

# Introduction

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SLIDE: Introduction

Good afternoon everyone, and thanks *NAME* for that excellent introduction. I know it's pretty late in the afternoon, and many of you have travelled considerable distance to be here, so a huge thank you for coming to the beautiful city of Geelong - my home town - and for sticking around for the afternoon sessions.

I'm Kathy Reid, and I work at the intersection of emerging technologies, open source and technical communities. As the Vice President of Linux Australia, I help oversee open source initiatives in Australia, such as WordCamps, DrupalSouth and Linux Conference Australia, and as part of Creative Geelong I help champion the creative and digital industries in Geelong.

The title of my talk today - "They're jobs, Jim, but not as we know them" - is very deliberately intended. If you think of some of recent job titles emanating from Silicon Valley - like *Cloud Architect* or *Big Data Visionary* or *Clickthrough Analyst*, they seem almost surreal. As we hear daily reports of increasing automation and artificial intelligence, you could be forgiven for thinking that jobs of the future are from another planet, unrecognisable, an alien species to be studied.

SLIDE: Alien

So, over the next 30 minutes, I'll be leading us on a *mission*. A mission to learn, to explore, understand, and hopefully learn to engage with these alien jobs of the future.

SLIDE: Mission

We're going to take a look at;

- Some of the technology trends that are re-shaping jobs
- And we'll take a look at the skills that will be needed to secure employment in the future.

My intent is that you, as individuals or as businesses, will be able to use the key takeaways today to help think about how *you* might respond to the changing nature of jobs.

## Back, back in time

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First though, I'm going to jump in the time machine and explore for a moment what jobs of the past looked like.

SLIDE: Rat Catcher

So, being a Rat Catcher was a lucrative role in 1830s Kent - there were plenty of rats, which were carriers of pestilence such as the plague - and while the OH&S standards weren't very high, if you had elite dexterity skills, you could make a pretty penny.

SLIDE: Switchboard Operators

If Rat Catching wasn't your thing because, say, you were a woman and equal opportunity hadn't been invented yet (!), then you might tip your hand at being a manual switchboard operator. Again, this required good physical stamina, and precision and accuracy..

Obviously, both of these jobs have died out, but through differing mechanisms. Rat catchers for instance lost business because better sanitation and urbanisation reduced the rodent infestation. Switchboards on the other hand became automated through technology advancement -

PABXs.

# Two drivers of jobs growth - population and technical advancement

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SLIDE: Drivers of Australia's economic growth

So, while these two jobs - rat catching and switchboard operating - might have died out decades ago, there are similarities with the forces which are in play today. While urbanisation and technical advancement may have ended the career of the rat catcher and switchboard operator, *in contrast* it is these two forces which are likely to drive Australia's jobs growth in the future.

Australia's population is likely to reach *28 million* people over the next decade, and there will be an additional *2 million* people in the workforce. That additional population will drive growth in jobs like caring and construction and teaching, because more people will have health and education needs, and they'll need places to live.

## Fourth industrial revolution

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While population growth will likely represent *incremental* change, we're about to undergo massive paradigm shifts in the labour market due to that second factor - technical advancement.

SLIDE: Fourth industrial revolution

Everyone here will be familiar with the concept of industrial revolution - starting in the 1780s with the mechanisation of factories and mills around the world - and then the second industrial revolution in the late 1800s was

driven - literally - by the steam engine and later the petrol engine.

The third industrial revolution is one some of you here may have lived through - when advances in integrated circuits gave us modern computers, and hard drives, and the internet, and eventually the cloud.

But we're now going through the *fourth industrial revolution*. This revolution isn't driven by steam, but it *is* driven by machines - smart machines and automation.

## Creative Destruction

SLIDE - Creative Destruction

And just like the industrial revolutions that came before it, the *fourth industrial revolution* will bring with it a wave of *Creative Destruction* - disrupting almost every sector, introducing new business models, economies and roles. The key question of course is what the roles that are created after this widespread disruption look like - and how many of them there will be?

So let's continue our mission by putting some of these advancing technologies under the microscope, and examining how they're going to impact on jobs of the future.

## Automation

SLIDE: Automation

The *automation* that started with the first industrial revolution and which continued unabated through the second and third revolutions will only increase in pace and scope during the *Fourth Industrial Revolution*.

Where once factory jobs were at risk from mechanical automation, we're now seeing the introduction of advanced automation in service roles. Has anyone used the touch screen ordering system at McDonalds?

SLIDE: McDonalds touch screen

Soon not only will your order be taken by a computerised system, the actual food itself will be prepared via robots specifically designed for this purpose. So, what was once the introduction to the workforce for tens of thousands of teenagers will likely become the realm of robots.

Customer service roles are also experiencing more automation - note for instance the rise of self-service kiosks in shopping centres, or self-service lanes at supermarkets. How long will it be before even complex transactions are conducted with machines rather than humans?

SLIDE: Autonomous vehicles

And perhaps the biggest change of all under the automation rubric is the rapid advancement of autonomous vehicles. We're going to see this impact first in logistics - in long-haul truck driving and the auxilliary support industries - petrol stations, motels, diners - that support it. Then, this impact will be felt in the private transportation market - taxis and private cars. Uber for instance has already had a significant impact on the transport market, but what happens when Uber no longer needs human drivers?

Does increasing automation create any additional jobs? It will create some - for instance in engineering roles, in maintenance of autonomous vehicles and in areas such as geographical information services - helping the autonomous vehicles map out where they need to go? The World Economic Forum estimates that only between 1 in 2 to 1 in 5 of the jobs that are disrupted will be replaced as a result of automation - and this is a trend that we've seen play out for several decades -it's not something new.

# Relationship between wages and productivity

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SLIDE - Relationship between wages and productivity

If we look at the relationship between wages and productivity over time, we see this play out at a macro-economic scale. Since the 1970s, wages - and this is true for all OECD economies - wages have been stagnant when compared to output and productivity.

The simple reality is that machines are quicker, cheaper and more productive - at some tasks - than human workers.

## Machine learning

SLIDE: Machine Learning

But it's not just entry level, or service-based jobs that are challenged by new technologies.

*Machine learning* is a special type of artificial intelligence that provides computers the ability to learn without needing to have each new piece of learning programmed into them.

There's some really interesting ways in which machine learning is being used:

## Facial recognition

Have you ever posted a photo to Facebook, and magically Facebook knows that the photo has a person in it, and is scarily good at picking which one of your friends? That's machine learning in action. Computers are trained on

hundreds of thousands of images to know what's a face and what's not a face, and whose face it is.

## **Recommendation systems**

Have you ever been on a shopping site, and put an item in your basket, and then the site suggests products that you might also like? Have you noticed that in the last few years those suggestions have become almost prescient? Again, that's machine learning at work, using the transaction data of hundreds of thousands of consumers to better identify what consumers just like *you* are likely to purchase next, and then suggesting it to you.

## **IBM Watson**

SLIDE: IBM Watson

Everybody's heard of Watson, right - IBM's artificial intelligence that won Jeopardy in 2011? Well Watson uses machine learning as well, and is now being put to use in a range of fields such as radiology - and identifying which scans means something suspicious and which are benign - with incredible accuracy - rivalling even experienced radiologists.

So we're now seeing that machine learning is not just assisting people in choices - decision support - it's able to replicate the specialist and discipline specific knowledge - such as interpreting radiology scans and determining if someone has cancer - of experienced and skilled professionals.

## **Narrative Science and Quill**

In fact, a company called Narrative Science in the United States offers a product called Quill - and this is essentially a machine learning program that replaces sports journalists entirely - and I can think of at least one case where that would be a very good thing!

The program uses statistics from the game, and data about players' history and past performances to construct a news article, in the same style as a sports writer. This is a further blow to any journalists in the room - who've already suffered serious disruption from smartphones, bloggers and citizen journalists.

## Tay.ai

SLIDE: Tay.ai

Of course, not all machine learning attempts have been successful.

In March of this year, Microsoft released a machine learning program called Tay, whose intent was to learn to interact with people on Twitter.

Unfortunately, Tay got trolled, and was fed racist interactions, in turn becoming a reflection of her environment. Tay was shut down after tweeting bigoted and racist tweets to her followers.

Perhaps Tay could have used a artificial intelligence trainer - a human to guide her learning and steer her development - much like a guidance counsellor would steer an adolescent. So, there's at least one new role that will be created! But what will some of the other jobs of the future look like?

Let's continue our mission and take a closer look at what those jobs are going to look like.

## 7 Job Clusters

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SLIDE: Job Clusters

In their recent report, the Foundation for Young Australians urged us not to think in terms of specific careers, but around a professional portfolio of skills - job *clusters* that we can use to drive their professional development.



Let's have a look at them.

## Generators

SLIDE: Generators

These are job clusters that require a high level of interaction - think about roles in retail, in sales, entertainment and hospitality - our 'people people'.

While some roles in this category such as service roles are likely to be destroyed by automation - for instance the McDonald's touch screen, there's going to be a higher need for instance for specialised sales staff for advanced technical products and services, who can understand and empathise with the clients' needs, build rapport, and then develop a matching solution.

SLIDE: Virtual reality performer

Some of the new types of roles that might be created here include:

- Virtual reality host

In fact, research from multiple areas - the World Economic Forum, KPMG, is showing that social skills and the ability to *empathise* is one of the key skills required for jobs of the future - and if you're a *Generator* then it's going to be essential.

## Artisans

SLIDE: Artisans

These are the job clusters that require manual and dexterity skills - construction, production and maintenance. Builders, plumbers, electricians and tradie type roles are all in this cluster.

The complex problem solving skills and systems thinking skills - the ability to understand what parts do within a whole - are going to be in high demand, according to the World Economic Forum. And Australia's population growth is likely to create new jobs in this cluster, so the future will generally be a favourable time for Artisans.

But even traditional construction roles are likely to be challenged by the rise of advanced manufacturing - such as 3D printing and 3D prototyping. In fact, we're getting to the point where 3D printers are now at an industrial scale, and are starting to print things as big as houses.

SLIDE: 3D printed house

In the past these sorts of roles have also required good physical strength - but a recent World Economic Forum report shows that the demand for physical capabilities - strength, dexterity and so on, is likely to account for only 4% of demand by 2020. So, if you're physically strong, you're going to need other strengths as well - those problem solving and systems thinking skills.

The Artisans cluster also includes many creative industries roles, such as painters, sculptors, makers, textile artists and so on. Interestingly, the creative industries, according to a recent NESTA report from the UK, are going to have a bit of a buffer against the rise of automation and artificial intelligence. And this is because Creatives are able to see the world differently, and bring unique perspectives to complex problems, using their cognitive skills to generate new insights.

So it's a good time to be a creative!

But even these roles won't be immune to advancing technology.

**AI-artisans**

## SLIDE: AI-artisans

Has anyone used a Prisma filter on Instagram? Where you can make a photo take on the appearance of an artist - such as Picasso or the style of say Studio Ghibli? Did anyone try Google's Deep Dream - the artificial intelligence that made wacky and sometimes plain weird images?

I've termed the coin *AI-artisans* to describe these developments - where machine intelligence consumes the works of human artisans, learns from these and is then able to produce works *in the style of* the artisan.

Take this a step further, with recommendation engines, big data and advanced manufacturing, and you could conceivably have an artificial intelligence who doesn't just *recommend* a product for you, but *designs it from scratch in your favourite style*.

## Carers

### SLIDE: Carers

This job cluster holds nurses, doctors, personal trainers and all the roles that provide personal health and well being services.

These roles are not going to be affected *as much* by trends such as advanced manufacturing or automation, but it's likely that that they will be challenged by advances in artificial intelligence, particularly in diagnosis and decision support - for instance using tools like IBM Watson to validate diagnoses.

Indeed, with Australia's ageing population, we're going to need more carers to look after our elderly, but these won't necessarily be highly skilled roles - and this is a trend we've seen across aged care, with facilities staffed with roles that might only require a Cert II or Cert III.

## SLIDE: End of life care planner

Were going to need people skilled in end of life care planning - and that's a possible new role that we'll see emerge. Again, the need for complex problem solving skills and empathy, emotional skills will be paramount in this job cluster.

More interestestingly though, *Carers* are going to need more entrepreneurial skills and business thinking skills. For example, dentists in some parts of Australia are struggling to find enough patients to keep their practices viable - so they're going to need entrepreneurial and marketing skills to attract and retain high lifetime value clients.

## Informers

### SLIDE: Informers

Our informers are those roles that involve professionals providing information, education or business services - for instance university lecturers, accountants, business advisors and so on.

These roles are going to be under increasing pressure from automation - for example, look at how many home loan calculators and do-it-yourself accountancy packages are on the market - such as Xero and MYOB.

With virtual reality and videoconferencing, we're also likely to see these roles go from a one to one or one to few setting, to a one to many setting - essentially delivering an 'expert on demand' type service.

### SLIDE: New role - video lecturers

## Co-ordinators

## SLIDE: Co-ordinators

Our co-ordinators are our back of house heroes - administrative and service workers who are often behind the scenes. Unfortunately, the outlook for these sorts of roles is bleak, as increasing machine intelligence takes on the role of assistant roles.

For example, I can manage my calendar, appointments, travel, email prioritisation, all using my voice, with my Android smartphone - the range of things I can do by talking to my phone is just going to increase over time.

So, if you're in an administrative or co-ordination function, you might want to transition into another field.

## Designers

### SLIDE: Designers

These are the jobs that require skills in science, maths, biology, engineering, lots of the STEM roles - engineers, architects, industrial designers and so on. With advances in genetic technology, nanotechnology, and increasing interaction between biology and computing - biohacking and implantable chips, these skills are going to be in significant demand in the future - leveraging highly developed cognitive skills, problem solving skills, systems thinking and so on.

### SLIDE: New role - genetic repair specialist

For instance, as genetic technology becomes more accessible using technologies like CRISPR, we'll be able to tackle diseases such as cancer at the molecular level.

So, you'd think that people would be gravitating towards STEM careers because of the future opportunities, wouldn't you? Paradoxically, no.

## SLIDE: STEM statistics

The Office of the Chief Scientist released a report in March of this year, showing that just over a quarter of Australians have a STEM qualification - and the vast majority of these are in engineering, not science, biology, geology, mathematics - where breakthroughs in genetics, in agriculture and in climatology are going to come from. There's many reasons for this, such as cutbacks in many government funded scientific departments such as CSIRO and NICTA, but the fact remains that many of Australia's future jobs will be driven by STEM.

## Technologists

### SLIDE: Technologists

These are my people - the geeks of the world - roles that require skilled understanding of technology and digital systems. These roles require strong cognitive skills and systems thinking skills, but increasingly, also entrepreneurial skills - being able to link technical pursuits with business outcomes.

Again, artificial intelligence is going to have an impact on technologists - instead of writing code line by line, there will be more 'building blocks' and components ready to assemble to put together new products - meaning that technologists won't need to be as skilled to be productive - and this will have a wages impact.

However if you're a technologist, your job prospects are looking pretty good - the World Economic Forum is predicting an overall increase in job prospects in ICT in Australia of around 3.6% in the next 3 years - one of the strongest growth areas - and organisations such as Slade Group and Australian Computer Society are predicting a significant digital skills

shortfall in the same timeframe.

So it's good to be a techie at the moment.

## Women in technology

SLIDE: Margaret Hamilton, computer scientist who wrote the Apollo moon mission code, and who was recently awarded the US Presidential Medal of Freedom

And that, unfortunately, is putting women at a disadvantage. Why?

Because currently, ABS stats show that only 1 in 5 people in tech identifies as female, and numbers are even poorer for other ethnic and gender minorities. And it's not just a *current* issue - it's a *future* issues too. Fewer women are studying ICT at high school and tertiary level - so we have this scenario where there's going to be strong jobs growth in ICT, but few women with the qualifications and skills to take advantage of those opportunities.

This is Margaret Hamilton, a computer scientist who wrote the Apollo moon mission code, and who was recently awarded the US Presidential Medal of Freedom, and a bit of a hero of mine. The world needs more Margaret Hamiltons, and fewer Kim Kardashians. *Ladies, get your code on*

## Skills demand recap

SLIDE: WEF future skills demand

So, let's just recap for a moment where the skills demand is going to be over the next few years - and this slide is from the World Economic Forum report. As we saw when we looked at the 7 Job Clusters, the key skills of the future are going to be

- Complex problem solving
- Social skills - empathy skills
- Process skills
- Cognitive skills
- Systems skills
- Technical skills

So what does this all mean? What have we learnt from our expedition, our mission?

## **Distopia vs Utopia**

SLIDE: Distopia vs Utopia

We've learned that there's really two polarised views about the future of work. On one side we have the utopian view - that automation and the rise of AI will generate limitless new opportunities for employment in a range of exciting fields - nanotechnology, artificial intelligence, genetics, agricultural technology, automated transport and so on. This is tempered by the pessimistic view that advances will cause massive dislocation of employment. The reality of course lies somewhere in between these two extremes.

## **How do we respond**

In order to harness that optimistic future, we will need to understand that we won't necessarily have a linear career, but will operate within a job cluster - a cluster that requires us to have new skills - like technical skills, social skills, entrepreneurial skills and new cognitive skills. We will need to recognise that STEM and technology are key growth areas for new employment, and we need to be mindful about attracting more diverse cohorts of people to these cutting edge careers.



But above all, in the future, weird is just going to be part of the job!

SLIDE: Weird is part of the job

Thank you very much.

Timing estimation: 25 minutes to this point

## Reference List

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SLIDE: Reference list