

# Reflecting on the Future of Work in Australia: Pessimism, Optimism and Opportunities

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## Abstract

This essay has been adapted from a presentation made at the *Royal Society of New South Wales*' forum on *The Future of Work*. The impact of technology and innovation on the future of employment in Australia is examined from both pessimistic and optimistic perspectives. It concludes with a discussion of Australia's opportunities and suggests a number of measures that could be implemented to help Australia improve its technologically driven prosperity.

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## 1. Introduction

Thank you, Donald, for the invitation, and Governor, thank you for your inspiration and wonderful hospitality.

Today I will assume the role of the techno-optimist, and I will present a broad-ranging discussion of some of the technologies and innovations that will impact jobs and job opportunities.

To start, though, I will put on the pessimist's hat and share with you some of the many reasons to be gloomy about future employment prospects. Then I'll explain why I am optimistic, and finally I'll review a number of measures that if implemented would help Australia improve its technologically driven prosperity.

## 2. Pessimism

First of all, if you look at GDP growth, not over the last year, but over the last two millennia, you'll see that it's been flat until more or less the industrial revolution, when it started on an exponential rise (Roser, 2015).

Which means that the pace of change that we're all dealing with is beyond that which we evolved to manage, and is almost enough to overwhelm people's ability to cope.

And then, of course, there are the many predictions of permanent losses of jobs. For example, in 2013 the Oxford Martin School at the University of Oxford predicted that in the United States almost half of all jobs in the United States will not exist within two decades, lost to computerization (Frey and Osborne, 2013).

Not to be outdone, PricewaterhouseCoopers (PwC) undertook a survey in Australia in 2015 and reported that 44% of jobs in Australia that we enjoy today will not exist in about 15 years from now. They also predicted that 75% of the replacement jobs will require science and technology skills (PwC, 2015).

Hugh Durrant-Whyte and his colleagues at CEDA recently published a report on the impact of computerisation and automation on employment in Australia. It predicts that

at least 40% of today's jobs have a 70% probability of being lost to automation in the next 10 to 15 years (CEDA, 2015).

And not so long ago, in 2011, two MIT economists, Erik Brynjolfsson and Andrew McAfee, analysed the trends in jobs and productivity and identified a displacement between productivity and job creation. They predicted that technology will continue to produce wealth, but not with accompanying new jobs, and therefore there will be a permanent loss of jobs (Brynjolfsson and McAfee, 2011).

If you look at what's been happening in Australia in the manufacturing sector in the last 30 years, the number of people employed in manufacturing has fallen from 16% to 8% (Conley, 2014). It's a staggering change that we've gone through in just three decades.

Another thing that adds to my pessimism about the future of jobs is the fact that in Australia our government invests very little to help researchers and other inventors translate their technologies into the market place. A couple of years ago the OECD published a report on competitiveness and innovation. In that report they presented the 2011 data for the direct government investment in business R&D and the indirect investment via tax incentives. On the direct investment data Australia was second last, just ahead of Mexico. The leaders such as Russia, the United States and South Korea had ten times or more direct government investment than in Australia (OECD, 2013).

A second surprising and telling indication from this data set is that the balance between direct and indirect government investment is completely inverted in Australia. The Americans give a lot more direct funding cash to inventors to help them undertake feasibility

studies than we Australians do. We provide most of our funding for business R&D through the indirect means of the R&D tax concession. It is not clear to me based on personal experience and discussions with other business leaders that the indirect investment through the tax system is an effective utilisation of the money foregone.

Yet another reason to feel pessimistic is the stop-start nature of government policy. You might have noticed; very few policies last for more than a handful of years. For example, in the innovation sector we've had Commercial Ready grants, START grants, COMET grants, Commercialisation Australia grants, Accelerating Commercialization grants and more. They come, they go; the rate of change is such that none of them are given the opportunity to have long term positive effect. This is in stark contrast to the United States, where the well-funded Small Business Innovation Research (SBIR) grant scheme has been in continuous effect since 1982.

Sometimes there are unanticipated drivers that dissuade innovation. For example, in Australia there is an excellent system for measuring research excellence. This system, called Excellence in Research for Australia (ERA) is administered by the Australian Research Council (ARC). The ERA collates a large range of data to measure research excellence. But because it is heavily weighted towards publications and citations it inadvertently creates a bias within the universities against engaging with industry, because the time that a researcher spends working with industry is time not spent at the bench or at the computer doing the research and writing up papers for publication and consequent citations that will give her department a good score in the ERA. It's not the intention of the ERA to discourage

engagement, but in some university departments it has that effect.

Here's another reason to be pessimistic. If the government is not driving innovation, you would hope that private firms would step in and carry the mantle. In some areas they do, but in the so-called high-tech space they don't. There is no agreed way to measure "high-tech" activity, but one way is to look at firms that are backed by venture capital. In the United States and Israel, more than 10% of GDP derives from venture-capital backed companies (NVCA, 2011; Cohen and Scheer, 2015). In Australia, the contribution to GDP from such firms is a mere 0.2% (AVCAL, 2013); private industry is clearly not picking up early stage translation of technology from the lab to the market place at an acceptable rate.

Of course, another reason to be pessimistic is the excess of regulations. We have what I refer to as vertical columns and horizontal layers of regulations. The vertical columns are the duplications going from federal to state to local government. The horizontal layers are the duplications across departments. This is a well-known problem, afflicting many countries. The solutions are in some cases to eliminate the duplications. In others, to appoint a lead regulator to coordinate the filings. It is worth noting that the Australian government is in the process of reducing regulatory duplications.

Another driver of pessimism is the media. Nearly every day I read in the paper something about job losses, or a report on a failure in our tax system, or school education that's not working in Australia, as if we are the most dysfunctional country on the planet. It's negative thinking. It is rare to see a positive report such as "3,000 jobs created". This negative reporting impacts people,

undermining their confidence to start companies or try new careers.

But the fact that pessimism is a state of mind doesn't mean that some of the concerns aren't real. Take the upcoming driverless cars. Many of the major car companies such as Mercedes, Volkswagen and Volvo are working on autonomous vehicles as too are new entries to the field such as Google. These new types of vehicles have the potential to deliver a lot of benefits. They'll reduce the rate of car accidents and deaths. As we grow older, unlike my 90 year old mother who still tries to drive herself despite the entreaties of her three children, we'll all have personalised 'chauffeur driven' driverless cars to take us around, which is fantastic. Further, since the cars will be able to talk to each other and central control computers there will be less congestion.

But the impact on jobs will be huge. You know about Uber. Uber is a novel model where private individuals arrive in their cars to take you to where you need to go. Now imagine that the cars drive themselves, and anticipate a complete change in car ownership patterns so that individuals don't own cars anymore. Thus instead of your personal car being parked on average 22 out of every 24 hours, we'll have far fewer cars each working a lot harder. But it will mean fewer jobs in manufacturing to make those cars. So the jobs for drivers will disappear and there will be fewer manufacturing jobs.

If anything can justify feeling pessimistic it is the onrush of super intelligence. For example, in 2011 an IBM computer named Watson (after the company founder) won the American quiz show named Jeopardy. This is a quiz show that requires not just knowledge but intuition and flashes of inspiration. Winning Jeopardy was a much tougher

challenge than winning chess or backgammon.

IBM won US\$1 million prize money in that game show, but they spent an estimated US\$900 million to \$1.8 billion developing Watson (CNN, 2010). Are they silly? Of course not. It was just a means of motivating their engineers, it was a challenge. But now they're rolling Watson out into very high end jobs. It is hard to think of a higher end job than a medical specialist. Well, at the Memorial Sloan Kettering Cancer Centre in New York, IBM Watson, the computer, acts as an expert computer oncologist providing second opinions to the expert human oncologists.

In banking, the risk assessors and financial advisors are on the way out, because IBM Watson is stepping in at the ANZ Bank and other banks around Australia. These are high end intellectually demanding jobs.

I've given you many reasons to be pessimistic. Time to flip, and talk about some of the reasons to be optimistic.

### 3. Optimism

I'm optimistic because the reality is that pessimistic predictions are rarely correct. You hear about impending doomsday all the time, but fortunately we're still here. Doomsday predictions rarely eventuate. In 1970, Alvin Toffler wrote a book named *Future Shock* (Toffler, 1970). In it he talked about the stress that people were feeling from the rapid rate of technological change. By today's standard the rate of change was modest. Video tape was being introduced for recording movies and home videos, and the first mobile telephones were available in the form of in-vehicle installations. Well, 40 years later the rate of change is far, far greater, and you know, what? We're all coping well. We

are dealing with the future shock, even today, despite it occurring at a much higher rate than concerned Alvin Toffler.

The classic doomsday prediction that did not come true is peak oil. After the Club of Rome published its treatise in 1972, I grew up worrying that I wouldn't be able to drive a car in my later years because there would be no oil. The concern started with Marion Hubbert, who predicted that oil production in the world would peak in the late 1990s, maybe as far out as 2000, and then go into terminal decline.

Well, the reality is, if you look at a graph of global oil production it is continuing to rise steeply, with no hint of reaching a peak or entering a decline. Oil production has grown steadily right past the year 2000 where Hubbert and others said we should have hit peak oil. Why does it keep going up and up and up? Because of innovation, because of technology. Technology can help us recover from the problems that technology causes. Innovation, or human ingenuity, is always there in abundance, wiping out the predictions of doom.

Let's talk about jobs. In 1779, the legendary Ned Ludd used a sledgehammer to smash the stocking machines that were taking away jobs from people in the garment industry in England. Hence the term Luddite. Ned and his co-workers didn't stop the machines. But neither did England enter an era of permanent unemployment.

John Maynard Keynes, the world famous economist, in 1930 wrote that the rate the United States was finding ways to replace the use of labour was outrunning the pace at which new jobs could be found (Keynes, 1933). He talked about a new disease – technological unemployment. He was

genuinely worried but he was smart enough to realize that the dislocations to employment were likely to be a temporary phase of maladjustment. Employment recovered. In 1961, Time magazine ran a story in which they concluded that the rise in unemployment in America at that time was due to automation (Time, 1961). Fear of automation got so bad that in 1964 President Johnson created a special commission to look into what could be done to save jobs in America from the threat of technology and automation. But by 1966 when the commission delivered its report, the United States was again approaching full employment.

Despite the fact that new jobs have replaced lost jobs again and again, it is always the case that the prognosticators say, “This time it will be different”.

So let me go back to the MIT economists, Brynjolfsson and McAfee, who published the book *Race Against the Machine* (2011). They predicted that this time it would be different, that we are entering a period of permanently increasing unemployment.

Let’s see how good they were at predicting the future, even in the near term. At the time that they published, unemployment in the United States was 9%. Today, August 2015, it is 5.1% (Bureau of Labor Statistics, 2015). It went down, not up. So in just four years they got it completely wrong. Prediction is difficult, especially about the future, and experts get it wrong all the time. They fail to take into account innovation, because as economists they only want to consider things they can quantify but in the case of innovation they don’t know how to quantify it. Innovation leads to the creation and the invention of new opportunities. Time and time again, predictions that ignore innovation

fail to anticipate major improvements to our health and wealth.

The biggest change in job sector employment that you’ll ever see is in the farming industry. In America, 90% of people in the year 1800 were employed in the farm sector. I don’t mean they were necessarily farmers, some were but the rest were rural merchants, or the manufacturers of the ploughs or the people storing the grain. Employment in the farm sector is now down to around 1.7% (Perry, 2011). At the same time, the output of the farm sector has grown enormously. Of course, as employment in that sector collapsed from 90% to less than 2%, unemployment did not increase by 88%. Instead, new jobs were created.

I’m also optimistic because here in Australia we have some fantastic examples of innovation. People think of innovation mostly as being in the high tech sector, in venture capital backed companies. But some of the big companies do a great job too. In high tech, we’ve got the cochlear ear implant, it’s done wonderfully well for Australia. But our traditional big banks are innovative, too. Our banks have spent and continue to spend billions and billions of dollars on developing software for their internal systems, and also software for their customers. Our banking system is, if not the most advanced in the world, one of the most advanced in the world. Innovative technology serves our banks brilliantly and they are making huge profits.

One of our biggest mining companies, Rio Tinto, has a *Mines of the Future* program in which they deploy driverless trucks in the mines and remotely operate underground drilling machines. Everything is either autonomous or controlled by experts back in Perth. This increases the safety profile of the

mine, improves the economics and reduces the environmental damage. This innovative approach has allowed Rio Tinto to continue mining profitably despite the collapse in iron ore prices.

I'm also optimistic because I think we do a good job on workforce discipline training in Australia, and we are getting better. Further, at our universities we're now teaching entrepreneurship, we're setting up mentoring programs and we are teaching postgraduate students broader skills in communications and project management.

I'm optimistic because new companies create new jobs. This is well documented in the United Kingdom where it has been shown that companies created between 2007 and 2010 contributed 36% of the new jobs in that period (Anyadike-Danes et al., 2013). Similar results have been shown in Australia.

It is important that job destruction should not be considered to be synonymous with permanent loss of jobs. What the UK study found is that in a 12 year period, from 1998 to 2010, each year about 28% of the jobs in the private sector were destroyed and replaced. Often that's within the one company but either way, it is a lot of job churn. We tend to focus on the losses, but there's simultaneous creation.

I'm optimistic because we have improved the public discourse in this country about how science and technology and research can contribute. We've got a national science policy underway and some research priorities established. The government is talking the right talk, although there's very little action yet. There are a lot of reviews underway on research funding, research training and research infrastructure to support the research endeavour. I would hope that with

the recent replacement of the Prime Minister there might be an even more welcoming acceptance of the need to do things differently.

So I've gone through why I'm pessimistic, and why I'm optimistic, but it's not enough. We have to think about where the opportunities lie and what we can do to drive growth and prosperity.

#### 4. Opportunities

Universities generate research outcomes. Companies want to commercialize proven technologies. We've got both these ends of the innovation spectrum in Australia. What we don't have is a means of getting the research outcomes from the university to the point of being a proven technology. This is often referred to as bridging the Valley of Death. As a result, we don't have enough innovative small firms in Australia.

There are many things that can be done to try to address that. To start, we can learn from the United States. There the government helps to provide the funds to build the bridge over the Valley of Death, through programs such as SBIR, many programs run by the Defence Department and programs for medical technology development run by the National Institutes for Health. These highly effective programs are why the direct investment by government in business R&D is so high in the United States, as I mentioned earlier. We would do well in Australia if we mimicked these programs.

Now, of course, in the United States they've also got venture capital funding and even debt funding for startups. There's a bank called the Silicon Valley Bank that, unlike our banks, seeks to invest in high risk companies. We would also do well in Australia if we could mimic these funding sources.

We need to attribute value to the effort by university researchers to engage with their industry counterparts. Earlier I talked about ERA, which despite being a robust measure of research quality inadvertently has a negative influence on how researchers engage with industry. Cognisant of this, the Academy of Technology and Engineering (ATSE), of which I am President, has proposed a new metric to encourage collaboration between researchers and industries. It will be a pragmatic measure and it will be quantitative. It will not replace the ERA, instead it will sit alongside it.

What improvements do we need to consider to prepare the workforce for the future? One often hears that we need more science, technology, engineering and mathematics (STEM) graduates. However, in a recently published paper, Bob Birrell (2015) from Monash University analysed demand and concluded that with current government policies we are actually training too many STEM graduates for the number of jobs available. It's sad to hear that, because like many others I have personally been doing my best to encourage young people into the pipeline.

We have to train people to work in a fragmented workplace of the future where there will be many more people self-employed, some working in micro or mini entrepreneurial start-ups. But at the same time, we must not neglect the need to train people to work in large firms. Employees need to be flexible, they need to have deep discipline knowledge. There's a tendency to believe that with so much easily accessible information available it is not necessary to train people in deep discipline knowledge. That is not correct, because coming to grips with the intricate details of a subject is a

necessary skill. Even if you're trained in arts, you can become a business person, or if you're trained in engineering you can become an HR manager, because the ability to deeply analyse is a skill that is required in the workforce and is learned by intensively studying any discipline. For all these reasons we need to support training and retraining for displaced workers.

Further, we will need new regulatory frameworks to manage the encroachment of artificial intelligence and robots. Artificial intelligence and robotics have the potential to do a lot of specific harm. For example, much concern is already being raised about AKMs, autonomous killing machines. These are drones that aren't controlled by somebody sitting in Los Angeles, but instead are given a mission, and given the authority to autonomously make attack decisions according to their mission profile.

We need to build confidence across our community in starting new businesses. Returning to the UK, it's stunning to learn that 200,000 firms are born every year creating about 1 million new jobs. Within 10 years four out of five have closed. However, the small fraction of firms that remain will still employ around half a million people (Anyadike-Danes et al., 2013). And all the time there are more and more startups that make a crucially important contribution to jobs and the economy.

So what if my optimism is misplaced? If I'm wrong then we need to be planning for a different society, and now is the time to be planning. We've got to be planning strategically. Unfortunately, for quite a few years now there's been a lack of long term strategic planning in our national government. We cannot afford to continue that way.

It's not necessarily all bad even if I am wrong and jobs disappear. Remember that loss of jobs does not necessarily equate to loss of wealth. What Brynjolfsson and McAfee from MIT were saying is that there will be massive productivity increases due to automation, huge amounts of wealth will be generated, but there won't be jobs. They've been wrong about employment in the last four years, but what if they're right in the long term? There will be tons of wealth. The challenge is to adapt our society to one in which the wealth can be distributed in an equitable fashion to the people who aren't working.

But wealth without jobs is not a comfortable solution because most people define their self-worth through their jobs. If our society goes this way at the very least we will create jobs for psychologists who will be needed to help people create their personalized definition of self-worth outside of employment.

Perhaps we can learn how to do this from the science fiction literature. One of my favourite books is called *The City and the Stars*, by Arthur C. Clarke (1956). I won't take you through the whole narrative, but wealth without jobs is exactly the theme that Arthur C. Clarke back in 1956 was tackling in this quite beautiful short novel, where no one, not a single person, had a conventional working job, because everything was taken care of by the central computer and the robots.

## 5. Conclusion

To summarize, we have to accept that the pace of change is rapid and will become even more rapid. Amazingly, young people, middle aged people, all of us, can cope. We have to invest in innovation to create the jobs that replace the jobs that innovation destroys. We can't just say "Innovation destroys jobs" and leave it at that. We've got to say "Okay,

that's the nature of innovation, but it can also create jobs". We have to optimise that result.

We have to invest in workforce training and re-training because the job opportunities will be changing at a rapid rate. And as I said, if I am wrong in my optimistic view of employment, we have to start planning a different society.

## 6. Discussion/Q&A

"Many thanks for your very interesting and stimulating presentation. It strikes me that most of the data and analysis are taken from the USA, Europe and Australia. They focus on national labour market trends, especially with regard to cost-benefit considerations concerning automation of various types of work. Today, much industrial production is structured by an international division of labour and by global value-chains. Developed economies still focus on industrial products, even though the actual production work is often carried out in low-wage economies. In other words a product like a computer or mobile phone may include components made in several different countries – such as China, Vietnam and South Korea – while design and marketing remain mainly in the USA, Germany or another apparently post-industrial economy. This enables transnational corporations – still mainly based in developed economies – to capture most of the value of the product and to maintain high rates of profits, due to the low-levels of wages and social rights in the places where most of the work is actually done. Please comment on this observation, and on the prospects for automation in economies which today have very low wage rates."

- *Professor Stephen Castles, Research Chair in Sociology, The University of Sydney.*



“It is true that the supply chain is global. For many products that has been the case for a long time. For example, I made scientific instruments in California during the 1980s and a lot of our components came from Japan and various European companies. But accepting that globalization of the supply chain is increasing, it is an opportunity as well as a jobs threat. The opportunity is for our domestic suppliers to provide components to global companies. If we don’t do that, and if we don’t manufacture much here, the manufacturing job numbers will go down again, starting from what is already a single digit percentage. But jobs will likely increase in other sectors. For instance, through my company Cosmos Magazine we publish secondary school science lessons. In the old days, these would have been printed, and there would have been manufacturing jobs for printers, storemen and packers. Today, we distribute the lessons out of the digital cloud, but we employ a team of software engineers to develop and maintain the digital delivery platform. These are new jobs replacing the manufacturing jobs.”

- Dr Alan Finkel, President ATSE.

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