the biggest disruptions may be expected in administration and safety (150,000 jobs, or 25 percent of total jobs). These are the workers who are less likely to find similar jobs elsewhere without significant reskilling. New roles in government departments will require advanced digital skills that are currently rare in the public sector, and agencies will need to add new roles such as software developer and network specialist.

Exhibit 32

Public disruption



Note: Numbers may not sum due to rounding

Source: Australian employment statistics, McKinsey Global Institute (MGI), ONED, BLS, Oxford Economics

⁶⁷ ABS 6291. This collection covers public-sector organisations, including commonwealth and state/territory government organisations, local government authorities, public corporations, universities, non-profit institutions controlled by the government, government marketing boards, legislative courts, municipal authorities and other statutory authorities.

Impact of automation by local area



Perth

Total jobs: 11,500

Automation rate: 21%

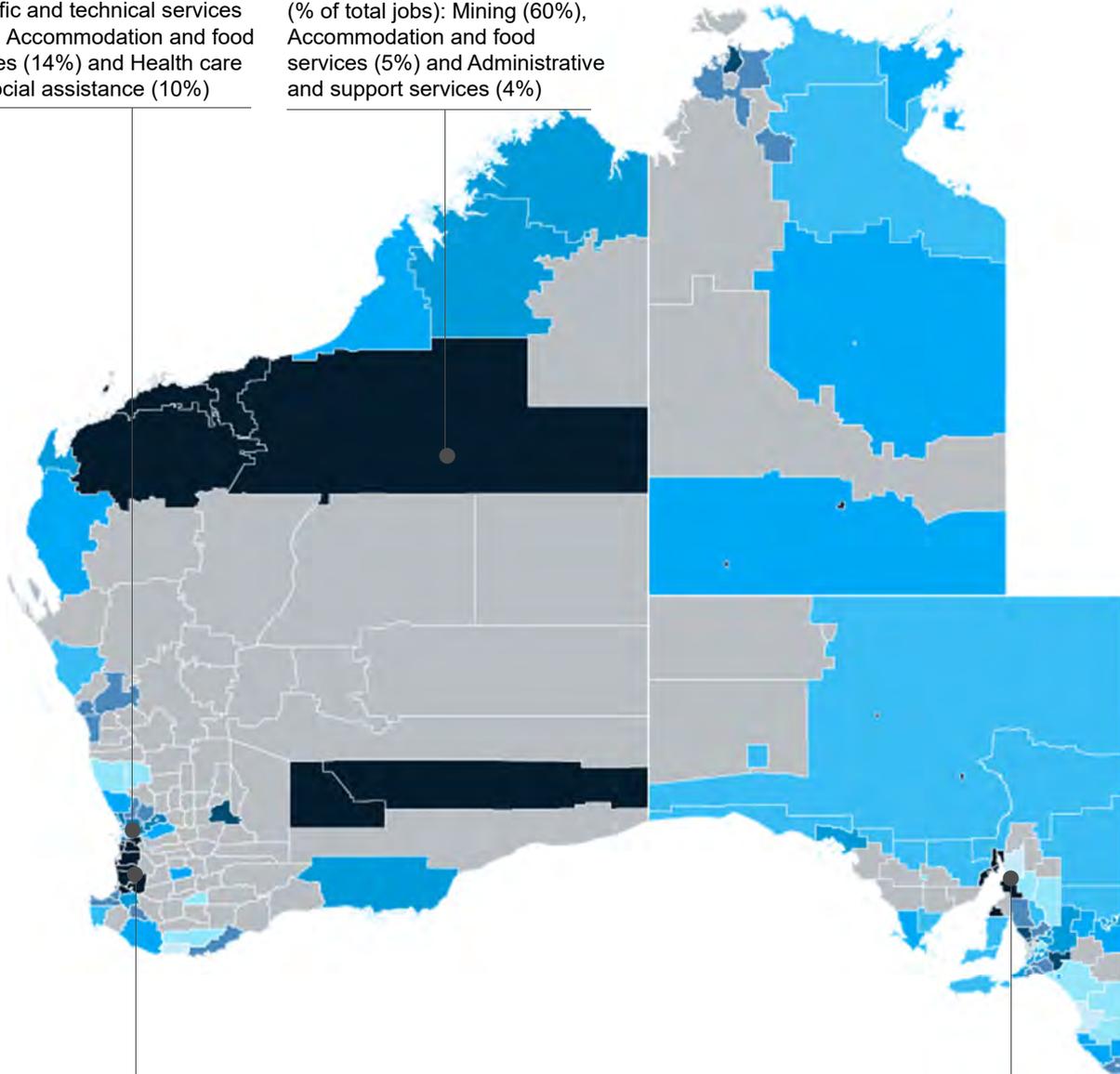
Top 3 employment sectors (% of total jobs): Professional, scientific and technical services (14%), Accommodation and food services (14%) and Health care and social assistance (10%)

East Pilbara

Total jobs: 5,800

Automation rate: 31%

Top 3 employment sectors (% of total jobs): Mining (60%), Accommodation and food services (5%) and Administrative and support services (4%)



Harvey

Total jobs: 11,700

Automation rate: 27%

Top 3 employment sectors (% of total jobs): Manufacturing (14%), Retail trade (11%) and Construction (10%)

Port Pirie

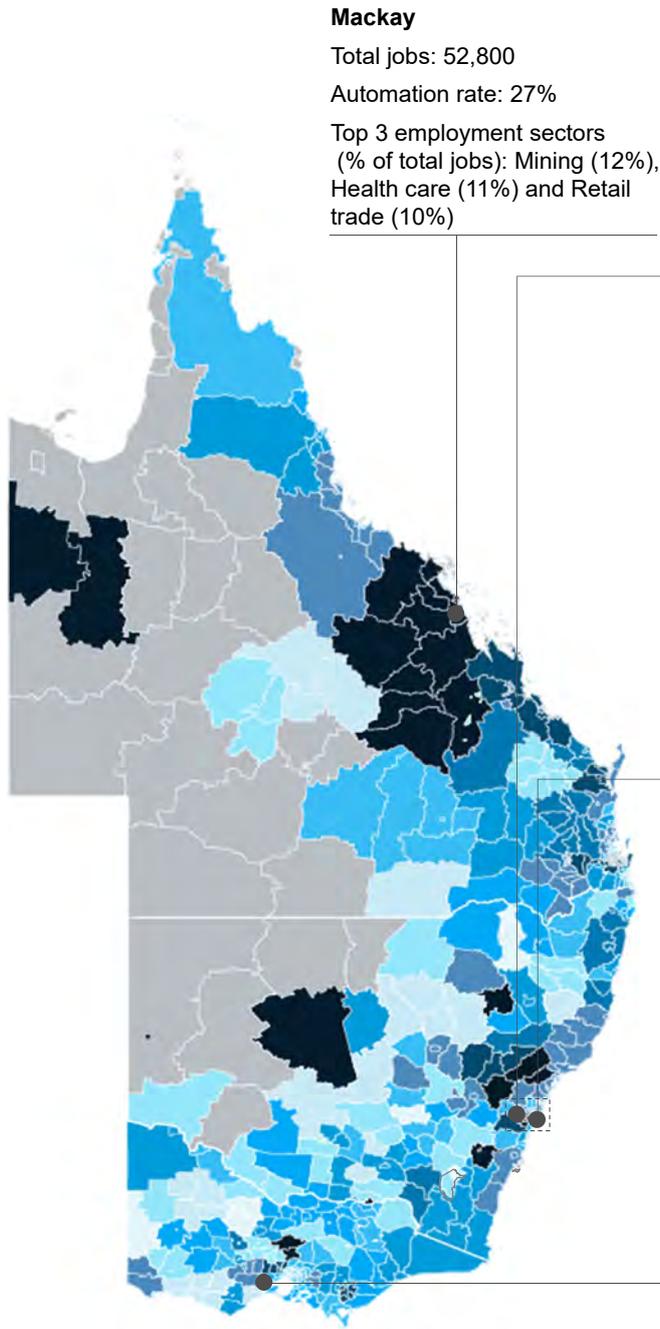
Total jobs: 6500

Automation rate: 27%

Top 3 employment sectors (% of total jobs): Health care (18%), Manufacturing (14%) and Retail trade (12%)

* Jobs at risk is an estimate based on 2016 segmentation of jobs by occupation and sector within each LGA, and does not reflect job growth that would occur in each area between 2016-2030.

Impact of automation by local area



Mackay
 Total jobs: 52,800
 Automation rate: 27%
 Top 3 employment sectors (% of total jobs): Mining (12%), Health care (11%) and Retail trade (10%)

Penrith
 Total jobs: 95,000
 Automation rate: 27%
 Top 3 employment sectors (% of total jobs): Construction (12%), Health care (11%) and Retail trade (11%)



Sydney
 Total jobs: 117,200
 Automation rate: 21%
 Top 3 employment sectors (% of total jobs): Professional services (17%), Accommodation and food services (12%) and Financial and insurance services (9%)

Greater Geelong
 Total jobs: 103,600
 Automation rate: 25%
 Top 3 employment sectors (% of total jobs): Health care (15%), Retail trade (12%) and Construction (10%)



West Coast
 Total jobs: 1500
 Automation rate: 28%
 Top 3 employment sectors (% of total jobs): Mining (23%), Accommodation and food services (15%) and Education and training (8%)

* Jobs at risk is an estimate based on 2016 segmentation of jobs by occupation and sector within each LGA, and does not reflect job growth that would occur in each area between 2016-2030.

The public sector will be affected in yet another way. Government is a major source of funding for fields that will experience an increase in demand for workers, including care for the elderly and people with a disability, higher education and infrastructure delivery. Governments at all levels will need to push for the right incentives, employment policies and training programs, not only to build their own workforces but also to ensure that the right talent and skills are available in these sectors, and to eliminate current barriers to automation and productivity improvement.

Some regions will be affected more than others

Given the broadly similar economic structures of Australia's states and territories, our model predicts that the rate of job automation will be relatively uniform across these jurisdictions. The automation rate may be slightly higher in Western Australia, whose economy is heavier in vulnerable sectors like mining and construction; and slightly lower in the Australian Capital Territory (ACT), where there are more resilient public and professional services sectors.

Comparing Western Australia and the ACT hints at the variations to be found at the community or local government level (Exhibit 33). Communities with concentrations of sectors that are vulnerable to automation will be harder hit. Overall, our model projects that automation adoption for local government areas (LGAs) will range from 18 to 31 percent, with about seven in ten LGAs clustering around the 24 percent national average.⁶⁸ East Pilbara in remote Western Australia is one example of an LGA with the highest level of automation adoption, as mining accounts for 60 percent of employment.⁶⁹ Conversely, professional services or healthcare are the major employers in all but one of the 20 LGAs least affected by automation. Most areas are near the average, however, because most have diversified economies, which reduces the extent to which particular sectors affect total employment, for better or worse. Most regions also have a relatively even spread across occupations. For example, about 30 percent of Townsville and Geelong workforces are professionals and managers, despite these areas having very different industry mixes.

The rate of displacement from automation could range from 18 to 31 percent across local government areas. The real risk lies in communities (particularly rural and outer suburban communities) that are heavily concentrated in vulnerable sectors and may not have the skills and resilience base to adapt quickly. As discussed in the section on inequality risks below, these are typically outer suburban or rural LGAs, and they will need to be the focus of individual support services (see Chapter 4).⁷⁰

⁶⁸ Only includes LGAs with more than 1,000 employees. All following analysis of LGA variation and statistics are quoted based on LGAs with more than 1,000 employees to exclude outliers.

⁶⁹ Industry of employment by occupation, ABS, 2016.

⁷⁰ Census data, ABS, 2016.

Different skills will be needed, and at a higher level

The nature of work itself is also changing as automation fundamentally alters the activities people perform at work and the skills they need, including both generalist skills and specialist skills. This may affect how Australia's education system prepares the workers of the future.

Shift to technology, problem-solving, collaboration and emotional skills

Four types of work activities will see an increase in demand: working with machines (technology skills), applying specialised expertise (higher cognitive skills), interacting with stakeholders (social skills), and managing, teaching and developing people (emotional skills) (Exhibit 34). Farmers, firefighters, sales managers, builders and others will all rely heavily on machines to collect data and take specific physical actions. These workers will need the cognitive skills to identify patterns, detect problems and prescribe courses of action. They will also need collaborative and emotional skills to create more effective teams, maintain productive and social workplaces, and engage with an ever-wider pool of customers.

In our mid-point scenario, workers will spend 66 percent more time using technology, and 43 percent more time in personal interactions that require social and emotional skills (such as leadership, management or teaching). By contrast, the amount of time spent performing physical and routine activities will shrink.

The precise changes in skill sets will vary substantially by occupation and by sector (see Exhibit 34 and Box 4). However, the perception that automation-driven changes will largely affect manual work is incorrect. Workers across Australia's large and growing service sector may have access to automated information-gathering but will need to upskill in technological and social and emotional skills. For example, automation and AI in education can enable more digital content, interactive and personalised learning, and virtual learning and support. This will increase demand for instructors with basic digital skills and the ability to work with people with advanced information technology (IT) and programming knowledge, as well as demand for new types of teaching methods.

It would be wrong, too, to assume that only blue-collar occupations will be affected. Many white-collar jobs will change too, as machines start to perform diagnostic and data functions faster and more efficiently. Today, 13 percent of a surgeon's time at work may already be automatable, including activities such as analysing patient data. Similarly, 23 percent of a lawyer's time may be automatable, including activities such as legal research and document preparation, which rely heavily on mechanical and replicable data research. Automation will inevitably alter the nature of these professions. A surgeon in the automation era will spend much more time using 'soft' skills, including cognitive skills and social and emotional skills, and the requirement for physical and technological skills will decline sharply. This will have significant repercussions for how universities train doctors and prioritise aptitudes among prospective medical students, how patients value their doctors, and how employers assess job applicants.⁷¹

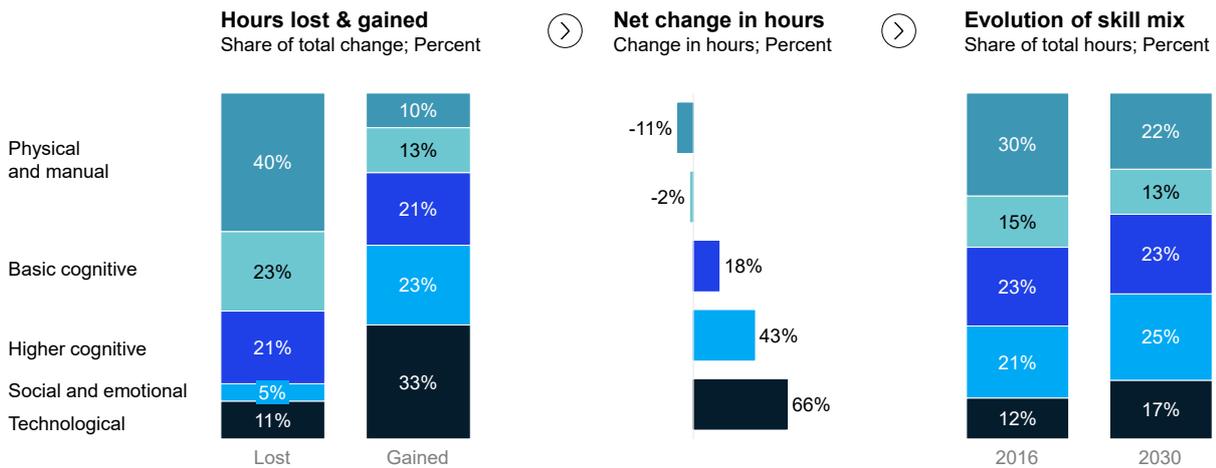
+66%

Time spent on technology skills by 2030.

⁷¹ Internal analysis, McKinsey Global Institute, 2018.

Macro skills evolution

Change in hours worked by skill category, 2016-30 (step-up labour demand, mid-point automation)

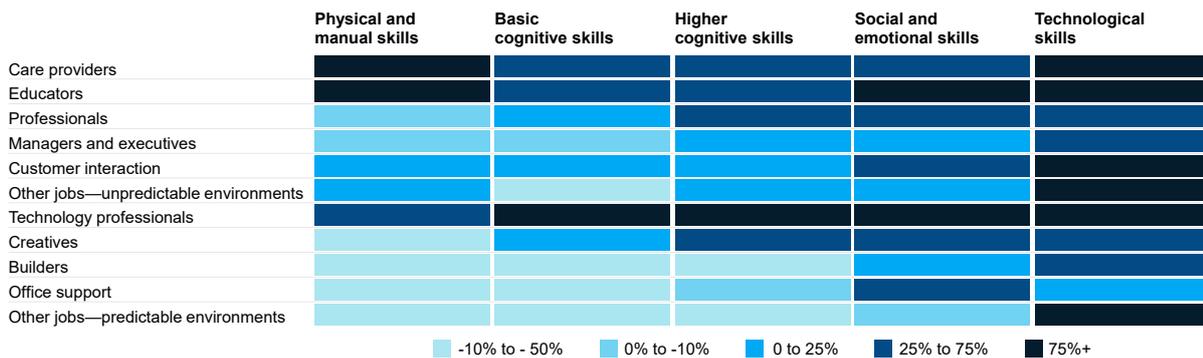


Note: Based on difference between hours worked per skill in 2016 and modelled hours worked in 2030 in step-up scenario and mid-point automation adoption

Source: McKinsey Global Institute workforce skills model, McKinsey Global Institute analysis

Skills evolution by occupation

Change in hours worked by occupation category and by skill category, 2016-30 (step-up labour demand, mid-point automation)

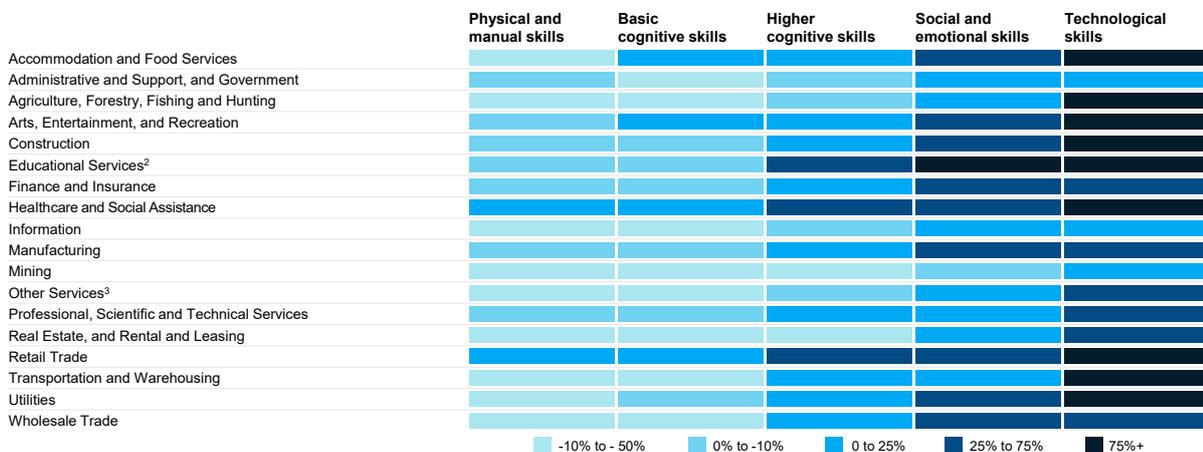


1 Based on difference between hours worked per skill in 2016 and modelled hours worked in 2030 in step-up labour demand scenario and mid-point automation. Numbers may not sum due to rounding

Source: ABS, Intergenerational report 2015, Oxford Economics; MGI Skills Model; McKinsey Global Institute analysis

Skills evolution by sector

Change in hours worked by sector and by skill category, 2016-30 (step-up labour demand, mid-point automation)



1 Based on difference between hours worked per skill in 2016 and modelled hours worked in 2030 in step-up scenario and mid-point automation. Numbers may not sum due to rounding

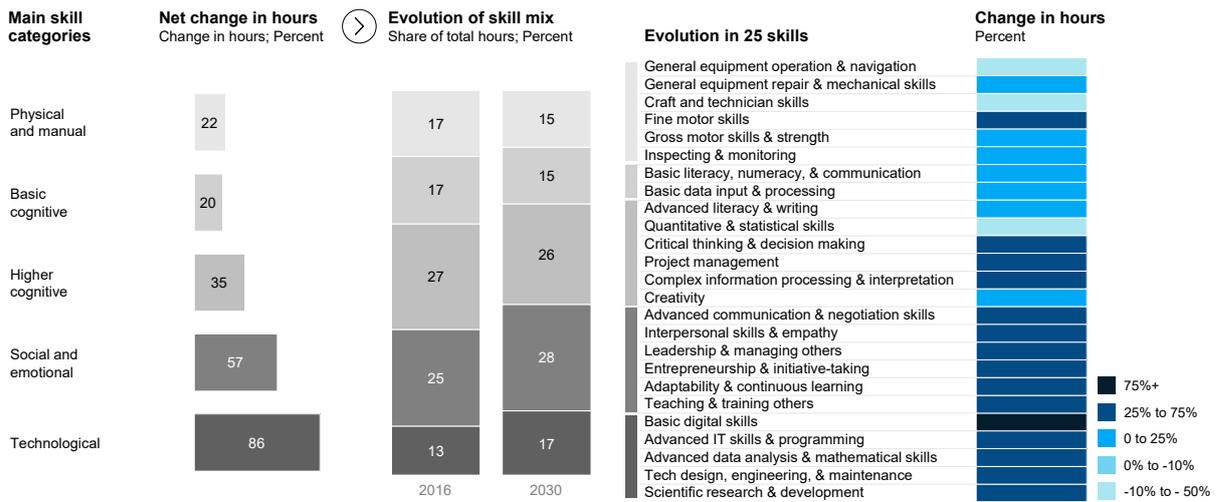
2 Including private, state and local government schools

3 Except federal, state and local government

Source: ABS, Intergenerational report 2015, Oxford Economics; MGI Skills Model; McKinsey Global Institute analysis

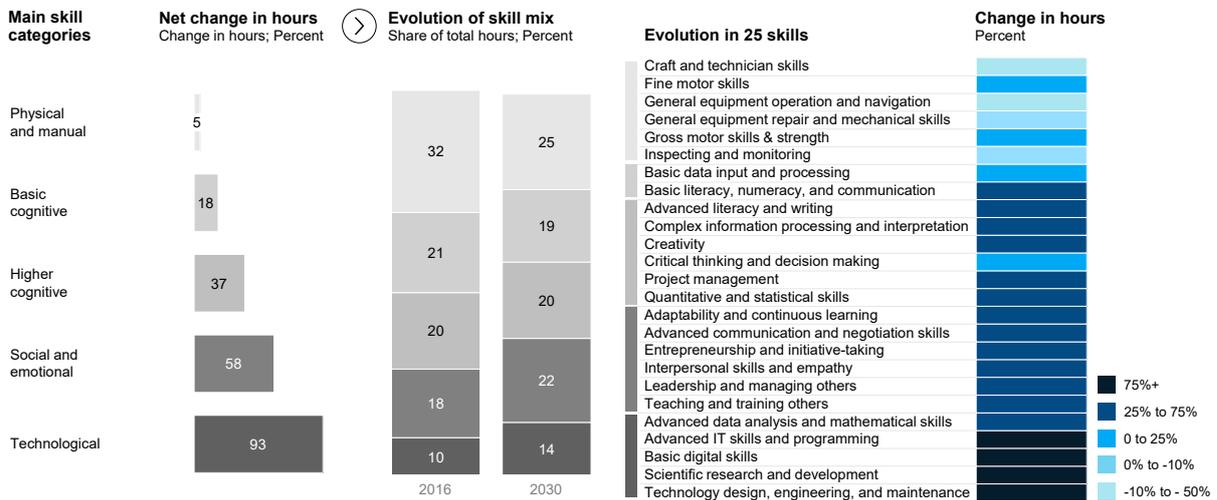
Skills evolution in healthcare

Sector skill shifts, 2016-30



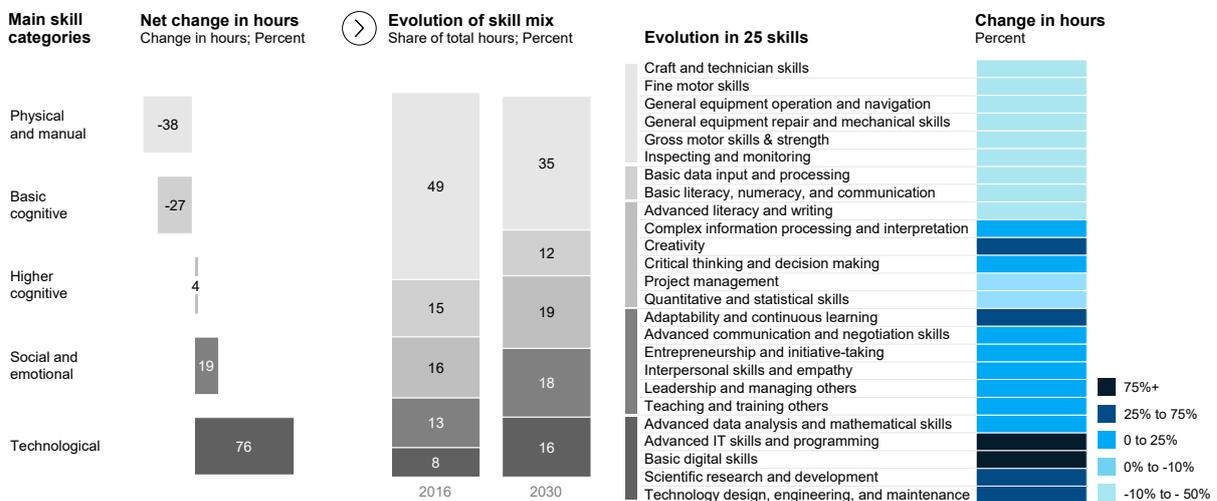
Skills evolution in retail

Sector skill shifts, 2016-30



Skills evolution in transport

Sector skill shifts, 2016-30



1 Based on difference between hours worked per skill in 2016 and modelled hours worked in 2030 in step-up scenario and mid-point automation. Numbers may not sum due to rounding

Source: ABS, Intergenerational Report 2015, Oxford Economics; MGI Skills Model; McKinsey Global Institute analysis



Box 4. How health, retail and transport work will change

This report has taken a closer look at how the skills needed for work in health, retail and transport may change due to automation in the Australian economy.

In healthcare, automation offers gains in both efficiency and quality, allowing for smoother coordination of complex cases, better diagnostic tools, remote monitoring and improved treatment methods. This would increase the need for healthcare workers with basic digital skills who can use these systems effectively—and, above all, who can interact with patients with empathy and care.

In retail, this pattern is even more pronounced. Today's retail worker spends almost a third of their day labelling goods or moving boxes. By 2030, these functions will take only a quarter of their time as drones, automated lifts, labelling machines, complex data management systems and advanced barcoding technology become widespread. Retail workers will direct the machines that perform these functions and have more time to interact with customers, which tends to be why they entered that occupation in the first place.

The transport industry will be entirely transformed by automation. Automated loaders will shift containers on and off ships, and advanced cargo tracking will inform senders, carriers and receivers where goods are at every point along the way. Self-driving trucks will transport products from ports to warehouses, and from warehouses to stores or to customers. An entire industry heavily dependent on physical skills will need workers proficient in data analysis and advanced IT skills.

Automation could exacerbate the mismatch between future graduates' skills and labour market needs

By 2030, people who are currently students in Australia's education system could account for about a third of the country's workforce. It is therefore critical that universities and vocational education and training (VET) institutes equip enough graduates with skills that employers can further develop for an increasingly technology-driven workplace. A supply-demand mismatch may occur both in the nature and the level of subject disciplines being pursued. And with a large chunk of tertiary education cost covered by the government, it's fair to ask whether an economic return is being made on taxpayers' investment.

To shed light on a possible mismatch, we looked at education trends over the past 15 years, the current levels of graduates by field of study, the current employment rates among those graduates (a signal of current demand) and the projected needs of the labour market (a signal of future demand). Of course, there is bound to be some mismatch between what students choose to study and what employers need, as young people pursue both their vocations and their interests. However, our analysis of this data highlights as many concerns as reasons for optimism.

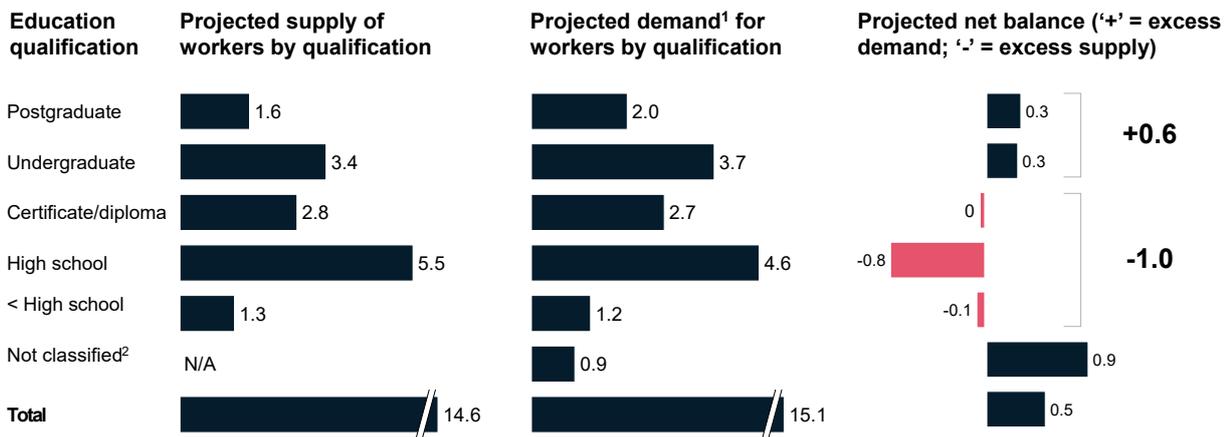
Australia could face an overall shortage of 600,000 university graduates to fill available jobs by 2030. At the same time, almost 1 million high school leavers could struggle to find work unless they obtain new qualifications.

Looking at the total volume of graduates needed, it is clear that automation and digitisation are lifting the level of skill needed in the job market faster than Australia currently produces graduates. If current graduation and employment patterns continue—and barring the wholesale collapse of the formal tertiary education sector, as some think tanks and futurists predict⁷² (Exhibit 35).

Exhibit 35

Time for (more) school

Projected change (mid-point adoption scenario¹) in employment supply and demand, by education qualification
Millions of jobs, 2030



¹ Mid-point automation scenario, step-up labour demand scenario

² New occupations created by automation and technological change

Note: Mid-point of earliest and latest automation adoption in the 'step-up' scenario. Numbers may not add up due to rounding

Source: MGI Automation Model March 2018, Jobs Lost Jobs Gained December 2017; McKinsey Global Institute analysis

Within the graduate body, there are positive signs that the tertiary system is aligning the supply of graduates with labour market needs. For example, over the past five years, students' field-of-study choices have shifted towards health, sciences and education, with rising demand for graduates in these areas indicated by employment rates of 80 percent and above. Through to 2030, however, employers in education, health and IT may still experience acute shortages of qualified workers—as high as 10 percent for postgraduates in education and health (Exhibit 36). The health sector is expected to need the largest number of new workers by 2030, and it has seen the highest jump in its share of all graduates, increasing by more than 2.5 percent between 2010 and 2016. More students are also acquiring the advanced qualifications that employers are seeking, with postgraduates in health, education and engineering all increasing their share of the total student population.

⁷² For example, see: *Here's how higher education dies*, The Atlantic, 2018; or *How Google and Coursera may upend the traditional college degree*, Brookings, 2015.

On the other hand, there are fields in which the education system may be producing more graduates than are required. For example, for entry-grade engineering jobs that are highly susceptible to automation (such as car mechanics and builders), current trends would produce an 11 percent surplus of VET graduates by 2030. The biggest gap between supply and demand centres on the high numbers of students studying humanities and social sciences. In 2016, about a fifth of students graduated from these disciplines but found their chances of full-time employment in the first year to be around just 60 percent—about 20 percent below engineers. This mismatch seems likely to persist as these fields have seen their share of graduates rise over the past five years.⁷³ The good news is that this 60 percent employment rate may well increase as the automation era seeks workers who can address issues such as ethics and bias in AI; motivate, train and manage others; and exhibit creativity. Many of the higher-level social and emotional skills needed in the workforce of tomorrow are also a core part of curricula in these fields.

Exhibit 36

Choose carefully

Projected net change¹ in employment, by field and qualification of education
Percent, 2030 ('+' = excess demand, '-' = excess supply)

	Natural and physical sciences	Information technology	Engineering and related technologies	Architecture and building	Health	Education	Management and commerce	Society and culture	Creative arts	Food, hospitality and personal services
Post-graduate	0	0	-1%	0	+10%	+10%	-1%	-1%	0	0
Under-graduate	-3%	+7%	0	+1%	-6%	+11%	+2%	-5%	-1%	0
Certificate/diploma	0	+1%	-11%	-4%	+5%	+2%	-7%	-6%	-1%	-1%

¹ Mid-point automation scenario, step-up labour demand scenario

Source: National Centre for Vocational Education Research (government-funded student database – 2010 and 2016), Department of Education and Training (Higher Education Statistics – 2010 and 2016 student data), MGI Automation Model March 2018, Jobs Lost Jobs Gained December 2017

These risks highlight the need to keep signalling to the education system what the future workforce demands will be, as changes may be needed in both the design and delivery of educational qualifications. It may be that more courses need to combine in-demand subject disciplines (for example, health, education and IT) with training in social and emotional skills, or that more humanities courses need to incorporate an understanding of digital processes and possibilities. All this means that undergraduate degrees may look very different to today, and all stakeholders will need to encourage more young people to continue their education after high school (efforts to better align study and work prospects are discussed in Chapter 4). Education institutions across Australia recognise the need to evolve and many are already doing so (see Box 5).

⁷³ McKinsey analysis using data from the National Centre for Vocational Education Research (government-funded student database, 2010 and 2016) and the Department of Education and Training (higher education statistics, 2010 and 2016 student data).

Box 5. Bachelor of Technology and Innovation

Australia's educational institutions are increasingly recognising that the skills students need are evolving, and that degree courses and educational programs need to innovate to ensure that they continue to prepare students for success in the workplace. For example, the University of Technology Sydney (UTS) has developed a transdisciplinary degree that is intended to teach students to combine expertise in technology with an innovation mindset, with the goal of preparing them for a variety of creative, management and technology roles. The degree program (Bachelor of Technology and Innovation, or BTi) is now in its third year.

In the first half of the degree, students complete a series of subjects across three core streams: technology labs; creative practice, methods and enquiry; and complex challenges. These streams focus on building students' technological capabilities; their ability to reflect on technology, innovation and the potential for impact; and their capacity to embrace collaboration and co-creation as key to effective teamwork. In the second half of the course, students complete live projects, professional experience placements and internships with industry partners. These are intended to help students develop their ability to think critically and creatively; to frame, model and respond to complex problems; to collect, analyse and visualise data; to make technological decisions that respect humanity, ethics and culture; and to become persuasive and articulate advocates for their own ideas.

UTS expects graduates with this degree to be equipped to undertake emergent roles in industry such as digital innovation manager, technology design officer, enterprise architect, technology engagement specialist, innovation business analyst, digital strategist, intelligence officer and creative strategist.

However, the core challenge in education isn't just with formal education; there are also challenges associated with how the broader education system has been designed, and with its responsiveness to employer demand for skills. For example, there are opportunities to improve career planning, advice and coaching; to increase flexibility by funding transferable, stackable modules and short courses, as well as degrees; to provide greater recognition and formal credits for educational achievements, including skills evaluations of non-formal activities; and to provide greater access to networks, so that people can be more easily matched with opportunities.

Without a strong societal response, automation could widen inequality

As noted in Chapter 1, Australia has moderate levels of income inequality compared to the world's other advanced economies. Although these levels have changed little over the past two decades, this has not quelled concerns about inequality or anxieties about the potential future impact of automation. Income inequality may be driven by disparities in skills and qualifications, age and regional opportunities, as well as the risk of unemployment.

Wages will tend to favour people who are more skilled

As detailed earlier in this report, rising demand for specialised skills and falling demand for routine and physical work could lead to a divergence in wage trends. By 2030, shortages of around 480,000 professionals (8 percent below demand) and 280,000 associate professionals (14 percent below demand) are projected (Exhibit 37). At the same time, there could be a surplus of around 840,000 trade and manual workers and 260,000 administrative workers.

These supply-and-demand forces could be reflected in pay cheques. Workers who can perform cognitive, collaborative and digital work may be in short supply and will likely enjoy strong wage growth. At the same time, an oversupply of workers who can perform routine or physical work will drive their wages down. The average wages associated with routine or physical work are already considerably lower than the average wages for a manager or technician, and automation could widen this gap.

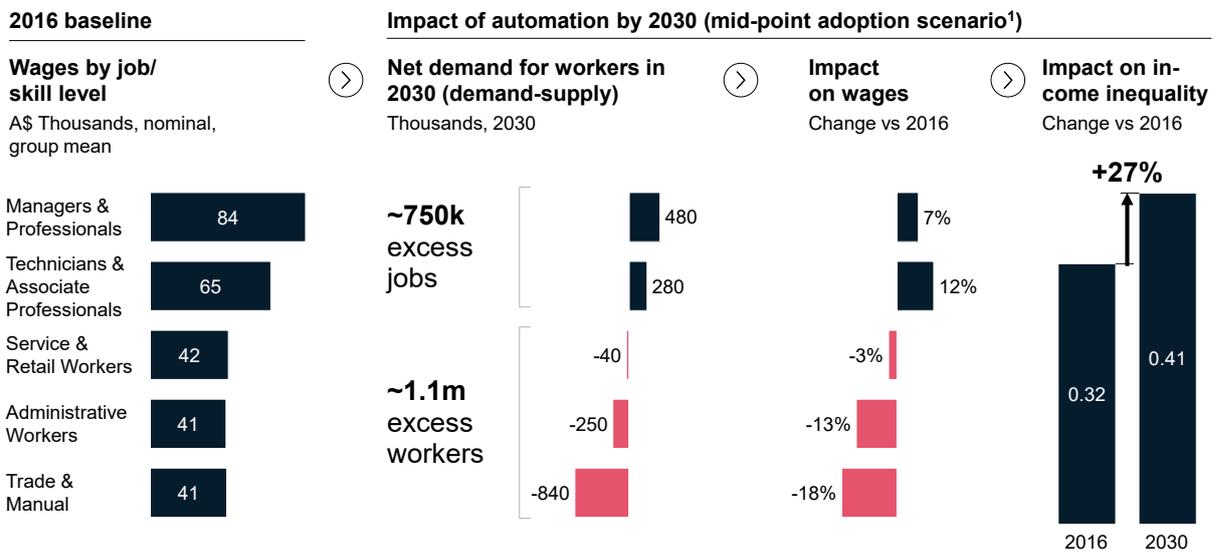
We used a general equilibrium model to estimate the potential magnitude of wage divergence, based on the impact of automation on supply and demand dynamics for five major occupational groups over time.⁷⁴ This model only provides a high-level, theoretical indication of the potential impact on income inequality, but its trends are worth noting.⁷⁵ The simulation indicates that the wages of managers and professionals could rise by 7 percent, and that those of technicians and associate professionals could rise by 12 percent. In contrast, the wages of administrative workers could fall by 13 percent, and those of trade and manual workers could fall by 18 percent (Exhibit 37).

Automation could lead to a divergence in future wage growth: managers, professionals and specialists could see their wages rise, while administrative, retail and trade workers could see their wages fall.

These estimates should be viewed as the high end of wage effects, as labour costs directly affect the attractiveness of automation. If administrative workers are not expensive to hire, for example, companies have weaker incentives to invest in automating administrative activities. This tamps down job losses and the oversupply of these workers, eventually stopping the cycle of falling wages.

Exhibit 37

Divergence



¹ Step-up scenario for labour demand, with mid-point automation

Source: MGI Global Trade Analysis Project (GTAP) general equilibrium model

⁷⁴ We employed a static version of McKinsey's Global Trade Analysis Project (GTAP) computable general equilibrium model. Wage rates were indexed to equilibrium wage rates and wage deviations for each scenario were reported by labour category. First-order deviations from the equilibrium wage rate occur in a general equilibrium model as a result of elasticities in the demand for labour, the supply of labour and the substitution of labour. Second-order effects are also accounted for—for example, as bundles of production and consumption fluctuate given new costs of production and consumption prices.

⁷⁵ The model does not take into account regulatory factors such as minimum wages, and it assumes that the entire impact of demand-supply mismatches will manifest in wage changes rather than job losses. This means that the wage effects on inequality are likely to be slightly overstated.



Income inequality will depend on retraining efforts

We then estimated how the expected wage trends for the five occupational groups would affect overall income inequality. If workers are not effectively retrained, there may be large imbalances between supply and demand. The resulting changes in wages would drive up Australia's Gini coefficient from 0.32 to 0.41—an increase of 27 percent by 2030.⁷⁶ This is almost four times the increase in income inequality that the country experienced between 1995 and 2016, and it would mean that Australia's level of inequality exceeded that of the United States today (a Gini coefficient of 0.39).

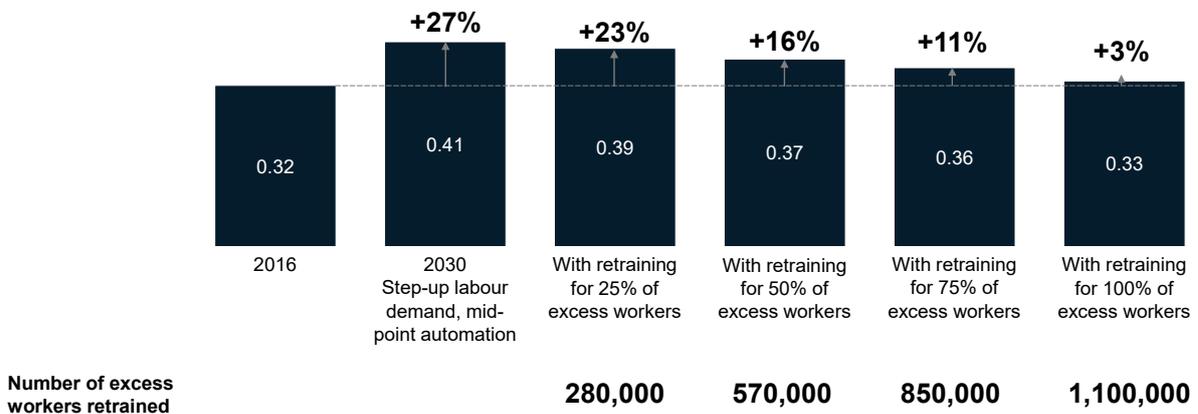
If just half of the roughly 1.1 million lower-skill workers upgrade their skills, the impact of automation on income equality could be reduced by half. If they were all retrained, income inequality wouldn't increase at all.

To illustrate how additional support for retraining could temper automation's impact on income inequality, we examined various scenarios that would allow the roughly 1.1 million lower-skill workers to qualify for higher-skill and higher paying roles, such as technician or associate professional (Exhibit 38). If just half of these workers (approximately 570,000) upgrade their skills, we estimate that the impact on income inequality could be reduced by half. With training, the downward pressure on pay for administrative workers could drop from 13 percent to 7 percent, and trade and manual workers could see their wages decline by 8 percent rather than 18 percent. As a result, the 2030 Gini coefficient would stand at 0.37 in 2030, rather than 0.41 if no retraining was offered. If all 1.1 million of the displaced workers in these categories could be retrained, income inequality would not increase at all. For governments, the clear implication is that the short-term cost of retraining would be more than offset by the longer-term gains of fewer unemployed workers and a more equal society.

Exhibit 38

Retrain for convergence

Scenarios for impact of automation by 2030 (mid-point adoption scenario)² on income inequality, with additional retraining for displaced workers¹
Gini coefficient



¹ Step-up scenario for labour demand, with mid-point automation

² Workers in excess supply (e.g. trade and manual workers) are retrained to move up one level and fill jobs with excess demand (e.g. technicians and associate professionals)

Source: MGI Global Trade Analysis Project (GTAP) general equilibrium model

⁷⁶ This model estimates impact on the Gini coefficient in two steps. First, it estimates the wage changes from supply-demand mismatches. Second, it applies the new wages to the current occupational split of the workforce. This means it does not take into account potential impacts on the Gini coefficient from the number of workers in certain occupations, or indeed any changes in unemployment rate.

Inequalities due to ageism

The need for retraining underscores the risks for older workers, who may not be prepared or able to undergo that training. As discussed in Chapter 2, automation is likely to create opportunities for people who have strong cognitive and collaborative skills and experience but no desire to undertake harder physical work, such as those over the age of 55. On the other hand, however, people aged 55 to 64 spend nearly 60 percent longer looking for work than typical jobseekers, in part because older workers often face age discrimination in recruitment processes.⁷⁷ The high levels of digital literacy required by jobs of the future may impose additional barriers for this demographic group, given that only 30 percent of Australians over 50 years of age currently have advanced digital skills.⁷⁸ The smoothness of this group's transition will largely depend on the extent to which mid-career workers have access to effective retraining programs, well targeted to their cohort's needs.

Inequalities due to regional circumstances

As previously discussed, some sectors will be more affected by automation than others, particularly those concentrated in outer suburban and regional communities. This carries perhaps the greatest risk of increased inequality for Australia. People will need higher levels of education to develop the digital, cognitive and communication skills needed for the automation age, which means that Australians living in areas with low education levels, previous experience of job losses, and/or socioeconomic and cultural conditions that limit opportunities for skill development will be at higher risk of being negatively affected by technological change.

Australians living in areas with lower education levels, previous experience of job losses, and/or socioeconomic and cultural conditions that limit opportunities for skill development will be at higher risk of being negatively affected by technological change.

The first hurdle for displaced workers in these communities is that regions that are heavily dependent on a few sectors may have few alternative local employment options. As sector concentration also implies similar experiences and skills among the workforce, job losses could also potentially leave many people with similar skill sets competing for fewer jobs. For example, in East Pilbara, the mining sector accounts for almost 60 percent of jobs. The second-largest sector, accommodation and food services, is much smaller, employing just 5 percent of workers, but this sector is also vulnerable to job loss. While the total impact on locals would be mitigated by the high proportion of fly-in-fly-out workers,⁷⁹ there would still be a considerable impact on local communities.

⁷⁷ *Willing to work: National inquiry into employment discrimination against older Australians and Australians with disability*, Australian Human Rights Commission, 2016.

⁷⁸ *Older Australians and digital confidence*, Office of the eSafety Commissioner.

⁷⁹ At its peak in 2011, an estimated 40 percent of workers in the greater Pilbara region were fly-in-fly-out workers. *Overview of the Pilbara regional development Australia region*, Australian Government, Department of Employment, 2014.

If these displaced workers choose to seek work in other sectors or locations, they may find that their level of education does not meet the criteria for the new positions. There is a clear shortfall in the average levels of education in at-risk areas. On average, 75 percent of people who live in Sydney hold post-secondary degrees, but this is heavily biased towards inner-city areas. Outer suburban or rural LGAs such as Greater Dandenong—where only 41 percent of residents have more than a high school education—could find it harder to secure new employment or further develop in-demand skills.⁸⁰

A region's history can also shape residents' attitudes towards work and their ability to embrace change. Greater Dandenong was deeply affected by the downturn in Australian auto manufacturing, losing roughly 7,500 jobs when GM Holden, Ford and Toyota plants closed.⁸¹ Layoffs such as these can have an ongoing impact on workers' mental health, self-esteem and financial circumstances,⁸² all of which may render them less resilient in the face of future workforce changes. In Greater Dandenong, the median weekly individual income is \$476—the lowest in Melbourne.⁸³ Its residents also have the lowest levels of English fluency in Victoria, with 18 percent not fluent—four times the level in metropolitan Melbourne.⁸⁴ Residents with low incomes have limited ability to invest in training, and language issues may make it difficult to perform jobs that rely on interpersonal engagement. Such indicators represent considerable challenges to a region's ability to adapt.

With few local employment options, residents may need to look further afield for work—and here they may face further challenges. Rural areas tend to be less connected through transportation and digital links, making it harder for residents to either commute to work or take advantage of remote-working opportunities. For example, in Tasmania's West Coast LGA, residents of Strahan (the largest coastal town) or Rosebery (a major mining site) would face a commute of roughly four hours if they wanted to work in Hobart. And while large towns within the West Coast have 4G internet connections, most of the region lacks high-speed internet coverage. Small towns in remote areas of Western Australia, Queensland, the Northern Territory and South Australia are similarly disadvantaged.

The contrast with Australia's metropolitan areas is stark. Central Sydney boasts a diversified economy and a highly educated population, and 55 percent of workers are professionals or managers working in sectors such as professional services, financial services, healthcare and education—all relatively immune to the disruption of the automation age. No single sector accounts for more than 17 percent of employment, which also lessens the impact of a tight job market in one sector. The city is already a regional hub for business and education, and the New South Wales Government plans to boost infrastructure investment and improve public transport connections with surrounding communities to further improve residents' job mobility.

Automation technologies will create new possibilities for productivity growth and innovation, but they will also usher in some labour market disruption. The challenge for policymakers and their partners in business, education and the social sector will be to maintain an acceptable opportunity gap between places like central Sydney and the outer suburbs and regions. Governments around the world are pondering these challenges with some trepidation, knowing that they may demand a new era of collaboration and effective policy. The next and final chapter of this report focuses on this very issue.

⁸⁰ Census figures, ABS, 2016.

⁸¹ *Closing the motor vehicle industry: The impact on Australia*, National Institute of Economic and Industry Research and Australian Workplace Innovation and Social Research Centre, April 2014.

⁸² For example, see: Silvia Mendolia, *The impact of job loss on mental health*, University of New South Wales, School of Economics, January 2009.

⁸³ Census figures, 2016, ABS.

⁸⁴ *Profile of health and wellbeing*, City of Greater Dandenong, 2018. Statistics sourced from 2016 ABS census data.



A national agenda for automation and inclusion

Automation presents a timely and important opportunity to sustain historic growth in Australia. However, the risks and distributional challenges need to be carefully managed to ensure that growth is inclusive and the benefits are broadly shared. New technologies can help organisations to boost output and revenues, supporting more employment. However, they will call for new skills in existing jobs and may displace some jobs altogether.

The challenge Australia faces is more complex than just driving automation. The growth and employment that flow from automation must be inclusive, and unacceptable levels of income inequality must be avoided. Equal opportunity remains a governing principle of all mainstream political parties in Australia, business groups and social support organisations, and while access to economic opportunity does not guarantee equal *outcomes*, high levels of income inequality may be a sign that the promise of access is not being kept.

Australia's successful history of structural reform offers lessons that should assist in managing this complex transition into the automation age. However, it will require vision and commitment from both the public and private sectors to translate the vanguards of automation best practice into adoption across industries, while also maintaining workforce inclusion and income equality. Most of all, Australia needs bold political leadership to make the case for change, obtain a mandate from the electorate to act, and follow through on its agenda in the long term.

All stakeholders in the Australian economy need to collaborate if automation is to spark inclusive and sustainable growth. This collaborative effort needs to address two challenges:

- How can Australia rapidly leverage automation technologies to reignite inclusive economic and income growth?
- How can Australia prepare and support displaced, continuing and future workers through the transition?

This chapter offers ten ideas for navigating these twin challenges, with the intent of advancing discussion across Australia about its automation future (Table 1).

Table 1: National agenda for Australia's age of automation

A. Accelerate automation both nationally and at the organisational level	
Governments	<ol style="list-style-type: none"> 1. Incentivise automation adoption by jump-starting the national competition agenda 2. Create national and regional mechanisms to drive reform and maximise the productivity and inclusion benefits of automation
Private and public employers	<ol style="list-style-type: none"> 3. Accelerate automation at the organisational level as part of a long-term strategy, with ambitious targets that only the latest technologies can deliver 4. Build the organisation of the future with the right size, shape and skills to deliver an automation strategy
B. Promote inclusion by supporting workers through job and skill transitions	
Private and public employers	<ol style="list-style-type: none"> 5. Mitigate the impact of automation on the workforce by investing significantly in worker retraining and building an agile and resilient culture 6. Support displaced workers prepare for roles beyond the organisation
Education providers and governments	<ol style="list-style-type: none"> 7. Better align course offerings with student and employer needs 8. Establish 'lifetime learning accounts' for adults of all ages
Governments	<ol style="list-style-type: none"> 9. Invest in individual support rather than regional or sectoral plans 10. Optimise re-employment incentives and capacity, and pilot social welfare innovations as needed

A. Accelerate automation both nationally and at the organisational level

Australia needs to reverse its decline in productivity growth. Automation could provide a boost to productivity and support labour force participation among under-represented groups. Australia already has many of the necessary foundations to make this leap.⁸⁵ The country's population is digitally savvy, with internet penetration at 88 percent and smartphone penetration at 77 percent. Australia also has pockets of impressive digital innovation, ranging from world-leading mobile banking to pioneering mine automation.

Governments should work to accelerate automation nationally

Starting at the policy level, governments could consider the need to:

1. Incentivise automation adoption by jump-starting the national competition agenda
2. Create national and regional mechanisms to drive reform and maximise the productivity and inclusion benefits of automation

Taking action on these two issues could create a positive environment in which organisations are incentivised and excited to embrace the automation age.

1. Incentivise automation adoption by jump-starting the national competition agenda

McKinsey's 2014 report, *Compete to Prosper: Improving Australia's Global Competitiveness*, highlighted how a lack of structural competition in many sectors—especially those focused on the domestic market—had contributed to Australia's relatively low competitiveness. When firms are protected from competition, they have less incentive to invest in R&D, innovate and adopt new technologies, holding back both the economy and consumers. If Australian governments work together to raise competitiveness, they can foster the automation adoption and innovation that boosts productivity and wages.

There is no shortage of reports, ideas and recommendations on how to improve competitiveness. Most recently, the 2015 Harper Review set out a series of recommendations for improving Australia's competition policies and institutions, including reforming the retail and small business sectors, creating a new agency that promotes competitiveness-related policies, and improving approaches to the delivery of healthcare, education and community services.⁸⁶ The Productivity Commission has also recommended competition-related changes such as greater transparency in superannuation funds, easier market access for new digital financial services and greater individual choice in healthcare providers.⁸⁷

Australia also has over 30 years' experience using 'carrot and stick' approaches to promote investment in R&D through measures like the Research and Development Tax Credit, the Innovation Investment Fund and the Strategic Assistance for Research and Development program. These approaches could be leveraged for the automation era. Policy examples include like-for-like funding grants for those investing in research in an area of high need. Australian businesses also have a vested interest in investing in R&D but could take on a more long-term perspective to enable that growth.

⁸⁵ *Digital Australia: Seizing the opportunity from the fourth revolution*, McKinsey & Company, May 2017.

⁸⁶ Professor Ian Harper, Peter Anderson, Su McCluskey and Michael O'Bryan QC, *Competition policy review*, March 2015.

⁸⁷ *Introducing competition and informed user choice into human services: Reforms to human services*, Productivity Commission, 2017; *Superannuation: Assessing efficiency and competitiveness*, Productivity Commission, 2017; and *Competition in the Australian financial system*, Productivity Commission, 2018.

The challenge in accelerating micro-economic competition reform is less about the ‘what’ and more about the ‘how’. Like Australia’s automation agenda, bold leadership will be needed to make the case for change and to follow through on that change.

The challenge here is less about the ‘what’, and more about *how* Australia can reverse its stalled micro-economic and competitive reform agenda. Like Australia’s automation agenda, this will require bold leadership to make the case for change and then follow through on that change. Australian governments could identify priority areas from the Harper and Productivity Commission reviews for reform and appoint strong leaders who can rally public and political support for such initiatives. To do so, for example, they could make competition reform key parts of their platforms and elevate micro-economic reform to the top of the treasurer’s mandate and/or appoint an assistant minister for competition reform. Such moves would help to accelerate competition reform, and the systematic and transparent monitoring of progress would heighten accountability.

2. Create national and regional mechanisms to drive reform and maximise the productivity and inclusion benefits of automation

The only way Australia can effectively prepare for the future of work is for all stakeholders in the economy to play a role. The Australian Government recognises the importance of collaboration and engagement and elicits input on regulatory design as a matter of course.⁸⁸ Businesses recognise the importance of working proactively with regulators and governments in shaping policies that may restrict their growth.⁸⁹ They also recognise the value of engaging with local communities to help regions, industries and individuals adapt and flourish.

However, Australia needs a systematic and wide-reaching engagement approach to tackle the automation challenge—one that takes into consideration the scale and rate of change; the cross-sectoral nature of technological developments; and the need to include educators, multiple levels and departments of government, and representatives of business, employees and interested individuals. Only the government has the resources and political mandate to coordinate across the economy, and this may require dedicated mechanisms and/or institutions.

⁸⁸ For example, it received 108 submissions from academics, members of the legal profession, business representatives, special interest groups and individuals in response to its 2018 consultation paper on data sharing. *Data sharing and release public submission*, Australian Government, Department of the Prime Minister and Cabinet, 2018.

⁸⁹ Facebook, Amazon and Google, for example, all have dedicated public policy teams that participate in the debate on the rights and obligations of technology companies. Google recently commissioned two reports on the impact of technological advances on Australia’s workforce and education system. See *Future Skills: The rise of the machines will drive a need for more lifelong learning in Australia*, AlphaBeta, 2019. Similarly, the Business Council of Australia produced a report on the impact of technology on education after extensive stakeholder consultation with government, peak bodies and tertiary education institutions. See: *Future-proof: Australia’s future post-secondary education and skills system*, Business Council of Australia, August 2018.

Three mechanisms could drive this approach: one to create an independent and systematic fact base, one to help forge consensus and one to coordinate action. These national mechanisms could also be supported by regional counterparts.

- **An independent information mechanism that can drive research and establish and maintain a credible fact base on automation.** A robust evidence base is an essential component of good policy-making around technology adoption. A useful example is the European Union's (EU) Digital Economy and Society Index (DESI), which measures 30 indicators of digital adoption and performance for member states, as well as the EU overall. McKinsey has suggested 37 indicators that cover the spectrum of how technology impacts business, including the extent of digital assets, industry use of digital tools, the share of people in digital occupations and business technology spending per employee.⁹⁰ The World Bank has also launched the Digital Adoption Index to monitor technology use by various nations' citizens, businesses and governments. Oxford Economics introduced a similar tracker last year, known as the Digital Society Index. Australia currently has no such measure.

Australia also doesn't systematically track worker displacement from automation at a macro level, let alone by employer, nor does it track what efforts companies make to support those workers to retrain or find new employment. The last Australian Bureau of Statistics survey that examined reasons for worker displacement—including the adoption of technologies—was conducted in 2001.⁹¹

The independence of this information mechanism is critical to avoid political interference, such as blocking 'bad news' or watering down potentially difficult but necessary recommendations. This mechanism could, for example, be analogous to the Productivity Commission and could be set up as a division within the commission or within another independent body.

- **A political mechanism to help forge consensus among key stakeholders with broad political support.** A high-level mechanism that spans representatives of business, unions, educational and research institutions, and different levels of government would be valuable. Such a mechanism could also be the public face of Australia's automation transformation, engaging with citizens and communities around the country. This mechanism could counsel government on automation opportunities and inclusion, similar to our previous prime minister's Business Advisory Council (BAC). The Danish Government set up such a council in 2017. Chaired by its prime minister, its purpose was to analyse the impact of digitisation and AI, and to generate proposals for harnessing new technologies to improve citizens' wealth and welfare. The council included eight ministers as well as academics, technology CEOs, labour union leaders and policymakers.
- **A dedicated coordination mechanism to integrate implementation across multiple levels and functions of government.** Given the far-reaching, cross-portfolio nature of automation, government may consider establishing dedicated mechanisms to both enable a whole-of-government view of policy and to coordinate implementation. Cabinet could, for example, set ambitious outcome targets then delegate leadership to a dedicated sub-cabinet with key ministers such as the treasury, employment, industry and education ministers, supported by secretaries of these departments. An implementation mechanism could then be led by a central government agency such as the Treasury or the Department of the Prime Minister and Cabinet (PM&C), or a dedicated cross-government taskforce like Singapore's Smart Nation and Digital Government Office (see Box 6).⁹²

⁹⁰ *Digital Australia: Seizing the opportunity from the fourth industrial revolution*, McKinsey & Company, May 2017.

⁹¹ *The Retrenchment and Redundancy Survey*, ABS, July 2001 (cat. no. 6266.0).

⁹² We note that historically the Australian Government has taken steps to merge or abolish numerous government bodies to increase efficiency across government, and adopted a governance policy with a view to limiting the creation of new government bodies (a new agency should only be established if deemed absolutely necessary). *Towards responsible government: Phase one*, National Commission of Audit, February 2014.

Involving the Council of Australian Governments (COAG) would also drive reform across federal and state issues. Its Industry and Skills' Council already has a mandate on industry competitiveness, productivity, labour market pressures and skills development, with which automation is deeply entwined. Such a mandate could maintain automation as a cross-portfolio priority area for reform.

Box 6: Singapore's digital and automation mechanism

Singapore serves as a good example of integrating the government's digital goals into a single office that spans business, government and society. In 2017, the country established the Smart Nation and Digital Government Office (SNDGO) to lead 'smart nation' project planning. The SNDGO is built on three pillars: digital economy, which encourages technology adoption and innovation (for example, by offering support for local digital businesses and small and medium-sized enterprises [SMEs] undergoing technological transformation); digital government, which raises digital capabilities in the public sector, runs public-sector digital transformations and co-creates digital public services with citizens and businesses; and digital society, which fosters digital literacy, expands and enhances access to digital infrastructure, and promotes digital inclusion and adoption. The office has been driving programs within each of these pillars across the government and is partnering with educational institutions and industry to foster technological advancement in each area.

Regional mechanisms for collaboration

Chapter 3 discussed the very real risk that regional inequalities may emerge during the automation transition. Against this backdrop, it may be tempting to believe that a regional plan is the best approach for generating growth and opportunities in affected areas. Unfortunately, Australia's many attempts at regional (and sector-specific) planning have enjoyed modest success at best, and at worst have distracted focus and investment from more effective measures. Put simply, the investments have not benefitted people looking for work in these regions (see Box 9). Assisting individuals to gain in-demand skills and secure the best opportunities available to them is likely to be a more effective intervention (see proposal 9).

It may be tempting to believe that a regional plan is the best approach for generating growth and opportunities in affected areas. Unfortunately, Australia's many attempts at regional (and sector-specific) planning have enjoyed modest success at best, and at worst have distracted focus and investment from more effective measures.

That is not to say that there is no place for regional collaboration. There is value in collaboration that acts as the connecting point between individual action and the national effort, and that manages data and coordinates national strategies at the regional level. Concerted government effort can ease the pain for communities at the regional as well as the national level. For example, Fairfield—an economically disadvantaged area in Western Sydney—is moderately exposed to automation because manufacturing and retail accounts for 21 percent of local employment. However, the Western Sydney City Deal may help Fairfield to weather the coming wave of labour disruption. This agreement between the federal and state governments and the LGAs of outer Western Sydney aims to foster job growth, improve transportation links and increase economic activity in the region. In Greater Geelong, 24 percent of jobs are at risk of automation. In response, several municipalities have formed the G21 Geelong Region Alliance to collaborate with the Victorian and Australian governments on policy ideas and infrastructure investments to improve the local economy.⁹³ Both of these

⁹³ Infrastructure investment and other measures to create local jobs (for example, locating public service functions in a particular region) should be balanced with the Productivity Commission's recommendation that such changes should be made in the interests of the community overall, rather than simply to create jobs, as they may be diverting jobs and business from other areas rather than creating a net contribution. See: *Australia's automotive manufacturing industry*, Productivity Commission, August 2014.

areas' proximity to large urban centres should further protect their workforces from the impact of automation by enabling residents to travel to jobs in the city. For instance, 'urban' infrastructure investments like the Melbourne Airport Rail Link could support added growth in Geelong.

These collaborations must feed into national mechanisms, however, and are a necessary complement to citizen-centred training rather than a substitute for it. Governments could also look for ways to increase the resilience of at-risk regional communities by improving physical and virtual connectivity—both to access more resilient and diverse job markets in the centres of major cities, and to access educational opportunities.

Private and public employers could accelerate automation at the organisational level

National actions will help to ensure that Australia has the right policy settings, public mandate, and national and regional coordination to embrace automation. It will then fall to private companies and public agencies to embrace new technologies in their own operations.

Over the next decade, the stakes will be high for both private and public organisations. Both are major contributors to the economy, with the public sector accounting for 37 percent of GDP and 16 percent of total employment in 2016–17.⁹⁴ Both have productivity concerns in key sectors: retail, logistics and financial services, as well as education, healthcare and utilities. Both have customers with rapidly increasing expectations of what services should be possible, and both have clear financial constraints, driven by either shareholder or public finance expectations.

Both private companies and public agencies will therefore be looking at automation technologies for opportunities to improve services, within their financial constraints. To capture these opportunities, they will need to push their strategic and organisational plans deep into the automation age. This could be achieved in the following ways:

3. Accelerate automation at the organisational level as part of a long-term strategy, with ambitious targets that only the latest technologies can deliver
4. Build the organisation of the future with the right size, shape and skills to deliver an automation strategy

These are the core elements of running an organisation, and while their principles may be eternal, their practice may look very different in the age of automation.

3. Accelerate automation at the organisational level as part of a long-term strategy, with ambitious targets that only the latest technologies can deliver

Companies and public agencies could accelerate their investments in automation technology, with the aim of opening up new business opportunities, improving customer outcomes or capturing productivity benefits. To do so, they would need ambitious targets, without which adoption will not occur. They would also need to take a long-term view on the returns on this investment, as well as on the short-term costs of the transition.

Setting the strategy

Automation presents endless strategic opportunities. These opportunities could promote business expansions, improve customer outcomes or tackle internal efficiencies, and they apply equally to the private and public sectors. For example, a 2017 report by MIT Technology Review and Genesys found that 91 percent of top companies (such as Alibaba, Lexus and Uber) use AI to boost customer service and improve branding. Similarly, over 90 percent of companies with world-leading brand recognition and high levels of customer satisfaction set targets and use AI solutions to increase customer satisfaction, compared to 42 percent of companies in their fields overall.⁹⁵

⁹⁴ Key economic indicators, 2018 (1345), ABS; government finance statistics, Australia, 2016–17 (5512), ABS; labour force, Australia, May 2018 (6202), ABS.

⁹⁵ 91% of top companies use AI to boost customer service, improve branding, TechRepublic, October 11, 2017.

91 percent of top companies such as Alibaba, Lexus and Uber use AI to boost customer service and improve branding. Similarly, over 90 percent of companies with world-leading brand recognition and high levels of customer satisfaction set targets and use AI solutions to increase customer satisfaction, compared to 42 percent of companies in their fields overall.



Automation can also do things more efficiently behind the scenes, freeing up time for more customer engagement. The National Library of Australia has started using high-tech robot couriers to deliver library materials from the basement to librarians and to visitors upstairs. The robots are not designed to replace librarians, but to work alongside them and allow the librarians more time to serve library visitors.⁹⁶ At the Department of Human Services, automation technology could help to ensure that customer details are automatically updated, increasing payment accuracy, reducing debt, and improving the citizen and employee experience. At the Australian Tax Office, automated technology could provide a fuller view of taxpayers' financial activities and ensure they pay their taxes in full.

Automation can also spur new business opportunities. For example, drones and unmanned aerial vehicles are able to quickly map, inspect or transport in places that are difficult to reach and are already used to spray crops, perform land surveying and inspect oil rigs.⁹⁷ Innovations in one company can also lead to opportunities for others. Medallia has developed an automated customer feedback platform which a client has used to enable contact centre employees to tag the root cause of issues, reduce customer pain points by 50 percent and increase transaction volume by more than \$2 billion.⁹⁸ Automation can also deliver one company an irresistible advantage: Amazon is expected to open 3,000 Amazon Go stores by 2021, featuring a smartphone-led shopping experience with AI-enabled 'Just Walk Out' checkouts.⁹⁹

Setting the targets

None of this will happen without setting ambitious targets. If there are relevant performance benchmarks that show what can be achieved for customers with automation, those benchmarks should become the target, even if they seem more ambitious than is possible. If a target can only be reached by engaging with available technologies, it is the right target and should be pursued over a reasonable timeframe. An Asian bank indicated to its workforce that it would reduce the labour base in certain areas by 40 percent over three years. Staff and stakeholders knew what the goal was and had time to adjust to a new way of working, enabled by technology.

If there are relevant performance benchmarks that show what can be achieved for customers with automation, those benchmarks should become the target, even if they seem more ambitious than is possible.

⁹⁶ *High-tech robot couriers set efficiency in motion at the National Library of Australia*, ABC News, August 2018.

⁹⁷ *Drones predicted to give British economy a £42bn lift by 2030*, The Guardian, May 29, 2018.

⁹⁸ www.medallia.com

⁹⁹ www.amazon.com

In the public sector, aggressive customer-centric targets could help to drive highly appreciated outcomes. For example, facial recognition or thumbprint identification could significantly reduce service times at hospital admission desks and in government agencies by eliminating the need to fill out lengthy identity forms. Tele-health services could increase doctors' outreach, particularly in rural areas. Targets may need to be set or approved by government to guide the operational plans of agencies, but publicly sharing progress towards targets on an annual basis could promote transparency and accountability.

In the private sector, aggressive customer-centric targets could help to drive the innovations needed for productivity and competitiveness. For example, the Australian retail sector could move from 90 percent to 130 percent of the US retail sector's productivity through a more rapid uptake of automation. Similarly, Australian tradeable sectors could catch up to their American competitors by adopting automation earlier. Within Australia, companies that invest early in automation technology stand to gain the most, and they do not need to be large companies to do so.¹⁰⁰

Finally, in setting automation strategies, companies are investing in the future. This means that ultimate returns on initial costs may only be delivered in the longer term. Adopting this longer-term focus may be challenging¹⁰¹ but it will pay off, with 'long-term' companies outperforming their 'short-term' peers, on average, in terms of revenue, earnings, economic profit and job creation.¹⁰² A longer-term focus also allows a company or agency to pay due attention to the organisational challenges in their transition to the automation age.

4. Build the organisation of the future with the right size, shape and skills to deliver an automation strategy

Chapter 3 discussed how the automation wave will affect employment numbers, working roles and job skills throughout Australia. This national picture is mirrored in individual organisations. Private companies and public agencies will need to build a future organisation of the right size, shape (in functional roles), skills and culture to deliver their automation strategies.

In doing so, it will not be sustainable for companies or agencies to simply retrench one set of people and hire another. Certainly, workers with the most in-demand skills will tend to gravitate towards the earlier technology adopters. However, that 'talent' will also want to work in a culture that respects and develops people—the most valuable asset—with retrenchment a last resort. Forward-thinking organisations are concluding that their resilience is strengthened by developing the skills of their existing employees and so are supporting them to transition to new roles within the organisation, removing fear of retrenchment from the equation.

Forward-thinking organisations are concluding that their resilience is strengthened by developing the skills of their existing employees and so are supporting them to transition to new roles within the organisation.

Building a future-ready workforce requires a focus on both the 'what' and the 'how' elements of what an organisation needs to do to get the right talent and skills in place, and how the organisation can build a culture that brings out the best in that talent.

¹⁰⁰ In the past, technology-driven productivity improvements were only affordable for large companies. However, automation technologies can be applied cost-effectively to smaller scale businesses. For example, cloud-based solutions are as cost-effective and work as well for a 10-employee company as for a 10,000-employee company, whereas a last-generation ERP IT system would have been cost prohibitive for a smaller firm.

¹⁰¹ Taking a longer-term view requires determination, as shown by a survey of 1,000 board members and C-suite executives around the world, which found that almost two-thirds of respondents said the pressure to demonstrate short-term financial performance had increased over the previous five years. See *Focusing capital on the long term*, McKinsey & Company, December 2013.

¹⁰² *Where companies with a long-term view outperform their peers*, McKinsey Global Institute, February 2017.

Building the 'what': the right skills in the right place

The possibilities of automation will force public agencies and private firms to rethink the roles and skills they need. This involves three basic steps:

- **Diagnose any gaps between today's workforce and future roles and skills.** Most organisations spend significant time and resources developing their strategic plan and significantly less time identifying the future roles and skills required to deliver that plan. Analysing the people implications of a strategic agenda often reveals that the intended results will not materialise unless the right people decisions are made early on. A granular diagnostic, down to the level of individual roles, is needed to give real-time insights into current and future skills of the workforce, and to identify skills gaps that will need to be closed.
- **Design robust plans to close future skills gaps.** A portfolio of initiatives is needed that goes beyond traditional 'hiring and firing'. The '5R' levers to close skills gaps start with reskilling and redeploying existing employees, then recruiting externals either permanently or in the short term, and 'renting' employees through contracting or activating freelancers in the gig economy. If it has too many people, a company or agency will need to plan for the release of employees, including providing retraining, education and transition support to prepare their workers for an external career (see proposal 6). Some organisations may have to recruit entire teams, partner with other complementary organisations, and/or pursue acquisitions and joint ventures that help them close their talent gaps. The best companies build their workforce strategies into their annual strategy processes to arrive at a joint financial and people plan.
- **Implement plans through rapid and disciplined execution.** The most effective talent transitions are governed by a dedicated, cross-functional 'future workforce centre of excellence' that includes both senior human resources (HR) and line managers. Its roles are to drive (re)skilling programs, create learning pathways, access the latest external thinking, resolve roadblocks and help management make quick and clear decisions when trade-offs are needed. Each subject area should have a business lead who is accountable for achieving results and ensuring targets are met.

B. Promote inclusion by supporting workers through job and skill transitions

The first section in this chapter discussed ideas for driving productivity through automation. This is essential to sustaining Australia's national prosperity over the long term. However, automation could also potentially displace large numbers of workers. It is therefore imperative that efforts to promote automation go hand in hand with efforts to support displaced workers.

This second section focuses on what employers, education providers and governments could do to promote inclusive growth and share the gains from automation by supporting displaced workers through job and skill transitions.

Private and public employers could support displaced workers to retrain

Employers of displaced workers in both the private and public sectors can help to mitigate the impacts of automation by helping their workers prepare for new roles, both within and beyond their own organisations:

5. Mitigate the impact of automation on the workforce by investing significantly in worker retraining and building an agile and resilient culture
6. Support displaced workers beyond the organisation

5. Mitigate the impact of automation on the workforce by investing significantly in worker retraining and building an agile and resilient culture

In the process of automation, it is discrete activities and roles that become redundant, rather than people. Organisations often fall into the trap of letting employees go when their roles disappear and hiring new workers for emerging positions. A smarter and more cost-effective approach is to equip existing staff—who may have many years of experience with systems, products, customers and culture—with the necessary skills for the new roles. For example, public agencies could set targets to move a proportion of staff from back-office roles into positions in customer service that rely on interpersonal skills. In doing so, organisations could avoid losing 'corporate memory' and a large slice of morale among retained workers, as well as the risks, costs and pressures of recruiting new employees or hiring temporary contractors. One company famously asked its workers whether their jobs 'could be better done by a robot' and promised retraining 'for another role at the firm' for those who said 'yes'.¹⁰³

In a recent study, 75 percent of executives reported that retraining would provide at least half the solution to their companies' current skills mismatches, and 64 percent stated that the main reason for investing in retraining was to increase employee productivity.¹⁰⁴ Most employees can carry their line expertise into an adjacent field through a 'domino reskilling model'. For example, when AT&T reduced its physical store footprint, it found that the skills of store managers largely mirrored those of 'scrum masters' who lead agile teams, so it retrained many displaced store managers into those roles.

Retraining programs provide an opportunity to partner with innovative educational institutions and can be extended to new recruits. The bespoke training may also result in a certification that advances careers and serves as a drawcard for recruits. The programs may draw on the same remote and digital technologies that will be used increasingly in the workplace, and may cost less to deliver due to those technologies. They may also form part of lifelong learning platforms (such as Degreed) to build skills and certify expertise. One conglomerate in the Middle East, for example, has created a technology academy that every employee must attend, with the aim of making all 40,000 of its workers proficient in digital analytics. Such initiatives develop in-house expertise, foster a common understanding of market opportunities and promote loyalty among employees.

¹⁰³ *Insurer asks its 16,000 staff: Could a robot do your job?* The Sunday Times, 2017.

¹⁰⁴ *Retraining and reskilling workers in the age of automation*, McKinsey Quarterly, January 2018. Another report showed that only 16 percent of digital strategies succeed, and that the top reason for failure (cited by respondents) was a lack of the right employee capabilities and mindsets. See: *Unlocking success in digital transformations*, McKinsey & Company, October 2018.

None of these initiatives can be completed overnight. A European technology company took three years to reskill one-third of its existing workforce (placing 1,000 employees a year into new roles), and its experience can be considered typical. Its programs had to cover both hard competencies to work with machine learning, IoT and cloud computing, and soft skills such as coaching and working in an agile environment.

Australian employers may consider making meaningful investments in worker retraining and upskilling. For example, in a 'Pledge to America's Workers' campaign, 200 organisations have committed to creating over 6.5 million working opportunities in the United States. In separate initiatives, Google has pledged US\$1 billion towards retraining the global workforce (not just its own); the Walmart Foundation has pledged US\$100 million in workforce development and reskilling; and Lockheed Martin has pledged US\$50 million in support of science, technology, engineering and maths (STEM) scholarships, and \$US100 million to expand employee training and educational opportunities. An Australian variant could propose that companies allocate a percentage of their annual budget to a corporate reskilling account that is tax effective and can be used by employees (and perhaps past employees, see proposal 6) to undertake training and reskilling programs, with courses beneficial to the future strategy of the organisation.

Create an agile organisational culture that can adopt and adapt to technology

As discussed in Chapter 2, automation will displace work activities but not necessarily entire jobs. Recent McKinsey analysis shows that the key to capturing the productivity benefits of automation is effectively redeploying the resulting freed-up time.¹⁰⁵ Accordingly, organisations must ensure that they establish the work environment and mechanisms to do so.

This is perhaps best done through new ways of spurring 'agility' in the workplace, such as Agile itself, 'no-collar' jobs and internal task-sharing economy models. As the term suggests, agility enables a company or agency to react quickly to changing market demand and dynamics. It typically depends on cross-functional teams that can innovate new solutions and diagnose and remove roadblocks, and a shift from traditional line reporting with an internal focus to one of digitally enabled collaboration, both internally and with external partners.

Agile shows significant promise, having been successfully deployed in several Australasian companies to create a more productive, flexible and engaged workforce. For example, Spark New Zealand has become the first fully agile telecommunications operator in the world. In just under six months, Spark established over 100 cross-functional teams or 'squads', organised into 18 'tribes'. Over 2,000 employees were transitioned through over 100 distinct agile trainings. Teams are self-managed, removing the need for multiple middle management layers. Roles are no longer rigid; team members can switch roles or even teams every few weeks to meet changing needs. Early signs indicate that the impact has been quick and impressive: the company is on track to achieve substantial gains in customer satisfaction, employee engagement, productivity and—most importantly—time to market.

Agile shows significant promise, having been successfully deployed in several Australasian companies to create a more productive, flexible and engaged workforce.

¹⁰⁵ *Jobs lost, jobs gained: Workforce transitions in a time of automation*, McKinsey Global Institute, 2017.



6. Support displaced workers prepare for roles beyond the organisation

While employers should begin by seeking to retrain and redeploy people whose roles have been made redundant, some workers will have to leave the organisation. Rather than leave these workers in the hands of the market and the government, employers could take steps to prepare them for a new career.

For organisations that support their workers to embark on the next stage of their professional journey, the benefits are immediate and reputational. The immediate benefit is that the organisation has signalled how much it values its people, and that it understands the impact of displacement (or the fear of being displaced) by automation. Without the hearts and minds of its workforce, a business or public agency has very little chance of a successful transition to the automation age. This approach is highly likely to reflect a healthy organisational culture, which helps to attract staff with in-demand skills; and is equally likely to contribute to a strong organisational reputation, which may attract funding and partnerships.

Without the hearts and minds of its workforce, a business or public agency has very little chance of a successful transition to the automation age.

Workplace retraining programs could offer modules in applicable marketplace skills, certification of skills and (where applicable) training on how to set up a business or transition to the gig economy, and organisations could fund specialists to provide these services. For example, the Transition Hub is a partnership between the UTS business school and WeWork that supports companies as they transition people out of their organisation by offering performance coaches, personal brand specialists, psychologists, financial advisors, mentors and recruiters.

By working together with other firms and agencies in a common location or sector, employers could offer a higher quality set of services and broaden the set of opportunities for former employees. The group of organisations could create a 'talent exchange' platform, in partnership with technology talent firms, offering workers a pathway to another job and employers a trusted recruitment channel for talent with the right skills. This platform could offer employees secondment opportunities, training programs and permanent transition opportunities within the group.

Education providers and governments could ensure that workers have skills for the future

As the automation wave accelerates, employers will be looking for people with the specialist and generalist skills that best complement their automated technologies. In fact, they will be unlikely to commit to large projects if they doubt they will have access to the workforce they need. Moreover, people who are currently in school, post-secondary education or training programs will account for around one-third of Australia's workforce by 2030,¹⁰⁶ and the skills they will need for workforce roles will change significantly as a result of automation. These new skills could be embedded in education courses now, rather than added when Australia is in the midst of job disruption, when the horse may already have bolted.

The skills people will need at work will change significantly as a result of automation. These skills should be embedded in education now.

Educators and governments each have a role in ensuring that future workers have the skills needed in future workplaces. Two education initiatives could help—one on the supply side, which would need to be driven by education providers; and one on the demand side, which would need to be driven by governments:

7. Better align course offerings with student and employer needs
8. Establish 'lifetime learning accounts' for adults of all ages

These two initiatives could help create the right incentives for educators to offer the courses that students need, and for people to keep up their training.

It is also worth noting that there are concerns about Australia's declining performance in primary and secondary schooling, particularly in maths, relative to the rest of the world. The recent Program for International Student Assessment (PISA) revealed that in maths and science, the average Australian 15-year-old is on par with the average South Korean 12-year-old.¹⁰⁷ Fewer than 10 percent of Year 12 students now study advanced maths, which is highly desirable for contributions to digital innovation. Fewer than 20 percent now study intermediate maths, which is highly desirable to work with automation technologies, and about 20 percent study no maths at all in the last two years of high school.¹⁰⁸ Whatever skills Australia's future workers need, it is highly likely they will draw on the cognitive foundations of mathematics, as much as the collaborative and emotional foundations of their social learning. While this section predominantly focuses on adult education, it is essential that parallel efforts continue to ensure solid foundations in the education system overall.

¹⁰⁶ *Education and work, Australia, May 2018: Key findings*, ABS, November 2018.

¹⁰⁷ *2015 key findings*, ACER Programme for International Assessment.

¹⁰⁸ *Year 12 mathematics participation in Australia 2007–16*, Australian Mathematical Sciences Institute, October 2017.

7. Better align course offerings with student and employer needs

Courses offered for working students could benefit from two changes: greater flexibility in the structure and timing of courses, and closer alignment with the mix of skills that workers at all levels need. For these changes to happen, new funding models would need to link funding to student outcomes rather than intentions.¹⁰⁹

Most mid-career Australians are looking for mix-and-match, skills-based programs and cannot afford to take time off work or pay the fees for university degrees. Increasingly, they are pursuing—and employers are demanding—more modular, skills-based certifications combined with work experience. Flexible short certificate courses and foundational training are also likely to be the most valuable for workers who lose jobs through structural changes.¹¹⁰ Australian institutions are starting to offer such options, including South Melbourne TAFE, RMIT and the University of Melbourne in Victoria. However, progress has been slow (see Box 7). Designing the right options takes deep collaboration. For example, Singapore's Workforce Skills Qualifications assesses and certifies specific worker skills and competencies based on definitions established by the Singapore Workforce Development Agency, in collaboration with employers and unions.¹¹¹

Box 7. Educators must accelerate their reforms

The changing nature of work has led businesses, students and government to demand up-to-date, skills-based curricula, with student-centred teaching integrated with work experience and technology, and course structures that include both short courses and modular certifications. While educators are responding to these demands, the rate of progress is too slow, particularly among universities. Organisational inertia and cultural barriers must be overcome to increase student engagement and improve outcomes.

There are positive signs. Most educators now incorporate technology into their courses, with online courses and digital learning platforms. Some are updating curricula to make them more relevant to employer needs, and to give students more adaptable skills. For example, in 2018 South Metropolitan TAFE collaborated with Rio Tinto and the government of Western Australia to introduce the country's first course in automation, which reflects the types of jobs and skills the mining sector increasingly needs. Similarly, RMIT has worked with Amazon to design short courses in virtual and augmented reality.

Educators are also introducing more modular, skills-oriented courses. The University of Melbourne is exploring the introduction of 'micro-credentials' that certify students' partial completion of work towards a degree. In 2017, they partnered with Learning Machine, a US company associated with the Massachusetts Institute of Technology, to pilot a micro-credentialing system based on a blockchain platform. Online education provider EdX, for example, offers MicroMasters courses that serve as bridges between bachelor's and master's degrees and can be used as credits towards full master's degrees.

Despite these signs, there is a considerable way to go. Universities need leaders who can communicate the need to modernise course design and delivery and drive its implementation. Teachers need new skills to make the best use of technology through enhanced coursework, personalised materials and learning experiences, and interactive simulations. These are not easy transitions for established institutions. They may need new governance structures and processes to ensure that course coordinators can integrate industry input into curricula, and lecturer evaluations may need to prioritise student experience over research outputs.

¹⁰⁹ The Productivity Commission emphasised this in their recent review, arguing that 'it is essential to have policy settings that... create the right supply-side settings for the skills system. That means an efficient, high-quality and flexible education and training system that is driven by the needs of users (the people acquiring the skills and the businesses that need them) rather than the interest of suppliers or legacy models of provision and government funding.' *Shifting the dial: 5 year productivity review* (p. 84), Productivity Commission, 2017.

¹¹⁰ *Australia's automotive manufacturing industry* (p. 223), Productivity Commission, August 2014.

¹¹¹ Transparency and data on post-study outcomes will need to be available to ensure that such courses, which are designed solely to improve employability, are in fact doing so.

Unified measures are also needed to link education funding to demonstrated student outcomes, rather than student numbers or research profiles. Currently, student fees subsidise universities' research, creating incentives for institutions to recruit more students into high-margin courses and making it difficult to assess how much public funding is supporting research compared to teaching, or the outcomes achieved for each dollar spent. The Department of Education and Training published a consultation paper on performance-based funding in December 2018.¹¹² That paper considers assessing universities for funding purposes based on graduate employment rates and the proportion of students from low socioeconomic backgrounds.¹¹³ An additional metric may be the proportion of mid-career students (people aged 45 or older, for example) in order to promote greater access for mature-age students.

Performance-based funding could also integrate a teaching excellence framework to assess instructor quality and promote better student experiences and outcomes, similar to the framework already in place in the United Kingdom. The UK Government uses a framework that tracks teaching excellence and student employment, classifying universities as bronze, silver or gold. In Australia, teaching evaluations could be used together with Excellence in Research Australia (ERA) assessments, and could be included as a metric in funding assessments.

8. Establish 'lifetime learning accounts' for adults of all ages

Education and training are lifelong pursuits and are essential for people to enter the workforce, find and retain jobs, and continue to grow throughout their careers. Yet many Australians complete their education in their 20s and work for 35 to 40 years without much additional formal training. As workplace technologies and employer needs evolve, Australia may need a different approach: lifelong training focused on skills development. While valuable at any time, this could better prepare people for the automation disruption, particularly older workers.

Lifelong training accounts could address this challenge. Singapore's SkillsFuture program, for example, establishes an account for each adult citizen over the age of 25, which they can tap into throughout their careers to acquire new skills or pursue higher education. The account can be used to cover the cost of around 25,000 pre-approved courses offered by a range of providers (including overseas Massive Open Online Courses, or MOOCs), including assessment and certification fees.¹¹⁴ France offers a similar program, financed through employer contributions of 1 percent of total payroll costs (or 0.55 percent for firms with fewer than ten employees).¹¹⁵ The US Congress is considering introducing a similar program in 2019, to be co-financed by matching employer and employee contributions (with an option for governments to also match contributions), up to an established cap.¹¹⁶ In each of these cases, the fund follows the account holder throughout their life, so that when they shift workplaces their new employer contributes to the same fund.

Australian governments could consider introducing such programs (similar to existing superannuation accounts) to help fund education throughout a person's life.

¹¹² *Performance-based funding for the Commonwealth Grant Scheme* (web page), Australian Government, Department of Education and Training.

¹¹³ *Performance-based funding for the Commonwealth Grant Scheme* (discussion paper), Australian Government, Department of Education and Training, December 2018.

¹¹⁴ www.MySkillsFuture.sg

¹¹⁵ *France: Employers obligation to provide skill development plans or training*, European Monitoring Centre on Change.

¹¹⁶ Skills Investment Act of 2019, United States Congress.

Governments could also ensure that safety nets remain fit for purpose

Despite the best efforts of governments, employers and the education system, there will inevitably be workers who through little fault of their own find themselves displaced by automation and struggle to upskill or find a new and better job. This has always been the case, and it will remain so in the age of automation. Australia is fortunate to have a welfare safety net for the unemployed and others in need. As outlined in Chapter 1, Australia's tax and transfer policies have historically been effective and relatively efficient at mitigating market inequality. This gives Australia some policy leeway to pursue more rapid automation (achieving higher national income in aggregate) while keeping income inequality under control (through efficient sharing of the gains).

To prepare for the age of automation, governments could consider new ideas to invest effectively in individuals and ensure that the welfare safety net remains fit for purpose:

9. Invest in individual support rather than regional or sectoral plans
10. Optimise re-employment incentives and capacity, and pilot social welfare innovations as needed

9. Invest in individual support rather than regional or sectoral plans

Automation will affect all sectors of the economy and all levels of work, but some demographic, sectoral and regional groups will be more susceptible to hardship than others. The government will be called on to assist these groups, and it will be tempting to pursue sectoral or regional plans, which will be strongly advocated for by the representatives of these constituencies. However, a better use of public funds may be to offer targeted assistance to individuals most in need—for example, determined by their skills profile, English proficiency and employment history.¹¹⁷ That is the lesson of previous structural adjustments, according to the Productivity Commission (see Box 8).

This approach aligns with a national shift towards more personalised approaches. The Australian Government already enables employment service providers to spend between \$300 (for those who are most 'job ready') and \$1,200 (for those most in need of assistance) per person on training, counselling, the purchase of basic work-related items and other support to help get a job.¹¹⁸ While this system is far from perfect, implementing the recommendations of the 2018 *Future of Employment Services* report¹¹⁹ could lead to better employment outcomes for Australia's unemployed.

Encouraging displaced workers to keep participating in the labour market will be critical, especially workers whose jobs are displaced within a decade or so of their retirement (see Box 9). At this stage of life, retraining is urgently needed so that workers can avoid the prospect of unemployment or a significant reduction in pay, responsibilities and job quality. However, many older workers lack the resources or the will to retrain so close to retirement. Here, government support and incentives become critical, not only to repay these workers for their years of service and taxes, but also to maintain their health and community engagement and so avoid higher future costs to the taxpayer. While the Department of Jobs and Small Business has announced Skills and Training Incentives,¹²⁰ training grants available to unemployed older workers (as part of the Employment Fund) are capped at \$1,200.¹²¹ The government could consider expanding funding support for older workers, perhaps linking funds to outcomes (such as the recipient finding and keeping a job for one year after training). Additional retraining funding could be offered as an alternative to wage subsidies, which have mixed evidentiary support and can total up to \$10,000 per worker (see Box 9).

¹¹⁷ *Australia's automotive manufacturing industry* (p. 209), Productivity Commission, August 2014.

¹¹⁸ *Using the Employment Fund General Account*, Jobactive Guidelines, August 8, 2018.

¹¹⁹ *I want to work*, Australian Government, Department of Jobs and Small Business, December 2018.

¹²⁰ *Skills and training incentive*, Australian Government, Department of Jobs and Small Business.

¹²¹ Part of the Employment Fund General Account. Funding amounts depend on jobseeker stream, with Stream C (the most in-need jobseekers) capped at \$1,200. *Guideline: Using the Employment Fund General Account*, Australian Government, Department of Jobs and Small Business, December 2018.

Box 8: The case against regional adjustment plans and funds

Australia does not have a strong record in investing funds to support its regions.¹ Urbanisation continues apace, and major industrial investments in regional Australia often depend on incentives of political rather than economic value. A better strategy may be to give all Australians the tools and support they need to compete in the labour market and then let them choose how to make the best use of this support.

In a 2014 report, the Productivity Commission emphasised the value of adequately resourcing general welfare, training and employment services and ensuring they are available for vulnerable workers, particularly those who are under pressure from retrenchment.² However, it expressed reservations about region- or industry-specific support, such as regional adjustment funds and infrastructure and defence spending.

The Productivity Commission found that regional adjustment funds were a 'costly and ineffective approach' to alleviating the impact of structural change on unemployment, and were likely to simply transfer economic activity from one area to another. It also found that regional adjustment funds could reduce regional income by distorting business and employee decisions about where to locate and diverting government resources from other areas that might return more for the investment. The Commission concluded:

*'These programs are unlikely to significantly affect overall long-term employment trends in targeted regions, have demonstrated little additionality in that they may fund projects that would have gone ahead without government support, and can divert resources from more efficient uses in other regions.'*³

While there may be political pressure for industry-specific transition adjustment funding, this does raise equity issues. For example, this funding could divert assistance towards one group simply because of sector affiliation—even if that group has less need of assistance based on skills and qualifications.⁴ Such approaches are also likely to be even less effective in a future where everybody is affected by automation, where job losses may occur across sectors, and where Australian jobseekers and employees will need more general, rather than ad-hoc, support.

¹ See, for example, *Investing in regions: Making a difference*, Grattan Institute, 2011. It is worth noting that the historical concentration of economic production in Australia's cities means that future urbanisation is unlikely to be as politically painful as in, say, the United States, where many large businesses are centred in small and medium-sized towns.

² *Australia's automotive manufacturing industry*, Productivity Commission, 2014 (see Recommendation 7.1).

³ *Australia's automotive manufacturing industry*, Productivity Commission, 2014 (see Finding 7.3).

⁴ *Australia's automotive manufacturing industry*, Productivity Commission, 2014 (see Finding 7.1).

Box 9: How government can increase worker participation in the labour market

Chapter 2 suggested that increasing labour force participation rates could help to rekindle income growth. Three groups are currently under-represented in the Australian workforce: women with children, workers over the age of 65 and people with a disability. While automation technologies could improve the employment prospects of these groups, additional initiatives could also be considered.

- **Women with children:** The McKinsey Global Institute's 2015 report, *The Power of Parity*, laid out four priorities for governments to raise labour force participation among mothers.¹ First, a clear case for change is needed at decision tables to prioritise policies that would boost participation. Second, data to support these decisions is needed; every labour policy should be evaluated for its impact on women, and more data should be collected on trends such as the proportion of women in leadership positions. Third, the economic disincentives of childcare funding and income thresholds need to be removed. Finally, positive workplace attitudes towards employing and retaining women need even more promotion.
- **Older workers:** Retraining for new jobs is a significant challenge for older workers, some of whom may not have had formal training for many years, and may be reluctant to invest in training so close to retirement (especially if there are large out-of-pocket expenses). This will be particularly relevant in the automation age, when digital skills will be needed. Several policies can provide incentives for retraining. The government has already started the process of raising the retirement age from 65 to 67 (among the highest in the world) and the preservation age to 60 (the age at which individuals can access superannuation).² In the Australian 'jobactive' scheme, wage subsidies of up to \$10,000 are available to employers if they hire an unemployed person aged 50 or over. Wage subsidies are intended to overcome the discrimination that some categories of jobseeker may face when looking for work (for example, young workers, older workers, parents and principal caregivers, the long-term unemployed and Indigenous Australians) by offsetting the costs of hiring or initial training.³ The government could also combine assistance for older workers with support for SMEs. In Germany, for example, the Federal Labour Office funds a job-related training program for workers aged 50 and over who are employed by SMEs. These programs have been correlated with an increased share of older workers in training and higher employment rates for those aged 45–54.⁴
- **Workers with a disability:** Recent reforms such as the establishment of the National Disability Insurance Scheme are helping to increase labour force participation among people with a disability. However, the OECD suggests that in focusing on job-market entry, Australia has 'long overlooked' the potential of improving retention policies.⁵ For example, Austria and the United Kingdom provide counselling and support services to all employees on sick leave for more than four weeks to help them overcome difficulties that might otherwise lead them to drop out of the labour market. For the same reason, Switzerland activates disability insurance claims after a short period of sick leave, while Denmark provides 'vocational rehabilitation'—coaching and support aimed specifically at people with a disability.

¹ *The power of parity: Advancing women's equality in Asia Pacific*, McKinsey & Company, April 2018.

² *Pensions at a glance 2017* (p. 82/167), OECD; *Pension age hike will force thousands of elderly Australians on to Newstart*, The Guardian, May 4, 2018; *Preservation age*, Australian Government, Australian Taxation Office.

³ For example, see: Jeff Borland, 'Wage subsidy programs: A primer,' *Australian Journal of Labour Economics*, Volume 19, Number 3, 2016.

⁴ Hila Zboralski-Avidan, *Further training for older workers: A solution for an ageing labour force?* (PhD dissertation).

⁵ *Connecting people with jobs: Key issues for raising labour market participation in Australia* (p. 82/118), OECD.

10. Optimise re-employment incentives and capacity, and pilot social welfare innovations as needed

If worker displacement through automation significantly pushes up unemployment rates, there could be additional pressure on Australia's existing social welfare structures. The government has already conducted a formal review (completed in 2015) to evaluate the effectiveness of the existing welfare system and, where needed, optimise incentives so that they give workers the capacity to reskill and find better jobs.¹²² There is still considerable public debate about the effectiveness and adequacy of Newstart—the main unemployment income support program.

While accelerating reforms in training and education is a key part of the equation, a more immediate reform option could be to extend the safety net to encompass all types of work, not just traditional, full-time employment. At present, for example, workers compensation is not available (at least not efficiently) for independent contractors, and there is no capacity to continue accruing long service leave between different types of job or across different jobs.

Australia could explore new ideas to incorporate into future reforms. For example, governments and researchers are already exploring new concepts to tackle income inequality.

Another option is to consider new ideas that could be incorporated into future reforms, in case the speed of automation adoption is faster than anticipated. Governments and researchers are already exploring new concepts to tackle income inequality, for example, such as wage insurance, the universal basic income (UBI) to guarantee a minimum living wage for all citizens, salary supplements to encourage labour force participation (some modelled on the earned income tax credits in the United States), minimum wage increases, or even a mandated distribution of capital when its returns exceed those to labour by an agreed margin.

Evidence on many of these policy ideas is limited or mixed. Wage insurance, for example, is intended to encourage displaced workers to take potentially lower paying positions by topping up their incomes. People who cannot find a new job with equal or better pay receive government-funded top-ups for specified periods (such as one year), capped at a particular amount (for example, \$10,000). The Brookings Institution has advocated for wage insurance in the United States on multiple occasions.¹²³ To date, there has been too little analysis to assess the effectiveness of wage insurance. However, it does have an advantage over other suggestions, in that it is a targeted initiative and therefore less costly to taxpayers. There is also insufficient data from overseas pilots of UBI to assess its efficacy. Finland ran a two-year UBI pilot from 2017–18, but the findings are not due to be released until 2020. Y-Combinator will start a basic income study in Oakland, California, in 2019. Canada started a pilot program in Ontario in 2017 but cancelled it a year later; its earliest trial was in Manitoba in 1975–1980 but no final report was issued.

¹²² *Australia's welfare system, a new system for better employment and social outcomes*, Australian Government, Department of Social Services, 2015.

¹²³ *Earnings insurance for Germany*, Brookings, July 25, 2002; *Wage insurance: A potentially bipartisan way to help the middle class*, Brookings, February 24, 2015; *Four cures for automation anxiety*, Brookings, June 21, 2018; *What is this 'wage insurance' Obama's talking about*, The Atlantic, January 14, 2016.

Accordingly, the Australian Government may need to pilot its own interventions to develop a deeper understanding of their potential, and to convince the public of the value of expanding worker transition support. This could provide public agencies with the necessary evidence to implement an innovative idea if existing welfare models come under strain. To enable a fair comparison between different interventions, the government could leverage advanced analytics and automation technologies. Quantitative data on jobseekers' outcomes (and the links between policy and outcomes) tends to be very weak,¹²⁴ but better use of technology for data capture and analysis would enable much more informed policy development.

The automation age may prompt innovation in our social welfare policies as much as in our businesses. However, this shouldn't distract Australia from the opportunity automation presents, particularly at a time when the economy is flagging and wages have stagnated. Automation is coming—whether Australia wants it or not. Australian firms will be taking on new technologies to keep up with their global competition and to seize opportunities at home, and public agencies will still be working to deliver what Australian citizens expect under tight budget constraints. The pace of automation adoption remains to be seen, as does the extent of disruption felt in organisations and communities. But the key question remains the same: Faced with the inevitable, what can Australia do to secure the best outcomes for all Australians?

Managing this type of transition is what Australia does well. When the country's economy has been under stress in the past—as in the 1980s and during the GFC—Australians have found the will and the capacity to develop effective solutions. To succeed in this new transition, Australia will need all of this talent, purpose and drive. Realising the opportunities of automation and navigating its challenges is not something that a government, a single firm or a single individual can do alone. Australia needs a clear strategy, the right skills and effective collaboration at all levels, and the determination to take action when needed.

This report explores what is needed to ensure that automation is at our service, offering both high-level and detailed suggestions on how this could be achieved. The challenge is clear, but so is the prize. The timely adoption of automation can restore Australia's economic lustre, make its workplaces more inclusive, create the wealth needed for higher income growth—and perhaps even usher in a new era of Australian prosperity.

¹²⁴ For example, see: *Lessons learned from large firm closures*, Nous Group, 2013.

Appendix

Appendix 1: McKinsey Global Institute methodologies

This report draws on the methodology and findings from the January 2017 McKinsey Global Institute report, *A Future that Works: Automation, Employment and Productivity*; and the December 2017 report, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation*. A full methodology of that work is detailed in the reports' technical appendices. Here, we provide a brief summary of this methodology and how it was applied to produce the findings in this report.

What our model does:

- This research develops a set of scenarios (necessarily incomplete) to serve as a guide as we anticipate and prepare for the future of work. This research is by no means the final word on this topic, and ongoing research is required.
- These scenarios seek to address some of the questions most frequently raised in public debate. Will there be enough work in the future to maintain full employment, and if so what will that work be? Which occupations will thrive, and which ones will wither? What are the potential implications for skills and wages as machines perform some or all of the activities that humans do now?
- To answer these questions, we analysed scenarios for the net impact of automation and future labour demand, which further depict changes in employment, sectors and skills. We examined both the potential labour market disruptions from automation and some potential sources of new labour demand that will create jobs.
- Our findings look into trends that may serve as catalysts of future labour demand and could create demand jobs by 2030. These trends include caring for others in ageing societies; raising energy efficiency and meeting climate challenges; producing goods and services for the expanding consuming class, especially in developing countries; and investing in the technology, infrastructure and buildings needed in all countries.
- Our analysis offers a static view of the potential labour demand that could be created from the seven trends. It does not factor in supply-demand dynamics and feedback from factors such as changes in wage levels.
- Sizing methodology varies by trend. However, we capture direct and indirect jobs that could be created from each of our seven catalysts, take into consideration the decline in hours worked per person, and factor in globalisation of work.
- For three of the seven trends—investment in infrastructure, investment in buildings and investment in renewable energy and energy efficiency—we examined two scenarios: a 'trendline' scenario, in which spending follows the observed trends across countries; and a 'step-up' scenario, in which labour demand increases as a result of societal and policy choices. For a fourth trend—the increasing shift to market of services that were long done without remuneration—we only examined a step-up scenario that assumes rising female participation in the workforce.
- We found that a growing and dynamic economy—in part fuelled by technology itself and its contributions to productivity—would create jobs. These jobs would result from growth in current occupations due to demand, and the creation of new types of occupation that may not have existed before, as has happened historically.
- None of this will happen by itself—it will require businesses and governments to seize opportunities to boost job creation, and labour markets to function well.

What our model does not do:

- The model is not intended to produce forecasts.
- We have not made assumptions in our modelling about sector trends, such as the growth of e-commerce in retailing, or the impact of fiscal constraints on public-sector employment.
- We do not model changes in work structure, such as the growth of the gig economy, or activities within an occupation that could change as a result of technological innovation.
- Our analysis of wage trends is based on current average wages for each occupation in each country. We do not model wages over time by occupation based on the dynamics of labour supply and demand.
- We do not model changing skill requirements for occupations or analyse the ‘skill bias’ of automation technologies—that is, whether they will enable high-skill workers at the expense of low-skill workers, or vice versa. They are not the cause for our approach, but they can be an effect.

Work hours that could be automated

The technical potential for automation of the global economy and projected adoption rates are determined by an analysis of the underlying work activities for each occupation, covering 46 countries. This analysis uses databases published by institutions including the World Bank and the US Bureau of Labour Statistics 2014 O*Net database to break down around 800 occupations into more than 2,000 activities, and it determines the performance capabilities needed for each activity based on the way humans currently perform it. The report further breaks down activity into 18 capabilities and assesses their technical automation potential. This framework is informed by academic research, internal expertise and industry experts. Our report focuses on 2016–30 and therefore takes the automation adoption percentage through to 2030.

We use these findings to size the number of jobs that could be automated by 2030. We assume that each hour of work that could be automated will result in proportional job loss. For example, if 10 percent of current work activity hours in an occupation will be automated, then 10 percent of jobs in that occupation will be displaced. It is unclear if this assumption is conservative or aggressive. Based on what we have seen historically, we expect in many cases that the result of activity automation will be a redistribution of efforts to other existing or new activities. However, it is also possible that with automation, existing work processes could be radically overhauled and reduced in complexity, reducing labour demand even further beyond the automation potential of current activities. We have not modelled these countervailing effects.

$\text{Jobs lost} = (1 - \text{weighted automation potential}) \times 2030 \text{ labour force}$

To calculate the work hours automated in 2030, we multiply the automation adoption percentage by the size of the labour force in 2030. In doing this, we assume that the occupation mix of the economy and the underlying work activities in each occupation in 2030 are the same as today. This is a conservative assumption, because in reality we would expect that jobs will not be added back with the same occupation mix, and that new jobs will be added in less automatable sectors.

To estimate the size of the 2030 labour force, we use population projections from the United Nations, labour force participation projections from the International Labour Organisation and the natural unemployment rate for OECD countries. For countries outside the OECD, we use the maximum unemployment rate from either 2007 or 2012 to adjust for the effects of the 2008 Global Financial Crisis on unemployment.

Labour demand drivers

Our work examines the labour demand created by seven catalysts. We selected these seven catalysts from a shortlist of 20, after conducting high-level sizing calculations to estimate their potential to create labour demand by 2030. The seven catalysts are: rising incomes, healthcare and ageing, development and deployment of new technology, infrastructure investment, residential and commercial buildings, energy transitions and efficiency, and marketisation of currently unpaid work. Detailed descriptions of these catalysts and the calculation approach can be found in the technical appendix of the 2017 report, *Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation*.

We capture direct and indirect jobs that could be created from each catalyst, take into account the decline in hours worked per person, and factor in globalisation of work. Our model offers a static view of the potential labour demand that could be created from the seven drivers and does not factor in supply-demand dynamics and feedback from factors such as changes in wage levels. It estimates potential labour demand; whether this potential is captured will depend on the choices and investments made by businesses, policymakers and workers. Beyond the seven drivers, our scenarios do not take into account any sources of labour demand that could play an important role in determining the future of work. We do not model entirely new industries and occupations that could exist in the future, in part enabled by technology. (Studies have shown that, on average, 0.5 percent of the workforce have been working in 'new jobs' per year in the past couple of decades.) We do not take into account sectoral shifts in industries that are not directly related to automation, such as the rise of e-commerce in retail. We also do not model changes in work structure, such as the growth of the 'gig' economy, or activities within an occupation that could change as a result of technological innovation.

Appendix 2: Income inequality methodology

In this report, we analysed several scenarios regarding the potential impact of automation trends and reskilling responses on inequality levels in Australia.

We used a static version of McKinsey's Global Trade Analysis Project (GTAP) computable general equilibrium model with GTAP_v9 dataset. The model was structured using Australia and 'Rest of World' as regions, with five labour categories (in descending order by wage):

- Managers and professionals
- Technicians and associate professionals
- Service and retail workers
- Administrative workers and clerks
- Agriculture, trade and manual workers

We began with a labour market in equilibrium, with labour supply equal to labour demand, and deviated from this equilibrium by adjusting the labour demand according to six scenarios that vary based on degree of reskilling (ranging from 25 percent to 100 percent). Labour supply was held constant for comparison between scenarios.

Wage rates were indexed to equilibrium wage rates, and wage deviations for each scenario were reported by labour category. First-order deviations from the equilibrium wage rate occur in a general equilibrium model as a result of elasticities in the demand for labour, the supply of labour and the substitution of labour. Second-order effects are also accounted for—for example, as bundles of production and consumption fluctuate given new costs of production and consumption prices.

We also calculated a 'Synthetic Gini Coefficient'. We began by ordering labour categories based on 2016 wages. We then calculated the area under the Lorenz Curve using labour category employment instead of percent of population and the wage bill for income. We assumed equitable distribution of income within labour categories, so changes to this synthetic Gini are a result of changes to labour categories, rather than changes within.

Appendix 3: Skills gap methodology

In this report, we estimated the potential size of the 'skills gap' in the Australian workforce in 2030. For the purpose of this report, the skills gap is the gap between the types and levels of qualification that employers are looking for, and the types and levels of qualification that Australians are graduating with.

To conduct this analysis, we built a model drawing upon data from the National Centre for Vocational Education Research (government-funded students' database, 2010 and 2016) and the Department of Education and Training (higher education statistics, 2010 and 2016 student data). Future employer demand was calculated using the McKinsey Global Institute model.

Future worker supply analysis focused on graduate completions only (assuming companies will only hire students who have graduated). The total number of completions included 100 percent of government-funded completions, 100 percent of domestic completions for higher education and 29 percent of international completions for higher education (considering only the share of international students who have been granted work visas in recent times). In 2016, 32,414 graduate work and post-study work visas were granted, out of a total of 110,383 overseas higher education students who completed their degree.

The total number of completions in 2030 was forecast based on expected population growth (using the same 2016–2030 compound annual growth rate).

Based on 2016 completion share by field of education and qualification level, and based on 2003–16 trends, we then computed the 2030 completion share by field of education and qualification level. By applying these shares to the total number of completions forecast in 2030, we determined the number of completions in 2030 by field of education and qualification level.

Finally, to compute the projected gap in employment by 2030 in terms of supply versus demand, we compared the projected share of 2016–30 cumulative graduate supply from education with the projected share of 2016–30 jobs gained (i.e.demand).

March 2019

Copyright © McKinsey & Company

Designed by Sydney Design Studio

www.mckinsey.com

 @McKinsey

 @McKinsey