

Keynote Speech, 19th ICBM, 08 December 2022

Technological Innovation, the Fourth Industrial Revolution and its Impact on the Changing World of Work

Pi-Shen Seet, Professor of Entrepreneurship and Innovation, School of Business and Law, Edith Cowan University (ECU), Australia

Good morning.

Thank you for the kind invitation to address this prestigious conference organised by the University of Sri Jayewardenepura in Sri Lanka on this important topic. Speaking of which, it is because of this highly disruptive innovation that is facilitated by high-speed Internet, namely the virtual platform Zoom that is allowing me to join you ‘live’ from Edith Cowan University, Perth, Western Australia. Platforms like Zoom and MS Teams and WebEx have changed the way we work in the last 3 years especially during the COVID19 pandemic. However, there are many other emerging technologies that are going to be making just as significant an impact in the near future.

In my speech, I will be covering the background for this phenomenon called the Fourth Industrial Revolution and showing what some of the research has been conducted on it and how this is already impacting Sri Lanka. I will also be presenting some of the research that me and a team of researchers in Australia have conducted and what Sri Lanka can learn from it.

I will start by providing an overview of the changing world of work by taking a broad perspective on the trends occurring in technology, in the Australian economy, labour market, and demographic and social factors relevant to my presentation.

We’ve all read the headlines about robots taking our jobs and heard about job cuts because of automation and changing consumer behaviour. And we’ve all heard about businesses moving production offshore and the decline of manufacturing.

The research is largely driven by research done in the last 10 years by Carl Frey and Michael Osborne from the University of Oxford. If you have the opportunity, you can enter your job into the website and see if it is susceptible to automation. The websites use an algorithm based on to calculate how likely jobs can be automated, by implementing a novel methodology to

estimate the probability of computerisation for 702 detailed occupations in the US labour market. So whether it is entirely relevant to Sri Lanka may be debatable. But if you think that some jobs are similar regardless of the country that you are in, for example, an accountant in the US or Australia is likely to be doing the same tasks of auditing, financial management and control as they would be in Sri Lanka, then some of the results may be quite relevant.

However, technology innovation and change has been happening for some time. A growing global technology innovation engine continues to create rapid widespread disruption across enterprise and consumer markets. This is essential for sustained economic development as researchers like Drucker and Schumpeter have noted over the years as this will lead to productivity gains, cost efficiencies and increased customer value. However, quicker innovation cycles have also led to changes in work and employment, which this research is concerned with. Some of these emerging technologies have significant multiplier effects due to technologies interacting with each other and can lead to major disruptions. One such example is Nokia, the Finnish mobile phone company, that at its peak in the early 2000s, was employing 55,000 people and dominated the mobile phone sector. However, their slowness in capitalizing on smartphone and mobile internet technology has seen them losing significant market share and laying off about half of their workforce.

The global consulting firm, McKinsey has identified 12 disruptive technology categories. Mobile internet is one of them, but there are 11 others which are predicted to cause as much, if not more disruption to industries over the next 10-20 years. Some are already having an impact in Australia like energy storage – for example, Elon Musk’s giant battery in South Australia. Working together, these technologies will result in a 4th Industrial Revolution.

To understand why it has been called an industrial revolution, we need to go back further in time.

- The First Industrial Revolution took place from the 18th to 19th centuries in Europe and America. It was a period when mostly agrarian, rural societies became industrial and urban. The iron and textile industries, along with the development of the steam engine, played central roles in the Industrial Revolution.
- The Second Industrial Revolution took place between 1870 and 1914, just before World War I. It was a period of growth for pre-existing industries and expansion of new ones, such as steel, oil and

electricity, and used electric power to create mass production. Major technological advances during this period included the telephone, light bulb, phonograph and the internal combustion engine.

- 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 mobile phone technology.

A little over 100 years ago, agriculture was Australia's largest employer, before the mechanisation of manufacturing and mass production took over. More recently, the advent of computers and the internet have changed the way work is done. Other changes, such as trade liberalisation and globalisation, have also transformed Australian workplaces.

- And finally, the phrase 'Fourth industrial revolution' was first used in 2016, by World Economic Forum.

The difference now, however, is the combination of significant changes occurring simultaneously which are amplifying one another. The result is faster, bigger and exponential shifts, vastly different from those previously experienced. These impending changes, sometimes called the 'Fourth Industrial Revolution', offer great promise for both future prosperity and job creation, as well as major challenges for people, corporations, societies and governments planning for and negotiating fundamental changes in the way we work and live and consequently skills and training required.

Technological advancements brought about by declining costs of technology and increasing capabilities and computational power are having a profound impact. The explosion in data volumes and rapid advances in automation and artificial intelligence, are producing robotic devices and other computational systems that can perform numerous tasks more quickly, more safely and more efficiently than humans (Hajkovicz et al, 2016). In the past, technologies affected manual jobs rather than knowledge-based jobs. Now, the level of routine in tasks determines a jobs vulnerability. Codifiable, conceptual jobs on the highly skilled end of the skill distribution as well as manual jobs at the bottom end of the skill distribution are vulnerable. The growth in technological advances is reshaping the labour market, workforce and jobs. It has also empowered consumers (think Trip Advisor).

A quick exercise for those of you who were old enough to watch movies in 2000. What was the most watched movie of 2000?

The slide shows the answer and it may surprise you.

So, the question is, why did I show this video clip? How did this movie/ video disrupt skills, learning, and work in the entertainment industry and beyond?

But it is not just technological innovation that is driving such changes. Australia has experienced nearly 27 consecutive years of economic growth, an enviable record. In this time, the economy has undergone changes which are reflected in the composition of the labour market. More of us are working today compared with 30 years ago, as measured by increasing participation in the paid labour force. This has been driven mainly by women; female participation has increased dramatically from around 40% to 60% in the last 30 years, with most in part-time work. Since the 1970s, male labour force participation has fallen from 80% to 70%. And part-time work has become more common in Australia. According to ABS data (ABS 2017), part-time employment now accounts for nearly a third of all jobs and about 68% of employed people in Australia work for small to medium size employers.

In Australia, the 4th Industrial Revolution is normally referred to as Digital Disruption, as most of the technologies involved are digitally enabled. There have been a number of studies showing the impact of these technologies and some of the worst case scenarios see up to 40 percent of jobs being threatened, as highlighted in the Productivity Commission report in 2016. However, a study by the Australian Industrial Transformation Institute found given the large amount of service sector jobs in Australia, only about 9% of jobs will be automated. In examining how will automation change the way we do our jobs, which is at the heart of *The Automation Advantage* recently released by the Australian firm AlphaBeta. By analysing 20 billion work hours each year, it finds over the past 15 years alone, Australians have reduced the amount of time spent on physical and routine tasks by 2 hours a week. Most of that change hasn't come from the loss of physical or routine jobs. Rather, it has come from workers switching to different tasks within the same jobs, as machines take on an increasing amount of the repetitive, routine work. The study also forecasts Australians will spend on average 2 hours per week more on interpersonal, creative and synthesis tasks and less time on routine and manual tasks.

What about Sri Lanka? The Sri Lankan government has also identified the need to upskill future workers. But the private sector is not waiting for the government and there are a number of companies who are now investing in these new industry 4.0 technologies or equipping their employees to be ready for these technological disruptions.

This slide summarises the drivers and impact of the 4th Industrial Revolution. Not all the drivers are technology related – some are socio-demographic ones. The Changing Nature of Work is more significant than the Changes to Technology. Most significantly, at the bottom left, and of relevance to the VET sector, there is significant concern in industry about skills and re-skilling which dominates the other solutions. As for short, medium or longer term effects, in terms of impact of work – as you can see, many respondents are saying that this is already impacting them. For example, our research has found that employers report difficulties in finding public and/or private providers with the capacity to provide education and training in specific disruptive technologies.

On the internet and social media age, there also appears to be a growing gap between perceptions and reality. For example, most researchers including prominent Nobel prize winners have found that technology contributes about 3 times as much to job changes than globalisation, which is the core economic principle of Trump’s “Make America Great Again” campaign.

Increasingly, there is also consensus that it is not just the technology that will disrupt things but also the business models. Just like the internet disrupted the airline industry about 20 years ago by allowing budget airlines to operate through customers booking directly, today, we are seeing mobile phone apps facilitating peer-to-peer business models like Uber and Airbnb disrupting the taxi and hotel industry. But as you can see, there is a lack of consensus about the impact of the Fourth Industrial revolution with many seeing it as an opportunity but some seeing it as a threat. In many ways, unlike typical consumers and employees, who are generally positive about this, as research by Citibank has shown, while researchers are more techno-pessimists but the general picture is that there is significant lack of consensus. And this is also something that bugs the industry and employers.

If we just take the example of consensus in the implementation of these new technologies in the area of work, there is significant lack of consensus e.g. Gig Economy or Sharing Economy platforms. As you can see, academics are generally pessimists. Curtin Uni, Griffith Uni and University of South Australia researchers have been debating about the insecurity level of Australian jobs. However, some like the University of Queensland research has found that there are more positives than negatives.

It was because of this lack of consensus that a group of researchers led by me received competitive research funding about 6 years ago. It involved a research team of 4 researchers

- Myself as the Lead Chief Investigator at the School of Business and Law, Edith Cowan University
- Dr Janice Jones, Senior Lecturer at Flinders Business School, Flinders University
- Professor John Spoehr and Dr Ann-Louise Hoardacre from the Australian Industrial Transformation Institute, Flinders University

Our research was concerned with the question of understanding the relationship between these disruptive technologies and skill development needs in the VET sector, mainly from the perspective of the industry – whether they be technology users or technology innovators. There were 4 related research objectives that we wanted to understand:

- The nature of the relationship between disruptive technologies and the demand for skills.
- The balance between specialist skills and generic skills.
- Whether there was consensus in the industry
- And what were the barriers to VET students and graduates acquiring these skills in the next 5-10 years.

We adopted a qualitative methodology for the research

- We interviewed 23 CEOs and CTOs from 2 industries that were predicted to be significantly affected by disruptive technologies – Advanced manufacturing and IT
- Then based on the findings of the industry interviews, we interviewed 18 key VET sector stakeholders
- We also developed 2 case studies, a power technology firm, REDARD and Swinburne Uni's Factory of the Future testlab.

The main findings of the research are highlighted on the slide.

- **Reduced need for some jobs but main issue = changing the nature of existing jobs** and in doing so has **expanding the range of tasks**, such as problem-solving and collaboration, creating the need for additional skills and knowledge.
- While **larger firms implement in-house training** to help fill gaps, including those that exist in VET courses, **smaller firms tend to hire workers with the required skill set.**

- **Specialist technology-related skills** are important from a range of engineering disciplines, as well as software development and computer programming
- **Importance of generic non-technical skills** and competencies to include team working, creativity and problem-solving to explore and deploy technologies effectively in workplaces.
- Probably most importantly in our research, Consensus among technology innovators and employers on the need to enhance skill development for disruptive technology. But when considering specific technologies, there is **substantial uncertainty about the skills needed and how the training should be delivered.**
- Some employers reported difficulties in **finding public and/or private providers with the capacity to provide education and training in specific disruptive technologies.**

The first case study comes from industry. REDARC Electronics was founded in August of 1979 by electronics engineer, Robin (Bob) William Mackie in South Australia. Bob started the business by designing and manufacturing vehicle ignition systems and voltage converters. In fact, the name REDARC is believed to have come from the spark developed in the first ignition system having a “red arc”. In 1997, Anthony and Michele Kittel along with Michele’s Father, Denis Brion purchased the business following the premature death of its founder. REDARC has grown from these humble beginnings to become a world-class, advanced electronics manufacturer, servicing both domestic and international markets. In 1997 they were operating out of a tin shed in Lonsdale, South Australia. At the time, they only had 8 employees. Today REDARC Electronics operates in a state-of-the-art advanced manufacturing facility, employing 190 people across 2 locations of which 40 are full time engineers. In terms of the future strategy, it has looked at its need to develop a workforce skilled in computer systems, electronics, mechanical/mechatronics, materials skills and chemical engineering. However, given the lack of Industry 4.0 training available in Australia and specifically, in South Australia, they have taken the initiative to prepare employees to become Industry 4.0-ready by:

- Engaging one of the German-based Fraunhofer Institutes to run dedicated sessions on Industry 4.0 capability-building,
- Sending staff to conferences and engineers to Japan to study lean manufacturing and Industry 4.0-compatible machine lines.

CEO Anthony Kittel says that the cyber-physical nature of Industry 4.0 means that there is a need to develop the application of an overarching Industry 4.0 lens across the core competencies. And a need for “some sort of intensive fast track program for the people that deliver these courses so that they are actually brought up to speed with what’s happening”

In the state of Victoria, they are doing things differently. In Melbourne, there is a partnership between Swinburne University, the employers Ai Group, Siemens and the Victorian government. They have set up a factory of the future testlab or what they call an advanced manufacturing and design centre. It is a key platform for developing and teaching Industry 4.0 technologies in a state-of-the-art facility providing strong links across the higher education, research, vocational training and manufacturing sectors. They have recently completed the first cohort whereby their students complete a diploma in Applied technologies and underwent training and apprenticeships in cutting-edge manufacturing technologies, including 3D metal printing, machine vision and virtual reality applications before moving on to complete an engineering degree. These were skills considered by the stakeholders as necessary to enable graduates to respond to disruptive technologies in all industries.

So what can Sri Lanka learn from this research?

- Firstly, one of the effects of disruptive technologies is the likelihood that a range of routine, and, increasingly, some complex tasks, will be subject to automation. While this is likely to change the nature of existing jobs, it is also likely to profoundly impact on the demand for skills and qualifications over time, requiring some offerings to be modified, some abandoned but others created.
- Secondly, in terms of Industry 4.0, most of the research has been done in Europe, notably in Germany. The sociologist, Hirsch-Kriensen has predicted that besides the automation or technology-centred scenario, there are 2 other possible scenarios where technology can have an impact but in a different way and focus others besides the technology-centred/ automation scenario.
 - The Hybrid scenario where monitoring and control tasks are performed via cooperative and interactive technologies, networked objects and people. Under this scenario, the distribution of tasks between employees and machines is based on the relative strengths and weaknesses of workers vis-à-vis machines. Employees will however face increased demand to be highly flexible.

- And the Specialization scenario where people use systems, and cyber-physical systems are used as a tool to aid decision-making. Thus, the dominant role of qualified workers remains.
- Thirdly, to cope with the changes introduced by disruptive technologies, the VET sector and employers need to work together to support the continual updating and upgrading of the skills of VET graduates after they have qualified and entered the workforce, by developing systems that support lifelong learning.
- Fourthly, there is a need to develop cross-industry units, skill sets and qualifications, and their adoption across multiple industries should be applauded and extended.

To illustrate the point for greater collaboration between research, government and industry sectors, I would like to highlight a case study from ECU's perspective. This concerns a start-up Juggler that we have been doing research with.

- It had a sharing economy platform for the gig economy helping mothers and we helped it conduct research into whether this could help employability of mothers.
- The research findings helped Jugglr to pivot focussing more on B2C business model and secure further funding and support e.g. Joondalup Innovation Fund and the Australian Government Landing Pad in Silicon Valley.
- We are now conducting further research with the City of Wanneroo on waste and recycling innovation.

In conclusion, thank you for the opportunity to share some of my research at this conference. If any of you would like to collaborate further or understand various aspects of how changing technology and societal trends are affecting work, the links to some of our research and my contact email is provided in the slide.