

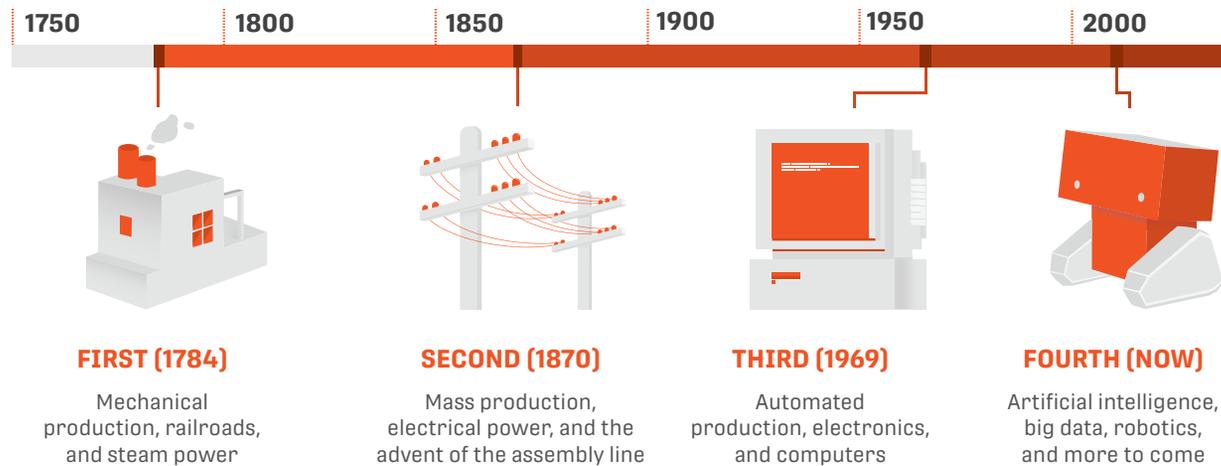
The age of  
**Artificial  
Intelligence**  
in Aotearoa

ROYAL  
SOCIETY  
TE APĀRANGI



We are living in exciting times. Many say we are on the cusp of the fourth industrial revolution. While the third industrial revolution was the rise of machines, the fourth revolution looks to be the rise of machines that can think, or artificial intelligence<sup>1</sup> (AI).

FIGURE 1  
Industrial development from a social perspective



<sup>1</sup> This report will be using the reo Māori words “Roro Hiko” for Artificial Intelligence.

Figure 1 source: Horváth, Bálint. “The recognition of resource use through industrial development from a social perspective.” *Studia Mundi–Economica* 5.1 (2018): 68-78.

**Artificial intelligence** is the term for computational methods and techniques that solve problems, make decisions or perform tasks that, if performed by humans, would require thought. The growth in its use is being helped by the convergence of advances in big data (storage technology), fast processing power (computers) and wide connectivity (internet).

Artificial intelligence can be applied in almost every industry and has the potential to transform economies and greatly enhance quality of life. However, it will present challenges, just as previous technological advances have. For instance, just as the demand for typing pools was reduced when desktop computers were adopted, many of our current jobs will change with artificial intelligence, and entirely new careers will open up.

Issues of disruption and inequality are likely as this transition occurs. However, it is difficult to predict the changes that artificial intelligence will bring. Yet, with any advance in technology, society does not need to blindly adopt it – we can decide how and where the technology can be used.

This report outlines what artificial intelligence is, how it is or could be used in Aotearoa New Zealand, and the risks that need to be managed so that all New Zealanders can prosper in an AI world.

This document is informed by a report prepared by the Australian Council of Learned Academies<sup>2</sup> with input from Royal Society Te Apārangi and New Zealand experts.

<sup>2</sup> Walsh T, Levy N, Bell G, Elliott A, Maclaurin J, Mareels IMY, Wood FM (2019) The effective and ethical development of artificial intelligence: An opportunity to improve our wellbeing. Report for the Australian Council of Learned Academies.



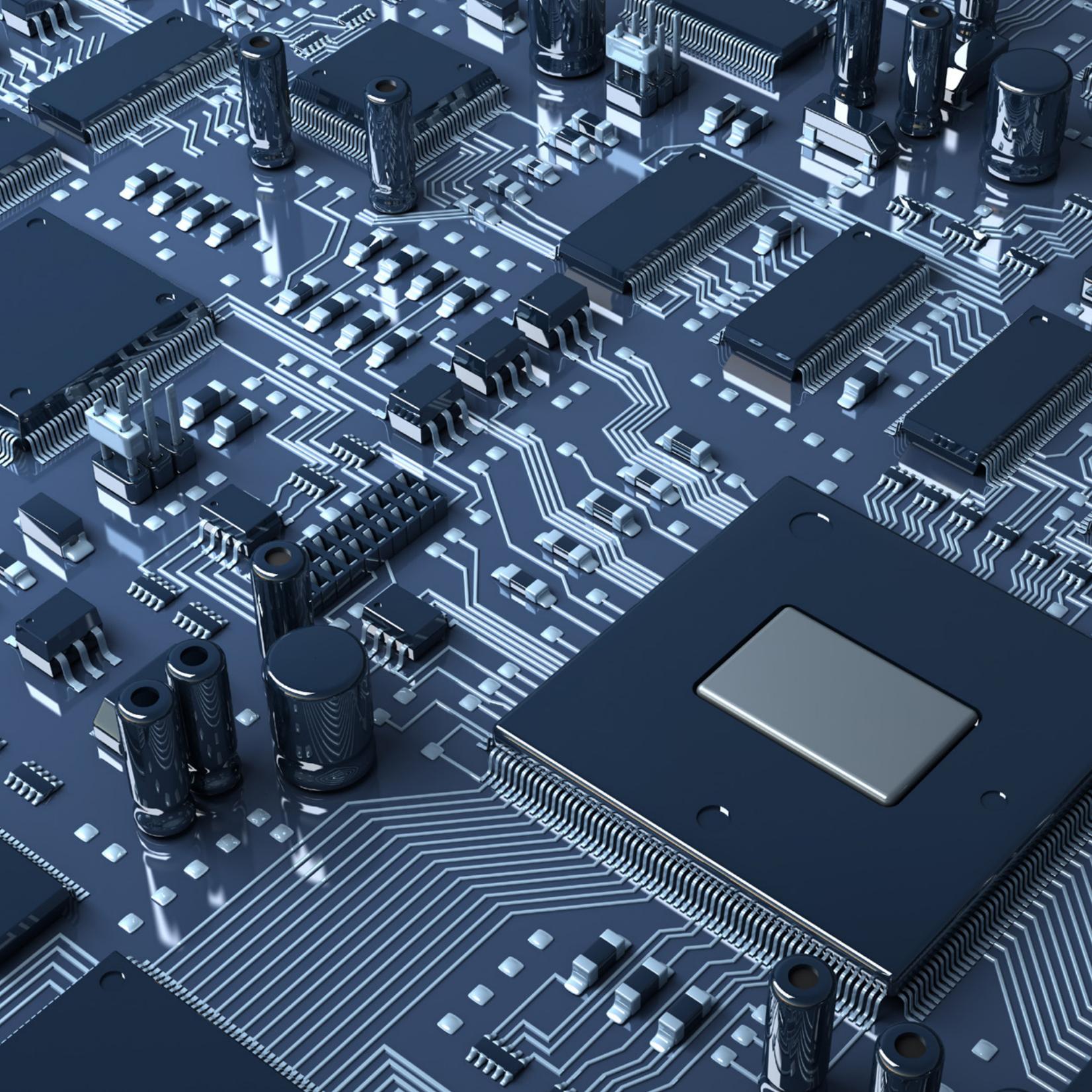
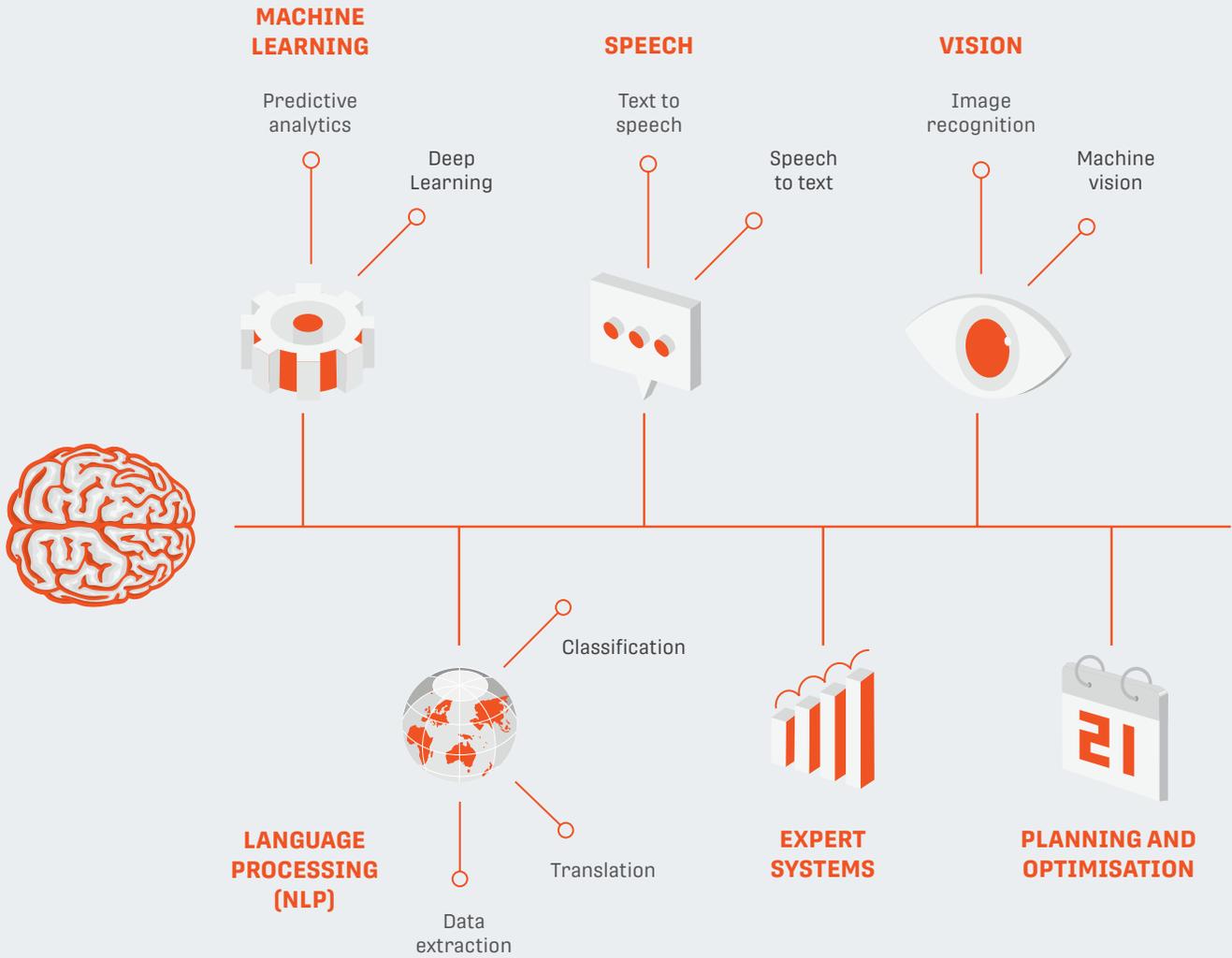


FIGURE 2

## Components of Artificial Intelligence



## He aha tēnei mea te roro hiko?

# What is artificial intelligence (AI)?

AI is not a specific technology. It's the term used for a whole collection of new computer methods and techniques that would otherwise require human thought. AI includes machine learning-based applications like natural language processing, speech recognition, computer vision, and automated reasoning (Fig 2). Much AI depends on access to large datasets, like medical and census information, and the continuous streams of data from social media and internet-enabled technologies and services in homes, workplaces, cities and governments.

Computers can be programmed to analyse and 'learn' from this data, and use it to make predictions. With big datasets, algorithms can be designed that identify patterns, trends and connections that were not obvious before.

Powerful new software applications are developing the capacity of digital devices to translate speech; recognise faces; drive cars; control robotics in manufacturing, health and agricultural settings; and run 'chat bots', the term for a computer-generated conversation, such as when a smartphone's intelligent assistant responds to a question such as 'who split the atom?'

AI requires high computing processing power, now increasingly available with modern computing infrastructure, and specially developed software or programmes. In addition, AI relies on the availability of rapidly increasing volumes of information, such as the DNA sequences of humans and other life forms. For example, each human genome comprises three billion base pairs, requiring a lot of computing power to analyse such a lot of data. However, people still have to determine what questions to 'ask' the data, and how to programme computers to get meaningful answers.

AI doesn't mean that computers will begin thinking for themselves, although philosophers, biologists and computer scientists are debating this possibility. Rather, AI helps us to process information much faster than is humanly possible, and select and weigh options.



## Ka pēwhea te pātahi o te roro hiko ki te hunga mahi?

# How will artificial intelligence affect jobs?

There is a lot of uncertainty about AI's impact on the future of work. Some estimates of worldwide revenues from the adoption of AI systems are over US\$47 billion by 2020, due to increased productivity. Currently, AI technologies tend to affect particular tasks rather than whole occupations. Almost every job consists of several interconnected tasks and the parts that benefit most from AI technologies are more likely to be assisted or replaced.

From 2000–2015, the average worker had two hours of routine or predictable tasks automated in each working week (Fig 3). It is predicted that this trend will continue and that by 2030, another two hours per week will be supported by automation with AI technologies.

There are also tasks that people do not want to do, or should not be made to do. For example, robots powered by AI can perform dirty and/or dangerous tasks such as inspecting, monitoring and fixing clogged sewer pipes, investigating unstable structures, mining and disaster response. We can also explore outer space from the comfort of Earth. However, it is also forecast that AI will free up more time to spend on quality contact with customers, and strategic planning tasks. People will still be required to oversee AI processes and ensure automated functions work appropriately.

Changing the tasks involved in a job is likely to impact on its value and desirability. Some commentators say that few, if any, existing occupations will remain untouched by AI, including high-value work in professions such as law, medicine, finance and academia. So, while AI might not take your job, it is likely to affect what you do – career flexibility, continuing professional development and training will be important.

The potential income gains from AI through higher productivity will need to be set against the costs of its implementation, including the cost of managing, trading and protecting data, and re-training workers. Also, to gain social acceptance, AI will need to be implemented in a way that avoids economic disadvantage or increased inequality – such as employment opportunities moving to either end of the skills spectrum (i.e. low skilled electric scooter recharger, or highly skilled doctor). It should bring broad socio-economic benefit to society, not just to businesses and some individuals.

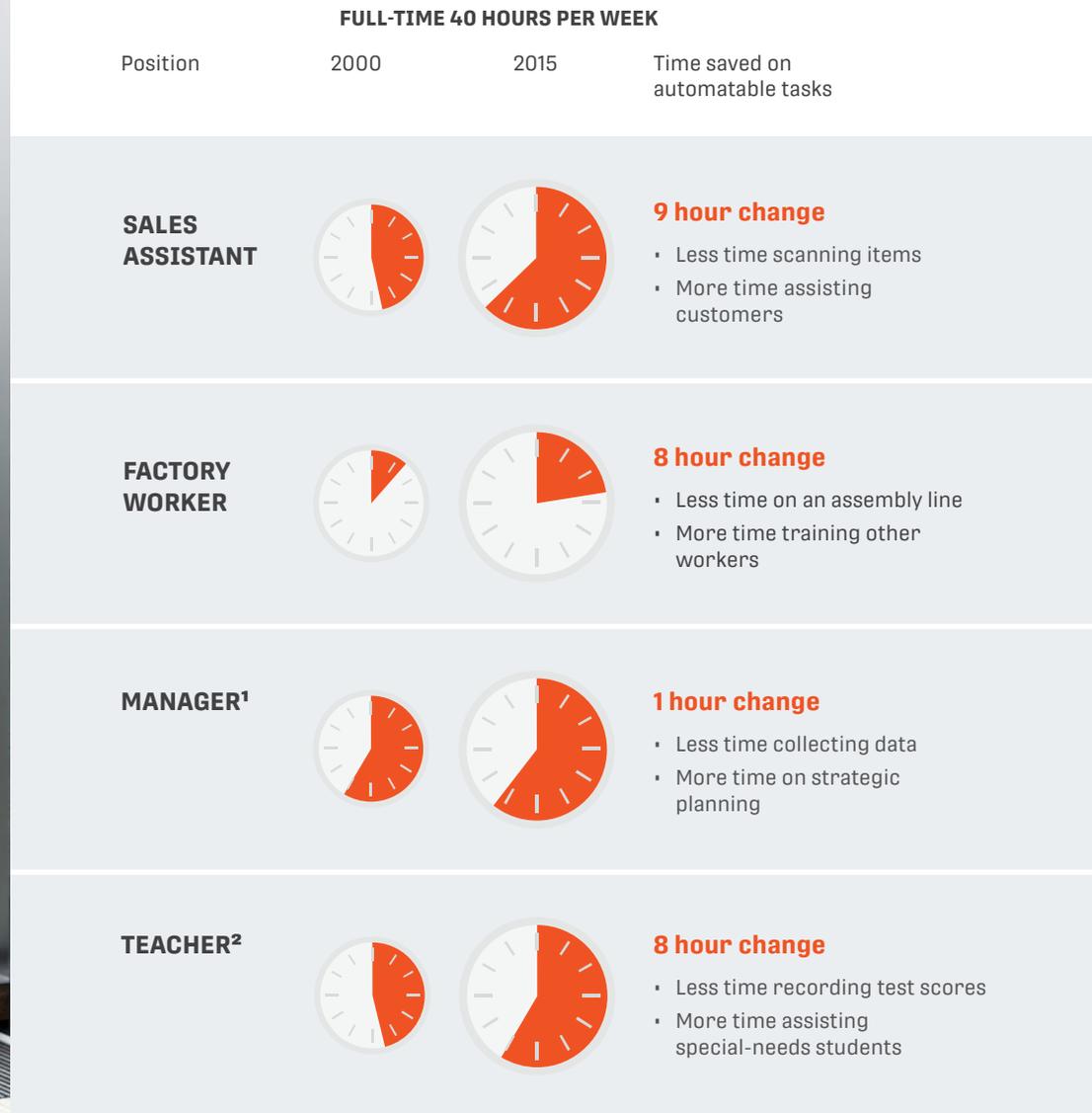


FIGURE 3

## Automation has freed up time for workers to focus on higher-value tasks.

The effect of automation on work and the workforce from 2000 to 2015 (from AlphaBeta, 2017)

Automatable  
 Non-automatable



**Notes:** Assumes a full-time worker works 40 hours per week, figures rounded to nearest hour.

Figure 3 source: ABS, O\*NET, AlphaBeta analysis. <sup>1</sup> Unweighted average of ANSZSCO 1 digit code to estimate manager timeshares (excluding farmers and CEOs). <sup>2</sup> Example based on high-school teacher

## Ngā whakaritenga o te roro hiko

# Applications of artificial intelligence

### Hauora

#### Health and care

AI can help doctors choose the right cancer drug treatment for an individual patient from the hundreds of drugs available. Potentially, AI could also diagnose illnesses, providing support and back-up for GPs and giving them more time to focus on the patient. Algorithms are already prioritising who gets elective surgery and in what order, based on clinically developed criteria. Other AI technologies are being used to rehabilitate stroke sufferers, and can interact directly with the brain to enable people to control artificial limbs and even robotic exoskeletons.

The aged care sector also looks to benefit from AI. For example, it may assist people in various ways to live safely and well in their own homes for much longer. Wearable devices could send an alert to a family member or health professional if the person shows signs of illness or has a fall. Surprisingly, researchers have shown that AI technologies can assist in preventing loneliness, which is a growing social issue. Research at the University of Auckland has shown that robot assistance is acceptable to older people.

### Ahuwhenua

#### Agriculture

AI will help solve environmental challenges, such as reducing the environmental footprint of agriculture through better management of water, fertilisers, on-farm waste, and through improvements to animal welfare. Wireless cattle collars are being developed that gather information on an animal's location and behaviour, to help farmers make better decisions about grazing management, feed supply and when to muster. Additionally, AI enabled robots can already identify weeds on a farm and apply herbicide in precisely controlled amounts.

### Tiaki taiao

#### Conservation

In conservation as well as the food production sector, AI can be hugely important for New Zealand by quickly identifying plants, vertebrates and insects that pose a biosecurity threat. In Australia, AI technology is being used to sample water on the Great Barrier Reef to analyse water temperature and chemistry related to the degradation of coral.



FIGURE 4

## How is artificial intelligence being applied already?

### HEALTH

The University of Auckland is developing machine learning algorithms to help hospitals triage GP referrals, identifying high risk patients.



### BIOSECURITY

AI is being used to digitally identify plants, vertebrates and insects suspected to pose a biosecurity threat in Australia.



### CONSERVATION

An AI sensor camera system is being developed that will record and circulate crucial data on animal tracking in nearly half of Victoria's national parks.



### EDUCATION

Jaipuna is a New Zealand-based tutoring business that has created an AI tutor for high school students, offering one-on-one interactive tuition.



### EMERGENCY RESPONSE

Australia is deploying a fleet of drones equipped with AI software at beaches that can distinguish sharks from boats and other marine life.



### AGRICULTURE

Lincoln Agritech is developing an AI solution to make early-season predictions of vineyard harvests.





## Pūngao hiko

### Energy

Using smart meters and batteries, AI can optimise energy production, consumption and storage in homes and commercial buildings, and can run energy management systems that control heating, ventilation and air-conditioning.

## Tahua

### Finance

Along with AI-assistants that answer client's questions on banking services or recommend financial products based on client needs, AI-empowered banking systems watch out for scams by monitoring all transactions and alerting customers if something seems unusual, such as an atypical payment to an overseas company.

## Ngā toi

### Arts and culture

The computer generated imagery (CGI) commonly used in blockbuster movies can rely on AI software to, for example, automate the movements of virtual soldiers so that they appear life like.

Many people will already be receiving recommendations from online entertainment companies like YouTube and Netflix, which analyse your viewing history to suggest other programmes you might enjoy watching. Also, online match-making may find you more compatible and successful matches than random encounters. How your preferences in online viewing and/or dating are determined are examples of major social and behavioural change that have been driven by one form of AI, computer algorithms.

FIGURE 4 (CONTINUED)

## How is artificial intelligence being applied already?

### ENERGY

Vector is introducing a machine learning and artificial intelligence system to manage Auckland's growing energy demands.



### FINANCE

In 2018, ANZ New Zealand launched an AI Digital Banking Assistant designed to answer 30 of the bank's most frequently asked 'help' questions.



### ARTS AND CULTURE

The computer generated imagery used in films such as The Hobbit rely on AI software to automate the individual movements of virtual soldiers so that they appear lifelike and convincing.



### JUSTICE AND LAW

AI applications are now being used by the legal profession to assist with intelligent searching of primary sources of law and precedents.



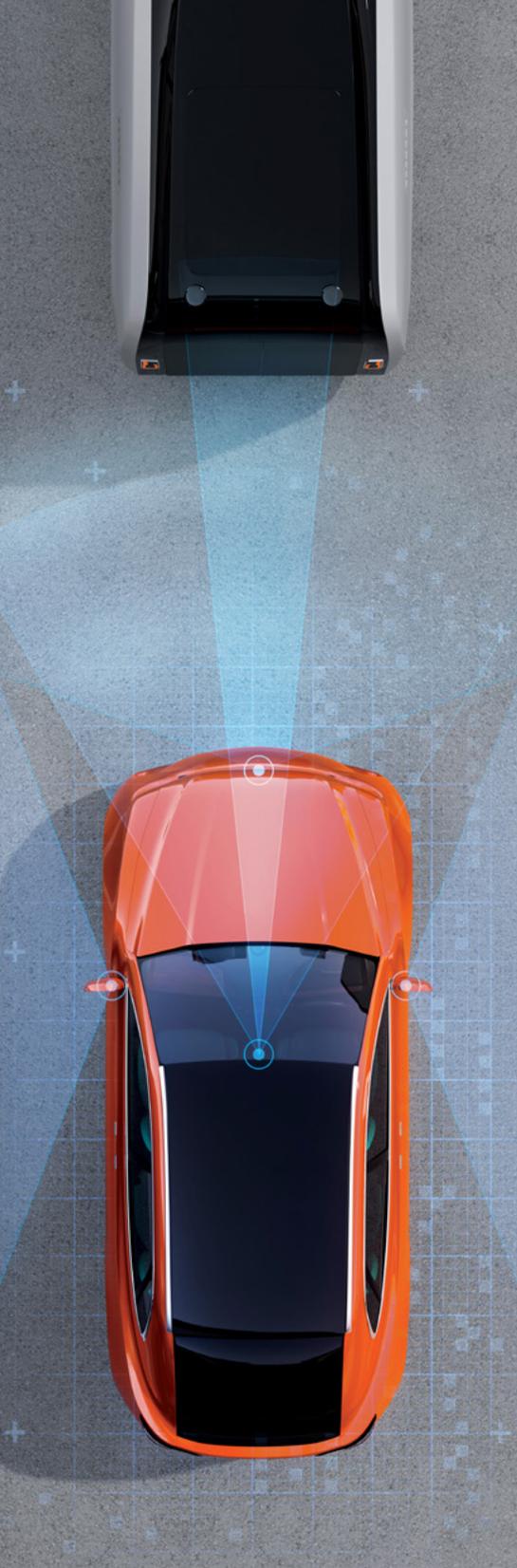
### GOVERNMENT

New Zealand is leading a network of the world's most advanced digital nations – to ensure digital rights are at the heart of policy design globally.



### TRANSPORT

New Zealand company Ohmio Automation is developing self-driving electric shuttles which use AI to navigate.





## He aha ngā momo pānga o te roro hiko ki te pāpori?

# How will artificial intelligence affect society?

The implementation of artificial intelligence carries risks for both individuals and societies. When people consider AI, many questions and concerns arise, such as:

- Who has the right to use and share our personal information, and to make money from it?
- How will we protect our privacy?
- Will we have the right to give or withhold consent for the use of our personal information?
- Will information be properly checked to make sure it's correct and not biased?
- How will we prevent our genetic information, health history and online activity being used to discriminate against us in employment and insurance?
- How is AI going to affect our jobs?

In the longer term, people have concerns about the unintended consequences of AI:

- Could we become too dependent on AI decision-making systems doing the thinking for us, or making decisions in circumstances where human judgement is required?

- Will human relationships change as a result of having AI interaction?
- Could AI get out of control?

Bearing these concerns in mind will be important as we prepare for the advances in AI, as will ensuring people are kept aware of risks.

### Risks to data security and privacy

The availability of large datasets is fundamental to AI. 'Smart' or internet-enabled technologies and services are already extracting and sharing large volumes of data from individuals, organisations and governments. This prompts questions about the legal, ethical and economic implications of data collection that people are often unaware of. For example, AI systems capable of deriving personal information from multiple sources can present technical and legal challenges related to privacy, anonymity and tracing the origin of information. Another consideration is the right of indigenous peoples to have control over their data, such as information about their DNA.





## Risks of bias

We need to be wary that algorithmic decision-making tools could contain bias or be discriminatory. Systems are only as good as the data they are built on, and biases in the data can produce spurious but plausible predictions, which may not, in fact, reflect the real world.

## Risks to democracy and national security

There is already public disquiet over the integrity of voting systems, manipulation of the news, distortion of financial markets, and how information gathered from social media channels is used. AI is also being increasingly integrated into military and security systems, raising ethical questions as to the decision-making of AI-controlled weapons. Trust issues are emerging, which are significantly affecting national and international politics.

## Environmental risks

AI relies on computing hardware that uses materials that are rare and finite, and their general disposal presents a waste management challenge. Assessment of the full life cycle of AI technologies – from the mining of materials, to the production of AI digital infrastructure, and the eventual disposal of it – will help minimise negative environmental and social consequences.

Another consideration is the amount of energy needed to power AI. The contribution of computers and smart phones to global greenhouse emissions is currently on a par with air travel (about 8% each), although AI should help to reduce global emissions by improving energy efficiency.

## How do we manage these risks?

In order for society to reap the full benefits from AI we need to build robust systems for the capture and use of data that people can trust. People need reassurance that:

- the data they agree to share will be handled appropriately
- decisions based on that data will be robust and not discriminate against them or other sectors of society
- sharing their data will contribute to their wellbeing or the wellbeing of society overall, not just profit a small number of companies.

People should be vigilant and only share their data when these conditions have been met. Regulation will be essential to provide assurance around this.

Across the world AI is now being used to make data-based decisions in a variety of fields – healthcare, loan applications, even sentencing decisions. These decisions need to be transparent, explainable and reviewable. Specific individual circumstances may be ignored in AI-run processes that are based on a statistically-averaged human experience. This is something that will need to be managed to ensure AI provides fair outcomes for people.

If responsibly developed within a regulatory framework, and with proper oversight, AI has the potential to enhance wellbeing and provide a range of benefits to society and the environment. For example, by minimising discrimination, identifying systemic bias, and improving access to education, information, finance, and welfare services.



## What will be the impact of AI?

It appears that AI could be as transformative for the world as the first industrial revolution. There are many commentators making predictions or issuing warnings about possible consequences, but we don't yet know how important some of these benefits or detriments will be. However, we can confidently say that the implementation of AI is moving at a far greater pace, and is immediately global, in a way that the first industrial revolution was not.

As with most new technologies, the potential achievements and cost benefits make AI unstoppable. However, the speed of its adoption means that regulations to control and monitor it will need to keep pace. Even with regulation in place, there are bound to be unforeseen consequences that we will have to respond to, such as impacts on jobs and incomes. It is likely that the changes AI brings will also shift the prosperity and competitiveness of nations. While recognising there is apprehension about the power of AI to do harm in the wrong hands, or if used incorrectly, its potential to help to feed and take care of humans, plants and animals, and halt and reverse climate change and environmental damage, will be welcomed.

We all need to have some awareness and understanding of AI to ensure it is managed wisely and we are able to maximise the benefits of this technology for all.

If you would like to learn more about AI, go to [royalsociety.org.nz/AI](https://royalsociety.org.nz/AI).





## Royal Society Te Apārangi

11 Turnbull Street, Thorndon, Wellington 6011  
PO Box 598, Wellington 6140, New Zealand

**Phone** +64 4 472 7421

**Email** [info@royalsociety.org.nz](mailto:info@royalsociety.org.nz)

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