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GONE FOR GOOD AI AND THE FUTURE OF WORK

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GONE FOR GOOD: AI AND THE FUTURE OF WORK

DR PAUL HENDERSON

Table of Contents

INTRODUCTION: LIVING WITH AI	1
EXPOSURE TO AI	5
Three considerations:	5
What timeframe?	5
Which industries?	5
Which occupations?	5
A further consideration	6
Assist or replace employees by tasks.....	6
Looking at timeframes more closely: now, the next five years, the next decade	7
Employment in New Zealand	11
Summary	11
INDUSTRIES AND OCCUPATIONS AT RISK—INTERNATIONAL FINDINGS	12
The current situation	12
The picture in five years.....	12
The ten-year picture—trends	14
AI'S IMPACT ON SOCIAL STATUS AND PAY	15
Summary	15
IMPACT ON NEW ZEALAND EMPLOYMENT	17
Men and women.....	17
Age	18
Ethnicity.....	19
European and Asian.....	20
Māori.....	21
Pacific Peoples	22
Summary	22
RESISTANCE TO AI	23
EFFECTS RELATING TO ADOPTION OF AI ON THE LABOUR MARKET	25
RECOMMENDATIONS	28
The value of work	29
CONCLUSION	30
BIBLIOGRAPHY	31
ENDNOTES	34

About the Author

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The paper in summary...

This report (the fourth in our series on artificial intelligence) outlines research on the impact of AI—encompassing machine learning and robotic intelligence—on employment, largely within a five-year timeframe. It draws on data from the USA, Europe, Australia, and other nations.

The degree of job creation or loss caused by AI's entrance into the workplace is contested. Some authors anticipate high unemployment within five years, while others are less convinced, viewing AI as an assistant to human labour rather than a replacement, with potential to increase national productivity. Literature also raises the possibility of job creation rather than loss. Caution with prediction relates to the capability, utility, and cost of the technology, as well as its ease of use and human sentiment.

Despite this, we can make provisional projections. Accurate longitudinal research has broken down the work people do into tasks (20,000 plus) across all occupations and industries. These tasks are matched against AI's current and emerging performance capabilities. The findings enable analysts to cautiously chart the impact of AI's adoption on the workplace.

The picture is very bleak, with potentially 40-60% of secretarial, administrative, and customer service roles exposed to and replaced by AI *today*. Many other occupations will experience similar threat levels over the next five to ten years. High-earning professionals are not exempt from risk. Introducing AI into our workplace will also change the social status of employees, flattening it for some while increasing it for others.

Just because AI *can* perform human tasks does not mean it will. Important variables will either accentuate or moderate its impact on our workforce. These include the area of work, gender, age, ethnicity, and specifically, whether employers regard AI as a replacement or assistant technology. Women in a number of industries and occupations are more vulnerable to displacement than men. Some ethnicities, too, tend to cluster in certain fields of work, such as manufacturing or finance, which are at higher risk of retrenchment.

This report anticipates a future with higher-than-current levels of unemployment. It expects new jobs to be created in relation to machine learning and artificial intelligence, but not as many as are displaced. It raises questions about the value, importance, and need for work. It recommends planning and preparation for a future where, even though jobs might be fewer and competition for employment fiercer, as a people and a nation we will continue to prosper.

INTRODUCTION: LIVING WITH AI

For at least two centuries, people have worried about the effects of machines and automation on employment. We have boycotted businesses and rioted over technological advances—such as spinning jennies in the workplace. These anxieties have intensified due to developments in robotic intelligence¹ coupled with machine intelligence and learning (AI).^{*} Intelligent robots are increasingly common in manufacturing and warehouse operations, and computer-driven machine intelligence is now widely used in offices, finance, trade, cybersecurity, medical research, logistics, gaming, travel, etc. Moreover, there is evidence that “while automation’s displacement effects [job losses in the USA] have *accelerated and intensified*, its productivity and reinstatement effects have been slower to materialize and smaller than expected. The *social and economic dislocations have grown*, while the offsetting benefits have not been as robust or rapid as anticipated and have not been broadly shared.”² More locally, the chief executive of the Australian Industry Group, Innes Willox, warns that 30% of the nation’s workforce will be adversely affected by AI within five years.³

Briefly stated, machine intelligence, which functions like the human mind by analysing and solving problems, is encroaching daily on activities, industries, and occupations previously enjoyed by people alone. Already, “the uses of AI include: coordinating machines and industrial processes (in manufacturing); managing all aspects of the workforce (HR, management, WHS); gathering, processing and evaluating information about business activities (accounting, forecasting, investing); predicting and evaluating outcomes for customers (expert advice in legal, medical, and psychological

matters); evaluating risks and benefits for customers and for internal purposes (insurance and finance); communicating with clients (customer service and counselling); anticipating, creating, and managing customer needs and market demand (marketing and advertising); stocking and distributing material goods (logistics), including by transporting them (self-driving trucks and cars); and supporting and potentially undertaking theoretical and applied research.”⁴

A distinctly human point of difference is being eroded: our analytic, summative, planning, and predictive abilities are being outperformed by machines. From attending to legal documentation to planning a detailed itinerary for a holiday, machine intelligence now does many things better and quicker than us. While debating the pace, analysts, researchers, and statisticians alike suggest we are on the cusp of a wave of AI adoption, and it will sweep away jobs we have taken for granted—jobs on which we have staked our lives.

The emerging reality of substantial job disruption in the job market is why academic writing and popular literature are focusing on AI technology and its relation to labour.⁵ The *Economist*, for instance, reports weekly on machine intelligence, its uses, and impact.⁶ Every news feed has a similar emphasis.

Indeed, new developments in robotic and machine intelligence are preoccupying governments, journalists, industry, and the academy alike.⁷ Why? Because they *increase productivity and reduce the cost of overheads*,⁸ especially payroll expenses. This carries implications for business models, C-suite decision-making, outsourcing, and offshore manufacturing,⁹ reshoring,¹⁰ trade, human resource practices,¹¹ and the scope and elasticity of domestic and international employment.¹² The power of AI allows it to function not just as a new industrial tool within pre-existing work processes—“it also becomes the centrepiece of a new business model that radically alters modes of working, as well as the conditions of employment and the interactions of workers with management and customers.”¹³

New developments in robotic and machine intelligence also affect how we think about the fundamental issues of compulsory and tertiary education, apprenticeship, and research practice—especially with an eye to preparing the next generation of New Zealanders for *a smaller workforce* and for *working with AI*. If the job market does

* **Key terms:** AI is a general term for machine learning and intelligence, and robotic intelligence. *Machine intelligence* is a capability that imitates intelligent human behaviour. *Machine learning* is a subset and advance of machine intelligence that uses algorithms trained on data sets to create models for performing tasks with images, languages (including computer code), and sets of data (e.g., statistical analyses of health, education, housing or analysis of financial figures). Machine learning specialises in statistical extrapolation, prediction, and, in consequence, prompting action. It works by probability, weighing best and likely outcomes based on the data it gathers, and in relation to previous “experience”. *Robotic intelligence* moves beyond the automated movement of machines (e.g., conveyor belt processing) to “intelligent” interaction with an operating environment. Machine intelligence and learning is deployed in robotics (robotic intelligence), for example, warehouse robots that scurry about processing orders or agricultural robotic pickers that assess the quality or ripeness of a fruit, and its readiness for harvesting. It is also deployed in servers, edge accelerators, desktops, and laptops (ChatGPT, Microsoft’s Copilot, recommender engines, etc.). Note, we use speech marks with the terms “intelligent” and “experience” above because we do not think AI has either. We use the terms as figures of speech.

tighten (and it is forecast to do so), then careful planning to ensure New Zealand's economy can survive and remain competitive will be essential. Getting its education and apprenticeship schemes right will be central to this.¹⁴ Accordingly, Laura Tyson and John Zysman maintain that "for many occupations, the future of work is likely to involve growing interdependence between human skills and AI skills: for example, between the interpersonal skills of doctors and teachers with the complementary AI skills of data analysis, diagnostics, and prediction. In turn, such complementary or partnership occupations will likely require high-level education and/or technical training for the human partners."¹⁵ And Jaures Badet: "Jobs displaced by automation require less skill than new jobs generated by the latter. The new jobs require high skills, which will depend on the quality of the educational system of each country. Much of the employment in the future created by automation will require high education levels."¹⁶

But why *another* report on AI and the future of work?*

Since 2016, policymakers, industry, and universities have discussed the subject on and off. What makes it so urgent?

The answer is twofold. Firstly, *AI technology and its eye-opening capabilities have advanced much, much faster than anticipated.*¹⁷ Dates first set for AI matching or surpassing human capability for the end of the twenty-first century have been revised down to mid-century, then to the 2030s, and now in certain areas to within two years—an astonishing, perhaps unparalleled compression of expectation. The hubbub around CEO Sam Altman's departure and then return to OpenAI, which produces ChatGPT, was over the Board's discovery that the company was "secretly" developing the building blocks for an Artificial General Intelligence (AGI)—the most advanced and potentially dangerous iteration of AI.¹⁸ Today. Not twenty years in the future.

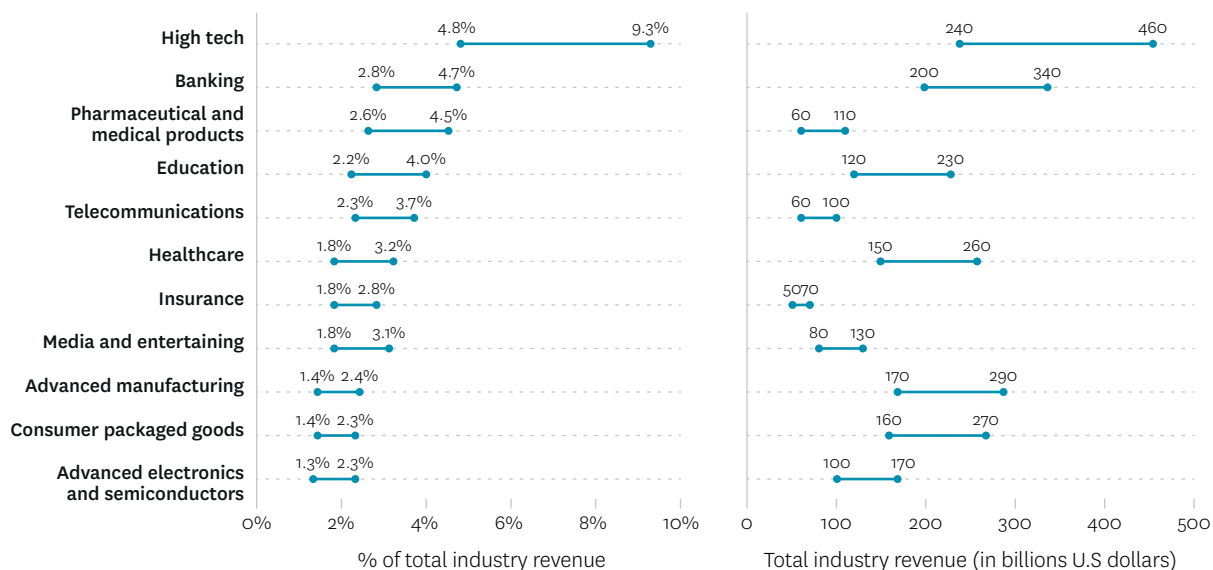
Readers might also have heard about NVIDIA's latest Blackwell chip. It carries an unimaginable 208 billion

transistors; its CEO, Jensen Huang, anticipates that it will be one of many microprocessors driving the uptake of AI in every sector of society.¹⁹ An AI uptake flush with machine learning—the game-changing technology which *learns* from its environment and adapts its operations accordingly. An AI uptake that is also thick with generative AI that works in multiple genres from technical writing to media releases, and love poetry, that composes music, makes static images, draws architectural plans, generates engineering blueprints, and creates movies. Activities that will disrupt human employment.²⁰ The impact of AI is not reserved for tomorrow; it is here now.²¹ Hence the need for action in relation to the future of work.

A second reason for urgent action is as follows. The argument trotted out to soothe anxieties²²—that history tells us we have been here before and that new jobs will be created—has limited force. It is in error: we have not been here before. Nor anywhere like it. And while new jobs may be created,²³ it is unlikely they will compensate immediately for those lost. Thus, Tyson and Zysman: "We are sceptical that AI and ongoing automation will support the creation of enough good jobs."²⁴ In brief, *humans have developed a technology that is unlike anything produced previously*: never before have we made something that mimics or betters aspects of our analytical, summative, and predictive capabilities.²⁵ We have built a potential *replacement technology*, which already and in certain circumstances (increasing in number) not only performs better physically but also mentally than we do. Stanford University's 2024 Artificial Intelligence Index Report states: "As of 2023, AI has achieved levels of performance that surpass human capabilities across a range of tasks."²⁶ Hence its potential to disrupt traditional patterns of employment. Why pay workers who are prone to error, take "sick days," work limited hours, strike for higher wages, and can disrupt a workplace culture when robots and machine intelligences can do their work faster, ceaselessly, with no hassle, and at less cost?²⁷ The following figure, taken from McKinsey & Company's research, predicts the economic impact of AI on industries. It features "the projected impact range per industry, both as a percentage of total industry revenue and in total dollar amounts. The high-tech industry could see its revenue increase by 4.8% to 9.3%, corresponding to an additional \$240 billion to \$460 billion, as a result of generative AI. Banking, pharmaceuticals and medical products, and education are other industries estimated to grow due to the adoption of generative AI."²⁸

* **Key term:** We use the term *work* in its common usage (What do you do for work—for paid employment?). We acknowledge that much work, for example, at home, or with children, or among volunteers is unpaid. We also acknowledge the wider use of the more precise term *labour* which carries the nuance of a contractual agreement between an employer and employee (work for pay). But for this report, we will simply use the term *work*, *workforce*, and *workplace* as they relate to employed, paid labour.

Figure 1. Revenue growth



Source: McKinsey & Company, 2023 | Chart: 2024 AI Index Report

Important to note is that revenue increases will only add pressure in favour of AI adoption, bringing questions about human labour to the fore. Richard Baldwin (2019) reports that between one and six of every ten jobs are at risk of being replaced by robots in the coming two decades. Estimates vary, but findings range from 36% for Finland (Pajarinen and Rouvinen, 2014), 47% for Germany (Brzeski and Burk, 2015), and 47% for the United States (Frey and Osborne, 2017), to as high as 60% globally (Bughin et al., 2017).²⁹ Moreover, the International Monetary Fund warns that AI “is set to affect nearly 40% of all jobs...around 60% in advanced countries.”³⁰

The seriousness of the advent of machine intelligence and learning, and its pending impact on society cannot be overstated. Take the subject at hand: employment. The matter is not just about the transaction of work for pay. A raft of more basic concerns is directly connected to it. Behind the issue of employment lies *financial security* and meeting a hierarchy of primary needs (food, shelter, etc.).³¹ Then there is the *sense of self and place* (status) in a network of social relations and dependencies. We understand ourselves and garner self-esteem partly by our place in the workforce. Perhaps more fundamentally, employment also raises *questions of value and purpose*. It pushes against questions of meaninglessness and nihilism. In sum, employment is fundamental to our psychological, material, and relational needs. It is central to society’s operations and stability. Widespread

disruption of labour leading to changes in, or loss of, employment, is a serious problem for society and, consequently, the government.

The key point is that new developments in machine intelligence and learning will likely disrupt our workplace ecology. For the last forty years, blue-collar workers have had to contend with robotic automation.³² Now, white-collar jobs are on the line.³³ The whole workforce—male, female, young, old, each ethnicity—is exposed to AI,* with the IMF noting that it will “lower demand for labour, affecting wages and even eradicating jobs.”³⁴ The particularity and possible degree of exposure are the subject of this report.

In sum, the accomplishments of artificial intelligence are causing organisational leaders to rethink workplace productivity, output potential, and the workforce itself.³⁵ In consequence, New Zealand is facing the prospect of permanent, higher-than-previous levels of unemployment because AI will compete cheaply and reliably with our skills.³⁶ Historically, high unemployment has generated social instability and increased crime,

* **Key terms:** *Blue-collar* workers are manual labourers engaged in physical work. Jobs are in maintenance, manufacturing, mining, and construction, etc. *White-collar* workers use specialized knowledge and expertise. They include professors, doctors, lawyers, and architects. They also work in managerial and administrative roles, managing teams, overseeing projects, and handling administrative functions.

tension between nations, and an accompanying angst³⁷—something we want to avoid. Emergent, powerfully capable AI is not the stuff of fiction or movies. It is a reality that is beginning to bite. Chess legend Garry Kasparov bluntly argues, “Romanticizing the loss of jobs to technology is little better than complaining that antibiotics put too many gravediggers out of work.”³⁸ Nevertheless, both society and government should plan and prepare for substantial workplace changes.

EXPOSURE TO AI

Three considerations:

When preparing for AI's possible impact on employment, the most important question is: What is the expected timeframe for change? Answering this question requires asking two further questions relating to (1) industry³⁹ and (2) occupation, although these intermingle, with the same occupations running across industries (e.g., secretarial work or accounting).

What timeframe?

The following questions will focus employers' and policymakers' minds on the timeframe question and should be central to the formation of strategy on AI and the future of work:

- Will job disruption happen quickly within the next couple of years? Or
- Will job disruption be a staged process—or a slow burn? Or
- Will AI's impact on employment be more of an exponential rise over the next decade? And,
- Do we have one, three, five, or ten years to plan and prepare for AI's impact on employment?

The answers to these questions depend on multiple factors, but by and large, they are balanced by the cost of change and the pressure to compete. Business owners, for example, might wish for slow change in order to protect a valued workforce or be wary of purchasing new technology with its uncharted return on investment. Still, if AI use equates to an increase in productivity and profit (by decreasing operating costs and meeting a demand for cheap, high-quality products), there is a strong incentive for its adoption at the expense of employees.⁴⁰

The cost of change and the pressure to compete aside, two other factors affect timeframes for adoption: questions of (1) industry and (2) occupation.

Which industries?

The impact of AI on employment is being carefully recorded in the USA, Britain, and Europe.⁴¹ It has been a focus of interest for over a decade, and research sample sizes are now massive, running to tens of millions.⁴²

As usual with the academy, there is heated debate on methodology and the value of research findings,⁴³ particularly around the creation of new jobs.* Yet a common theme has emerged: some *industries* will be affected by AI more immediately than others. The nature of their work provides low-hanging fruit for owners and executives looking to quickly enhance production and reduce expenditure, especially on wages.⁴⁴ In blue-collar industries, such as car manufacturing,⁴⁵ we have seen the rise of AI automation over several decades; now, white-collar industries are vulnerable. Industries such as law and banking are being affected, too.⁴⁶ For instance, in the context of legal work, JPMorgan Chase (New York) is using an AI programme called COIN that interprets commercial loan agreements. It saves an estimated 360,000 work hours per year.⁴⁷ McKinsey & Company records "that in 2023, 55% of organizations surveyed [1684] have implemented AI in at least one business unit or function, especially in call-centre automation, for customer acquisition, the creation of new products, and customer-service analytics."⁴⁸ The point being that different industries, depending on the nature of their work and the depth of their pockets, are adopting and being transformed by machine intelligence and learning—some more quickly than others.⁴⁹

Which occupations?

Industry-type apart, a second factor in possible timeframes for AI adoption in the workplace is *occupation*. Extensive, international, longitudinal, granular research has tabulated which occupations are exposed to AI and at what speed that exposure is increasing.⁵⁰ With AI taking on correspondence, calendars, documentation work (analysis, comparison, and summary), filing, and data management, back-office employees face possible evisceration across all industries. Accordingly, C. Jung and B. S. Desikan note, "Organisations will target 'low hanging fruit' use cases. These are the cases where generative AI programmes are relatively easily plugged into existing processes, without many changes to workflows. About 11% of [all working] tasks will be heavily impacted by this. Back-office jobs (such as personal assistants), entry-level jobs, and part time jobs will be

* There are additional difficulties commenting on AI technology and predicting its impact because of its rate of change. Digital and particularly AI development runs much faster than government policy, and much quicker than the academic process of peer-review and journal publishing. Many methodologically sound pieces of work in the field are dated, even inaccurate, on publication. The AI landscape has shifted notably during the writing of this research paper.

most exposed in the first place. And we find that *women* will be significantly more affected (as they are more likely to work in the most exposed occupations, such as secretarial and administrative occupations).⁵¹

Such an observation highlights a further issue: gender. Women in some occupations are more at risk of losing their jobs to AI than men. Thus, Ruiqui Sun and Daniel Treffer note AI's impact may be similar to the effects of "the mechanisation of textile work in the late 18th century, which brought huge labour market disruption: reversing women's employment participation. Indeed, the female employment share did not return to its late 18th century peak until the 1980s—150 years later." As we shall see shortly, statistical evidence indicates that there is a need to recognise not only gender but also age (people in their 20s, 30s, 40s, etc.) and ethnicity as compounding factors on the impact of AI upon employment. Fifty-year-old men, counterintuitively given their experience, might see more job displacement than twenty-year-olds in specific occupations. The same may be true for Māori or Pacific Peoples over and against Asians and Pākehā (see *Figures 19-21*).

A further consideration

Before describing timeframes for adoption and disruption and trends emerging from overseas with reference to industries and occupations affected by AI, one further question needs to be addressed. It concerns the relation between assistance and replacement: i.e., will policymakers and/or employers limit the incursion of AI into the workplace, allowing it to assist employees, but not replace them? Their determinations will impact the timeframes for change and the degree of employment disruption.

Assist or replace employees by tasks

Analyses of the impact of AI on employment are commonly predicated on the do-ability of a task.⁵² How complex is it, and how easily is it accomplished? Such analysis is not new; it is longstanding and highly developed in every industry and occupation. It forms the basis for employment (placing the right person in the right role at the right level), the nature of that employment (what a person does), performance reviews, remuneration, and social status. Complex work, such as surgery or piloting an aircraft is highly rewarded financially and socially. Less complex work has less compensation and standing.

Non-complex white-collar and office tasks are easily automated by robotic and machine intelligence. Hence, occupations that do not require high degrees of intellectual acumen or physical ability are soft targets for AI. The industries and occupations that will be most rapidly affected by AI are those characterised by repetition and low levels of complexity.⁵³ Jaures Badet writes: "Studies point out that automation mainly affects jobs where workers have low skill levels. According to a European survey about skills and employment 'around 14% of jobs in the EU are [currently] at risk of displacement by computer algorithms. The jobs most likely to be affected are those which depend more on routine tasks, and which require few transversals and interpersonal skills.'"⁵⁴

The kicker is that AI is beginning to do better than humans in executing not only simple tasks but also multiple and highly complex tasks, such as the summarisation and synthesis of themes from thousands of documents.⁵⁵ Carl Frey and Michael Osborne argue that "artificial intelligence will directly replace 13% of jobs [in the USA], including those that are more brain-intensive and more financially rewarding, such as finance, accounting and senior management."⁵⁶ So, questions of assistance and replacement will become progressively important in employment as white-collar jobs become increasingly vulnerable to machine intelligences.⁵⁷ With reference to management, Jean-Philippe Deranty and Thomas Corbin observe that

Algorithmic management [machine intelligence and learning] is covering the tasks traditionally performed by human managers: the hiring of employees (from CV selection to automation of the hiring process), optimisation of the labour process (through the tracking of worker movements, for instance GPS tracking or route maximisation in transport and logistics), evaluation of workers (through rating systems), automated scheduling of shifts, coordinating customer demand with service providers, monitoring of workers behaviour, algorithmic incentivisation (through algorithm-based "nudges" and penalties) (Duggan et al. 2020 for a thorough review). Algorithms are widely used, by companies such as Airbnb (Cheng and Foley 2019), Uber (Möhlmann and Henfridsson 2019; Muller 2019; Amorim and Moda 2020), and Amazon (Park et al. 2021; Chesta 2021) in precisely these ways, to manage, direct, recruit, evaluate, and even terminate workers. Business scholars highlight the technology's ability to improve workflows, for instance for optimal job allocation (Jarrahi et al. 2021), to cut costs, say

in hiring, and to improve predictive power in all dimensions of the business activity. From this point of view, AI-based algorithmic management offers organisations the chance to delegate decision making power to more efficient and effective managers (Von Krogh 2018; Araujo et al. 2020).⁵⁸

Business owners and executives of public-private partnerships, etc., as well as policymakers and government ministers will all need to make difficult decisions on labour—and this difficulty will be compounded by competitive and geopolitical pressures, where the health of fewer employees and companies might be better than the survival of none. But how they answer the question of assistance or replacement will affect the timeframes of AI disruption on the job market.

The figure below gives examples of the degrees of exposure various occupations carry with respect to assistance or replacement by machine and robotic intelligence.⁵⁹ Interestingly, employment, which is characterised by tasks that are less predictable and therefore less easily learned by an AI, and/or that are more personal and physical, has lower exposure to assistance or replacement.⁶⁰ We provide a more detailed table linking salary and social status to employment later in the paper (page 16).

Jung and Desikan write: “Our central take on these debates is that, with the advent of generative AI, the game has changed. Rather than having to reason about possible future technical capabilities, a technology now exists that has been proven to produce high-quality outputs that are often indistinguishable from human ones, in a fraction of the time that a human would take across a wide range of applications. It can hardly be

overstated just what an astonishing achievement this is. Until recently, it was thought to be feasible only in the distant future. Given many knowledge work processes are already digitalised, it does not require huge process changes or capital investments to introduce AI to these.”⁶¹ The question of the degree of employee exposure remains unanswered, but replacement technologies are here, available, and evolving.⁶²

Looking at timeframes more closely: now, the next five years, the next decade

While the rate of AI development has surprised pundits, several tech experts have repeatedly warned that generative AI will become extraordinarily capable in a short period of time. Indeed, it “continues to advance at an amazing pace, complementing and substituting for various types of workers.”⁶³ The development and sizable commercial uptake of large language models and image and video generators confirm their warnings: “The speed of adoption is going to be faster than during past technological waves. ChatGPT reached 100 million users worldwide within two months of its release (Reuters, 2023). Steam engines took about 120 years to be adopted. Electricity took about 60 years to spread (Frey 2019). Generative AI, similar to ChatGPT, may transform the realm of knowledge work within a matter of years—as many knowledge economy jobs are already digitised and the extra investment needed to use generative AI for them is relatively small.”⁶⁴ Generative AI is already being widely deployed in the legal industry, journalism, content creation, finance, and, increasingly, health care.⁶⁵ Moreover, An Edelman report commissioned by Samsung found that about 73% of around 2,000 Zoomers with side

Figure 2. Degrees of exposure to AI.

High Exposure	Medium Exposure	Low Exposure
Accountants	Doctors	Carpenters
Actuaries	Executive roles	Childcare workers
Back-office workers	Fundraisers	Electricians
Corporate managers	Interior designers	Firefighters
Financial analysts	Lawyers	Hairdressing & barbers
Technical writers	Sales managers	Massage & beauty therapists
Transport operatives	Teachers & academics	Nurses
Web designers & developers	Veterinarians	Plumbers & pipelayers

jobs surveyed across five countries were using AI during those extra-occupational pursuits. The top three types of tasks included summarising long documents or meeting notes, conducting research, and developing new written and visual content. A separate Morgan Stanley report last year predicted that side hustles—or “multi-earning”—could balloon into a \$1.4 trillion market by 2030, with generative AI being responsible for \$300 billion of that figure, per the report’s most bullish scenario.⁶⁶ The *Economist Intelligence Unit* (July 2024) records the rapid incorporation of AI by industries across G12 countries, noting it is “enhancing innovation, operational efficiency, and customer service,” especially in financial, automotive (car), energy, consumer goods, and healthcare sectors.⁶⁷ Capgemini Consulting finds more than half of Europe’s manufacturers (51%) are implementing AI solutions, with Japan (30%) and the US (28%) following in second and third.⁶⁸ Its findings support Coatue’s observation that technology adoption in the US has been twice as fast with each platform shift:⁶⁹

The concern, however, re-estimating the impact of AI on employment is not only the speed of adoption but also how quickly the technology is improving:⁷⁰

Figure 3. Halving of penetration time with new technology waves

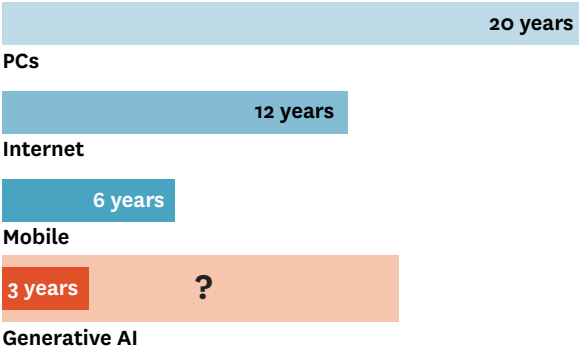
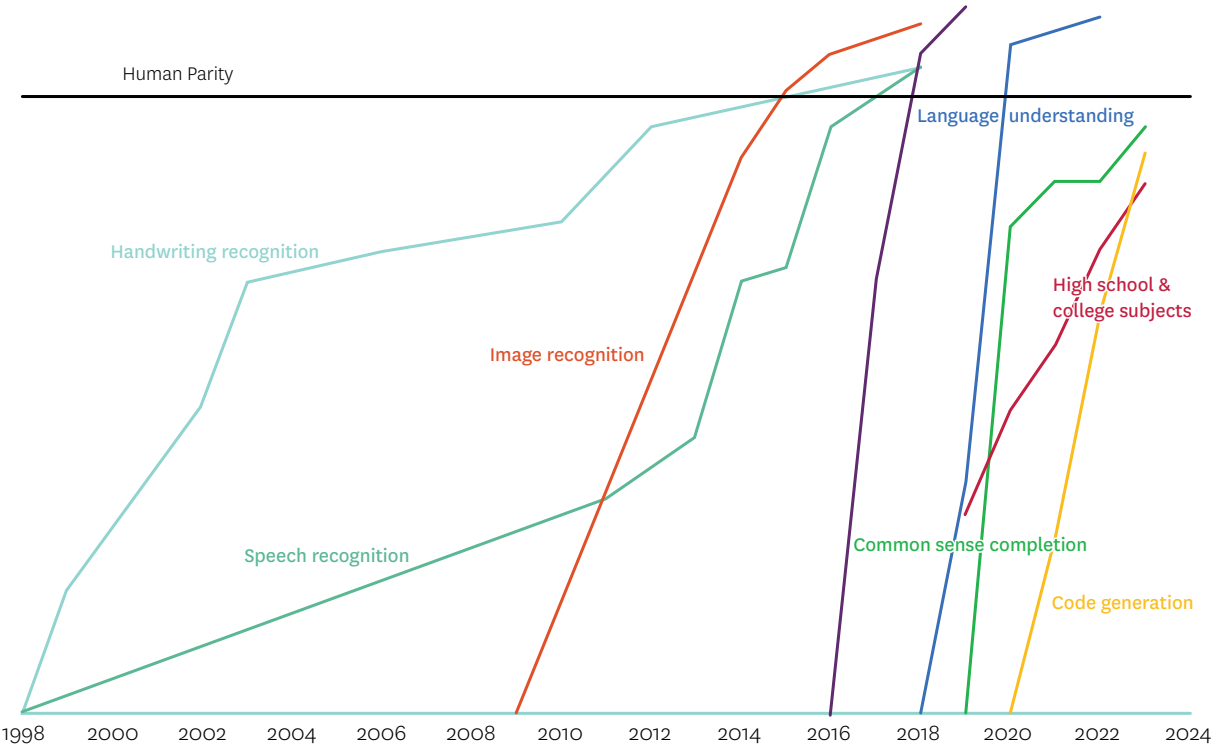


Figure 4. Speed of improvement



The point is that while electricity grids might not yet support the demands of the GPU processing farms that spawn AI products and service customers, the technology is now advanced enough to create machine intelligences that can do much of our work.⁷¹ In terms of business models, companies are building on the tradition of infrastructure-as-a-service, platform-as-a-service, and software-as-a-service. Their new platform is intelligence-as-a-service.⁷² Even so, Microsoft has integrated OpenAI's generative products into its offerings, and AI- or intelligence-as-a-service will lower user costs.

Yet certain factors will probably slow AI incorporation into the workplace. For example, loyalty to staff and caution (which looks for a track record with technology, business value, and tangible benefits from its use). For these reasons, and others discussed later in this report, and notwithstanding the speed with which the technology is improving, analysts believe the wisest way to describe the impact of AI on the workforce is in three parcels of time: (1) the immediate/now; (2) within five years; and (3) within ten years.⁷³

Within these three segments, research highlights the industries, occupations, and skills sets⁷⁴ that will be increasingly penetrated by AI. As previously noted, the more complex the work, the greater the period of time before encroachment. Evidence suggests, however, that AI is unlikely to soon replace work that is highly relational or tactile or that is not data-rich and repeatable.

The following table outlines the type and complexity of tasks (from 22,000) performed across industries in the UK and their susceptibility to replacement by AI now and within five years.⁷⁵

If the numbers above prove correct, then the degree of exposure for strategic, organisational, and non-repetitive analytic tasks will increase dramatically for employees over the next five years, potentially putting their livelihoods at risk. Even if AI were to create new opportunities, it is seen as unlikely that numbers would match the need.⁷⁶

Looking more closely at the replacement exposure, this time from the USA, the following charts (page 10) break down the gender, ethnicity, and levels of education of employees exposed to AI replacement in the immediate term.⁷⁷

Esther Faia et al. observe that “most of the top ten in-demand roles today require post-secondary training and not always a full university degree. In the digital age, employment will not always require a college degree, but will rely heavily on continual skills development as even the most traditional roles are augmented with new technology.”⁷⁸ The rapidly changing environment means “there is no more one-and-done college degree or occupational credential that will necessarily cover a worker for life.”⁷⁹ Ironically, in terms of education, those perhaps most at risk of redundancy hold postgraduate degrees. Machine intelligence is projected to whittle down white-collar employment prospects and tighten the job market in their fields.⁸⁰ Moreover, research indicates that machine and robotic intelligence have reduced the perceived meaningfulness of jobs across the board, irrespective of age, gender, skills and the type of work. In theory, AI frees up time for more important and interesting tasks; in practice, it seems to have the opposite effect.⁸¹

Figure 5: Tasks as % of hours worked per day, and degree of replacement exposure (1) now and (2) within five years

	Simple Repetitive Analytical Tasks	Strategic and Organisational Tasks	Non-repetitive Analytical Tasks	Communication Tasks	Manual Operational and Technical Tasks
Tasks as % of hours worked per day	7%	21%	20%	33%	19%
Replacement Exposure Now	19%	13%	8%	5%	0%
Replacement Exposure within five years	70%	78%	72%	40%	10%

Figure 6: Employees at risk of replacement by AI now

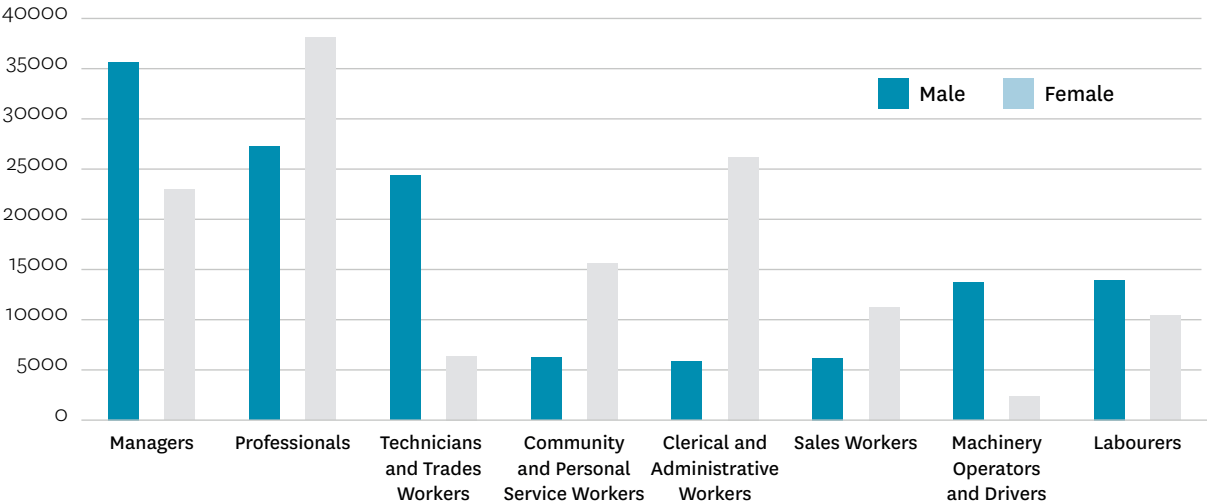
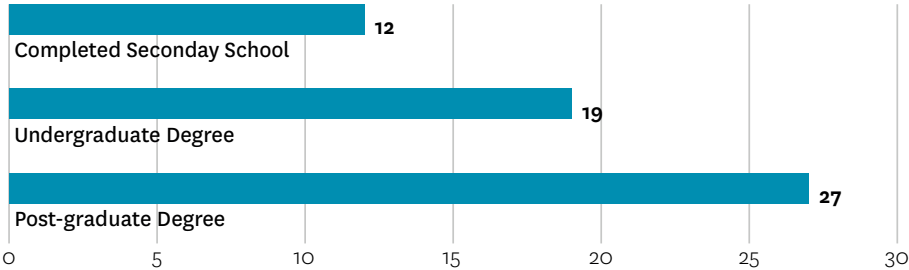


Figure 7: Education of employees at risk of replacement by AI now



While these statistics are American-based, and those later in the report European, and while it goes without saying that the demographics, scale of business, venture capital availability, and wealth of New Zealand are marginal compared to the countries cited, the findings are useful because they are suggestive of the industries, occupations and accompanying tasks that are most vulnerable to AI penetration. They also point to how gender, ethnicity, and levels of education affect employment in relation to AI encroachment in the workplace—factors that will probably play out in the New Zealand context, too.

Employment in New Zealand

Before examining more detailed evidence regarding the industries, occupations and tasks that are *already* being disrupted by robotic and machine intelligences, and those that will be so in near to mid-term timeframes, we chart the current status of employment by industry in New Zealand. The summary forms a backdrop that we will use to develop a “*What if this were to happen here?*” comparison.

New Zealand statistics (2024) show that 2,991,355 respondents work across 19 industries and services.⁸²

The largest industry employer was Professional, Scientific and Technical services (10.5%), followed closely by construction (10.4%) and then Health Care

and Social Assistance (9.5%), Manufacturing (8.6%), and Retail (8.4%).

Back-office work in Health Care and Social Assistance and in Construction will be eroded in the mid- to long-term, but the sectors as a whole will probably be less immediately impacted by AI than Professional, Scientific and Technical Services, Manufacturing, Retail and other industries where robotic and machine intelligences can more readily perform both simple automation tasks and complex analytical, comparative, and summative tasks.

The table below, breaks down the current status of employment by industry in New Zealand.⁸³

Summary

When planning for the impact of AI on employment timeframes, industry, and occupations matter. Ethnicity, gender, and age will also play a role in job security. Mechanical automation is an age-old phenomenon; machine and robotic intelligence is new. AI does not simply automate and repeat actions; it analyses data, summarises it, and offers options for action. It is “creative,” and it solves problems.⁸⁴ For this reason, and those of competition and the need to make a profit, AI will increasingly be deployed across the workforce, either as an assistant or replacement technology to humans (more likely the latter). Right now, professional, scientific, and technical services, manufacturing, and retail are vulnerable to AI encroachment because it can reach into many of their tasks and perform them cheaply, reliably, and efficiently.⁸⁵ The next section describes the impact of AI on employment today in the UK and the US. It also points to its potential effects on the workplace over the next decade.

Figure 8. The below includes multiple responses where individuals work in more than one industry.

Industry	No. of people
Accommodation and Food Services	178,817
Administrative and Support Services	172,180
Agriculture, Forestry and Fishing	182,383
Arts and Recreation Services	52,281
Construction	310,787
Education and Training	207,677
Electricity, Gas, Water and Waste Services	28,585
Financial and Insurance Services	92,042
Health Care and Social Assistance	284,559
Information Media and Telecommunications	456,00
Manufacturing	256,415
Mining	6,710
Other Services	95,047
Professional, Scientific and Technical Services	315,445
Public Administration and Safety	179,386
Rental, Hiring and Real Estate Services	137,097
Retail Trade	252,328
Transport, Postal and Warehousing	33,732
Wholesale Trade	50,183
Total	2,991,355

INDUSTRIES AND OCCUPATIONS AT RISK—INTERNATIONAL FINDINGS

The following charts rank possible industry and occupational exposure to AI over the next ten years. The data is drawn from the Institute for Public Policy Analysis study of O*NET (2023)⁸⁶ and the Labour Force Survey (LFS, 2023).⁸⁷ The O*NET database provides a detailed description of 277 occupations and covers 923 tasks.⁸⁸ It is based on employment in the USA, which runs at approximately 164m people. The LFS is a UK survey done by the Office for National Statistics. It is taken by 27,000 households quarterly and currently carries data from 44,338 individuals.

The first figure below shows in greater detail the replacement and assistance capability of machine intelligence and learning on employment in 2024.⁸⁹ It presents a snapshot. Only a few occupations are quite heavily exposed. We can see that administrative, customer service and secretarial roles by task can be quickly replaced by AI (the latter reportedly with 35% productivity gains).⁹⁰ The remaining occupations are

temporarily sheltered from a coming storm. However, business, media, and public service roles, corporate managers and directors, and leisure, travel and related personal services may see assistance turn to replacement quickly.

The current situation

The next figure (Figure 10, page 13) also relates to the immediate timeframe.⁹¹ It summarises the data in a different form. It shows the percentage of tasks exposed to machine intelligence and learning by occupation. Secretarial and related services have high exposure; AI can mimic from 37% to 60% of their tasks (median 41%). Customer services and administration have high exposure, too. However, currently, most occupations are only slightly vulnerable to AI encroachment.⁹²

The picture in five years

The picture changes dramatically when we look five years into the future (Figure 11, page 13). Every occupation in the same list has a percentage of tasks that AI can complete, arguably, quickly, flawlessly, and

Figure 9: Replace and assist capability of machine learning on employment in 2024

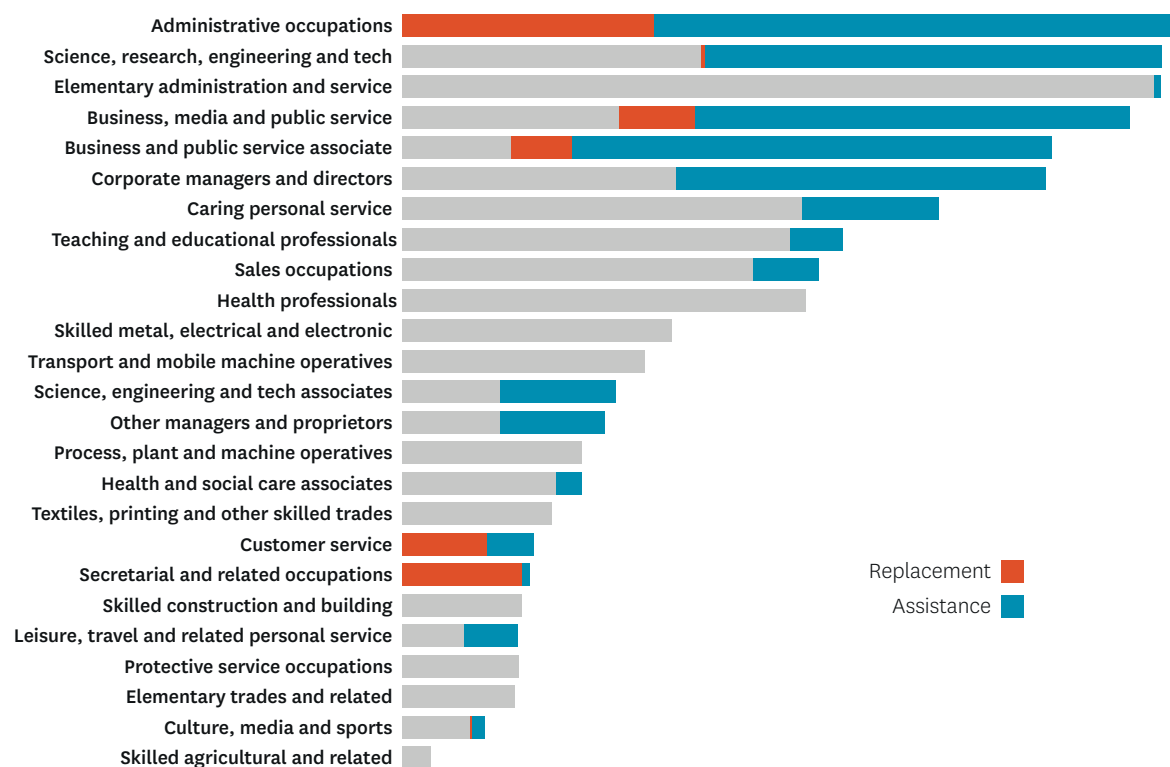


Figure 10. Percentage range of tasks exposed to AI today.

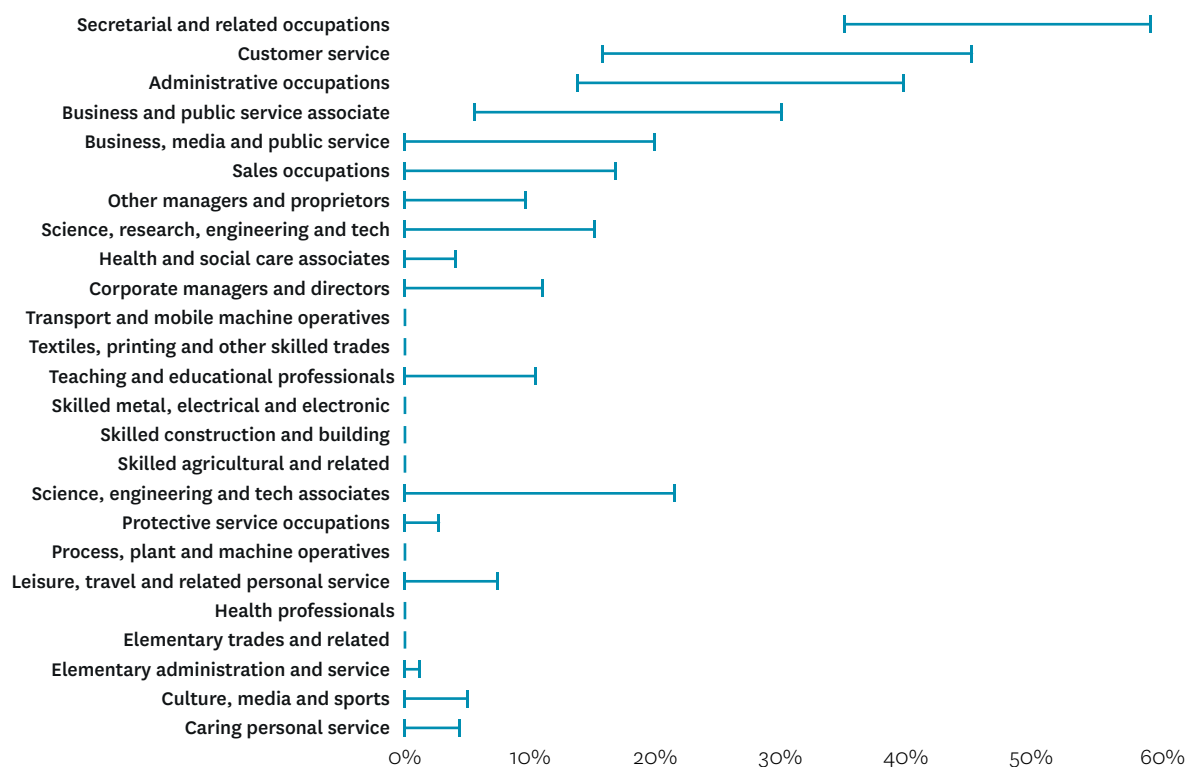
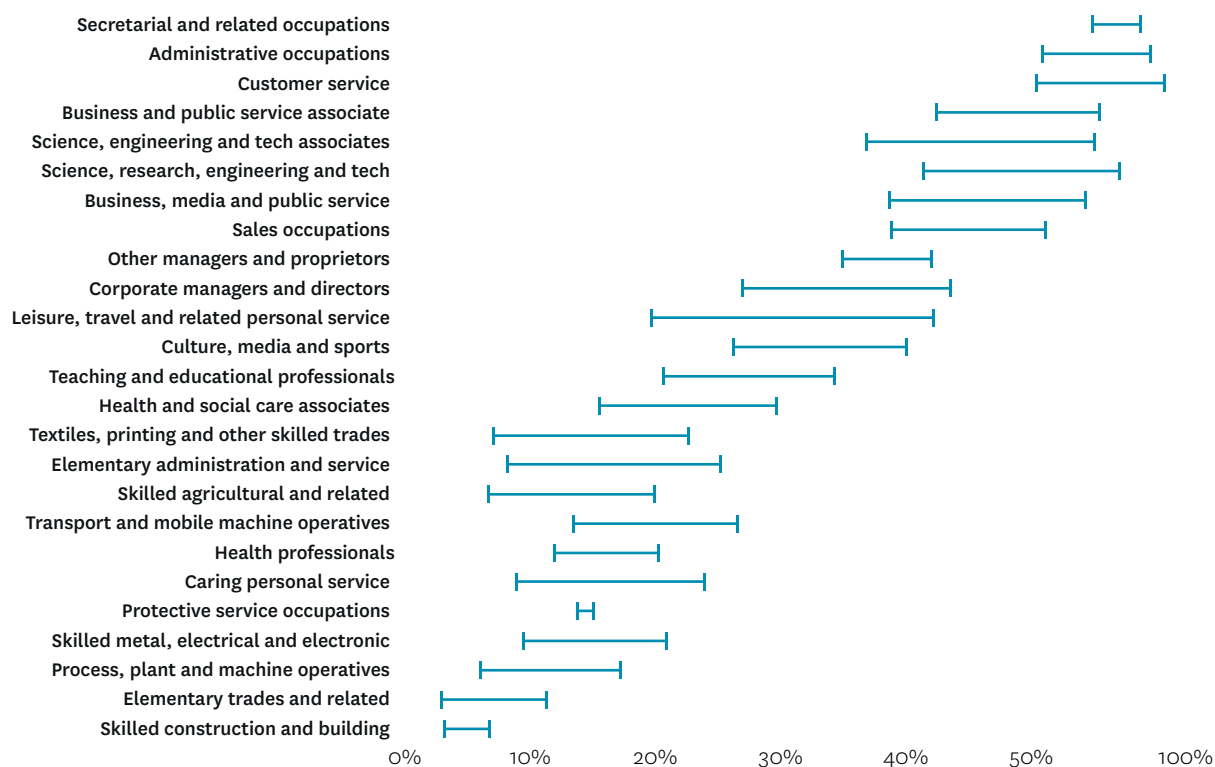


Figure 11. Percentage range of tasks exposed to AI in five years.



at little cost. Occupations such as leisure, travel and related personal services; science, engineering and tech associates; business and public service associates; and sales occupations, have a wide and high percentage of tasks that can be done by machine intelligence and learning.⁹³ More strikingly, occupations today with little to no threat of exposure—for example, health and social care associates, health professionals,⁹⁴ culture, media, and sports associates—have a range of tasks that in five years AI is predicted to perform.⁹⁵

We should pause to reflect on the impact of technology on sport. It is hard to imagine that sportsmen and sportswomen will be replaced by robotic and machine intelligence. Little to no academic literature sees this as probable. Both at a participatory and an audience or supporter level, sport is about teams, individual attainment, psychological and physical fitness, and people. Few people would go to a game to watch a team of bots battling it out. However, one area where AI will make increasing gains is in training. It is already doing so. Businesses that make AI products, which analyse video or data on a team and an individual's physical performance will create opportunities for coaches who can use the technology adeptly. Current literature does not speak to AI and sport, but given New Zealand's sporting prowess and know-how, it is perhaps an area in which it could specialise.⁹⁶

The ten-year picture—trends

The ten-year picture of the impact of AI on industries and occupations is difficult to portray.⁹⁷ But the trend to replacement is there. McKinsey & Company has stated that activities accounting for up to 30% of hours worked across the U.S. could become automated by 2030.⁹⁸ Furthermore, 12 million workers in professions with shrinking demand may need to change jobs within the next seven years (Gonzalez, 2023).⁹⁹ The speed of development among companies like NVIDIA, NXP, and AMD of the chips needed for AI computations is one significant factor. The growing awareness of the demands these technologies place on electrical grids is another that will influence AI adoption.¹⁰⁰ Its roll-out will be easier in wealthy countries, such as Canada, that can afford AI investment and have expertise and reliable and plentiful electrical supplies. In these countries, it is possible that AI will press further into every industry and occupation as an assistant or replacement technology. It will take

on an increasing number of the physical and intellectual tasks that work requires. Teaching and educational professionals, for example, will see more students using AI for personalised learning through augmented and virtual reality, with companies like Khan Academy offering technologies that will analyse student performance and instantly adapt its means of teaching to help them learn. Educators will have less direct contact time with students, teach less content, and be less involved with the learning process. And sales, the way we purchase goods, and delivery (transport and mobile machine operatives) will be highly, if not completely, automated by AI. Their logistics will be covered. Moreover, it is predicted that AI will do more of the work of health professionals, even in surgery. Just as electricity invisibly and continuously affects our lives, AI will ineluctably reach into all our occupations. Because something can be automated, it does not mean it will be or *should* be. However, the lure of efficiency, less hassle, and lower overheads, together with the pressure of competition from AI adopters, all but guarantee that industries (and governments) will increasingly use AI in their operations during the next ten years.

AI'S IMPACT ON SOCIAL STATUS AND PAY

One of the most disruptive aspects of AI on employment may prove to be workplace standing and social status.¹⁰¹ Some jobs, such as plumbing, that have traditionally belonged to blue-collar workers and have had low social standing may enjoy increasing status.¹⁰² Conversely, aircraft pilots might see their employment prospects drop, salaries fall, and status collapse over the next ten years. The aviation technology for this to happen is already available. Drones take off, land, carry, and deliver heavy payloads, both for peaceful activities—spraying pesticides over large areas of farmland or transporting medical supplies and packages—and for war. The USA (and probably China) is also trialling pilotless planes, aircraft that do not need to take into account the effects of G-force on personnel and are less prone to pilot error.¹⁰³

The same threat to social status and salary arises for medics, surgeons, and other professionals who have trained and specialised for years and who are highly adept in their roles. Moreover, an argument will be mounted that there is a strong moral case for using robotic and machine intelligence in medicine as it will secure better diagnoses (melanoma detection, etc.) and greater precision in surgery than its human counterpart, providing better outcomes for patients. MediTron-70B, CoDoC, and CT Panda, for instance, are powerful technologies in the fields of clinical knowledge and diagnosis.¹⁰⁴

This line of reasoning can also be applied to employment that has lower social standing, such as those in transportation—cars, taxis, trains, trucks, etc. Why put lives at risk from inattentive, drunk, elderly, or young and reckless drivers? Or education: why put children's futures at risk from bad teachers? Or research and development—AI may soon analyse and summarise a wider range of data more effectively than human researchers.

The point is that the promise of reduced costs, greater efficiency, better use of resources, cheaper goods, and the pressure of competition might accelerate the adoption of AI, but *a moral argument may also propel its uptake*. Why risk people's lives and futures with old technology (humans) when a newer "safer" technology exists?

The figure on page 16 outlines a number of occupations and their exposure to AI assistance/replacement within five years, as well as the impact this might have on pay and social status. The question of whether salaries increase or decrease in this scenario relates to the job market. If it is tight because machine intelligence and robotics are rapidly replacing jobs, we might expect salaries to sink because many people will be vying for fewer remaining roles. However, it is possible that only individuals who are highly skilled will win these and that they will negotiate high pay levels. The consensus, though, is salaries will fall—that people will take a lower salary to have work.¹⁰⁵

Summary

We have witnessed giant strides in AI technology in the last five years. In a growing number of areas, machine intelligence and learning, as generative AI, is now matching human capabilities and surpassing them. Figuratively speaking, it listens, watches, reads, and works intelligently with the data it feeds on. Historically, we have broken down paid work into tasks in order to secure particular outcomes and to monitor progress and performance. Given AI's current capabilities and the fields in which it is being applied, we can tentatively predict which tasks it can assist humans with, and/or do without them. This has led to the summative work cited above on AI's current and likely future impact on industry and occupations. The predictions do not take into account attitudes to adoption by employers, the investment a country can make in AI technology, policy on AI and labour, uptake disruption from conflict, etc., but they do indicate something more than a possibility. They underline the potential for serious and sustained disruption in national workforces, upon salaries and social status. The research should prompt thought and action from the media, industry, and government. Attention has focused on regulating AI development, data security, privacy, and ethics.

When policymakers last addressed the effects of AI on employment in the 2010s, generative AI had not broken into the workplace. Hence, the need to turn to it again now.

Figure 12. Occupational exposure to AI.

Occupation	Exposure within five years	Impact on pay by AI assistance/ replacement	Impact on social status
Data entry	Very High	Low	Lower
Marketing	Very High	Low	Lower
Personal assistants & secretaries	Very High	Medium-Low	Lower
Record keeping & clerks	Very High	Low	Lower
Administration	High	Medium	Lower
Communications	High	Low	Lower
Company secretaries	High	Medium	Lower
Consultants & business analysts	High	Medium	Lower
Data analysts	High	Low	Lower
HR & administration	High	Medium-Low	Lower
Journalists	High	Medium	Lower
Writers	High	Medium	Lower
Researchers	High	Medium	Lower
Travel agency managers & staff	High	Medium	Lower
Accountants	Medium	Medium	Lower
Agricultural Workers	Medium	Low	None
Directors	Medium	High	Lower
Lawyers & solicitors	Medium	Medium	Lower
Public relations	Medium	High	Lower
Receptionists	Medium	Low	None
Sales personnel	Medium	Medium-Low	Lower
Surveyors	Medium	Medium	Lower
Tax advisors	Medium	Medium	Lower
Teachers & teaching assistants	Medium	Low	None
Veterinarians	Medium	High	Lower
Transport & delivery	Medium	Low	None
Aircraft pilot	Low	High	Lower
Care workers	Low	Low	None
Childcare workers	Low	Low	Higher
Dental practitioners	Low	High	Lower
Directors of creative industries	Low	High	Lower
Electricians, plumbers, carpenters	Low	Medium	Higher
Forestry & fishing workers	Low	Low	Higher
Hairdressers & barbers	Low	Low	Higher
IT director	Low	High	None
IT network professionals	Low	Medium	None
IT trainers	Low	Medium	None
Judges, barristers, & senior partners	Low	High	None
Massage and beauty therapists	Low	Low	Higher
Medical specialists	Low	High	None
Nurses	Low	Low	None
School principals	Low	Medium	None

IMPACT ON NEW ZEALAND EMPLOYMENT

Multiple variables make it difficult to predict the impact of AI on employment in New Zealand. While we hold some cultural, legal and economic practices in common with commonwealth countries, the USA, and other nations, we also have our own way of doing things. The way we value employees, our attitude towards change, and our trust in and adoption of technology will each affect the speed and scope of AI adoption in the workplace. So will capital availability, pressures of competition, and the actual viability of the technology itself. Forecasting employment figures in relation to AI encroachment is akin to crystal ball gazing.¹⁰⁶ Yet the confirmed and growing power of AI to execute an increasing number of tasks humans perform at work suggests it is prudent to do so. It allows for a measured rather than reactive response to threats of replacement, and if higher levels of unemployment are to mark the future, to plan and prepare for them.¹⁰⁷

Men and women

The following table (Stats NZ Tatauranga Aotearoa) provides a snapshot of the number of men and women employed in New Zealand, with a total of 2,991,355 respondents.¹⁰⁸ The largest employer is Professional, Scientific and Technical Services, followed closely by Construction, Health Care and Social Assistance, Manufacturing, and Retail. The degree of AI encroachment into each of these, with the exception of construction, may be significant. However, even construction will see back-office work, logistics, and haulage change, with the corresponding impact on employees.

Although there are a higher number of people employed in other areas, there is a greater risk of replacement for staff in Financial and Insurance Services; Electricity, Gas, Water and Waste; Transport, Postal and Warehousing; Administrative Support; and Education and Training. The tasks they do are more readily accessible to AI than those, for example, in construction.

Figure 13. The below includes multiple responses where individuals work in more than one industry.

Industry	Male	Female	Total
Accommodation and Food Services	75,501	103,136	178,817
Administrative and Support Services	92,171	79,986	172,180
Agriculture, Forestry and Fishing	111,454	71,565	182,383
Arts and Recreation Services	25,637	26,624	52,281
Construction	255,726	54,472	310,787
Education and Training	52,125	155,723	207,677
Electricity, Gas, Water and Waste Services	20,402	8,222	28,585
Financial and Insurance Services	44,531	47,535	92,042
Health Care and Social Assistance	58,986	225,551	284,559
Information Media and Telecommunications	23,764	22,703	45,600
Manufacturing	166,811	90,413	256,415
Mining	5,301	1,800	6,710
Other Services	39,620	58,717	95,047
Professional, Scientific and Technical Services	173,097	142,489	315,445
Public Administration and Safety	83,059	96,294	179,386
Rental, Hiring and Real Estate Services	69,002	67,830	137,097
Retail Trade	116,124	136,390	252,328
Transport, Postal and Warehousing	89,708	84,168	33,732
Wholesale Trade	82,876	80,865	50,183
Total	1,627,999	1,627,458	2,991,355

Age

The data above becomes more germane when we consider the *age* as well as *gender* of employees across industries. This can be parsed in several ways. With regard to age, we have taken two age groups: those who are experienced and well-embedded in the workforce, and those who are just starting out in their careers. We have chosen the first group because it will be reaching what has traditionally been seen as the most stable and highly paid period of a person's life over the coming decade—the same timeframe in which AI is most likely to disrupt the workforce. We have chosen the second group because the assumptions and securities they stand upon at the beginning of their career are likely to be upended by AI during the same decade, beginning now. The figure below represents employment patterns among the first group.¹⁰⁹

The potential number of employees facing job disruption in the 45 to 49-year-old group is sobering, especially when we realise that at least 30% of the tasks of managers, professionals, technicians, machinery operators and drivers, 40% of the tasks of sales workers, and 50% of the tasks of clerical and administrative workers will be effectively done by AI. Baum proposes that “organizations should form cross-functional teams comprised of legal teams, tech teams, and engineering teams who regularly communicate and are apprised of how the organization may be using AI to make decisions that impact employees.”¹¹⁰ But even taking a conservative stance and

arguing that capability will not necessarily translate into action—and that we might see businesses and employers replacing at most 10% of their workforce—that still results in workload disruption,¹¹¹ for example, for nearly 3,400 male managers and 4,200 female professionals with many forced to find new employment (though not all at once). If the same trend runs across other areas of work (sales workers, administrative workers, etc.), 25,000 people might be retrenched in this 5-year band alone. For mid-life employees, this will produce distress and hardship to varying degrees, depending on their aspirations around home ownership and retirement. Some may argue that the idea of machine and robotic intelligences bringing about 30% replacement levels to employment is ridiculous and that it does not bear thinking about, but this may be to bury our heads in the sand—and in the future, to leave roughly 75,000 people in this age bracket wondering what they will do for work.

The following figure (page 19) has the same structure as the one below, but it focuses on 25- to 29-year-olds.¹¹² They have begun to find their feet in the labour market and carry certain hopes. The women in this generation are advancing more in their careers than ever before.

Applying the same metrics as those above, 2,100 male managers, 4,600 female professionals, 1,800 female and 800 male clerical workers, , and 1,000 female sales workers will potentially be replaced by AI. Across the workforce, numbers at 10% replacement would equate to nearly 26,000 job losses for 25- to 29-year-olds.

Figure 14. Occupation counts, census 2023. 45-49 years

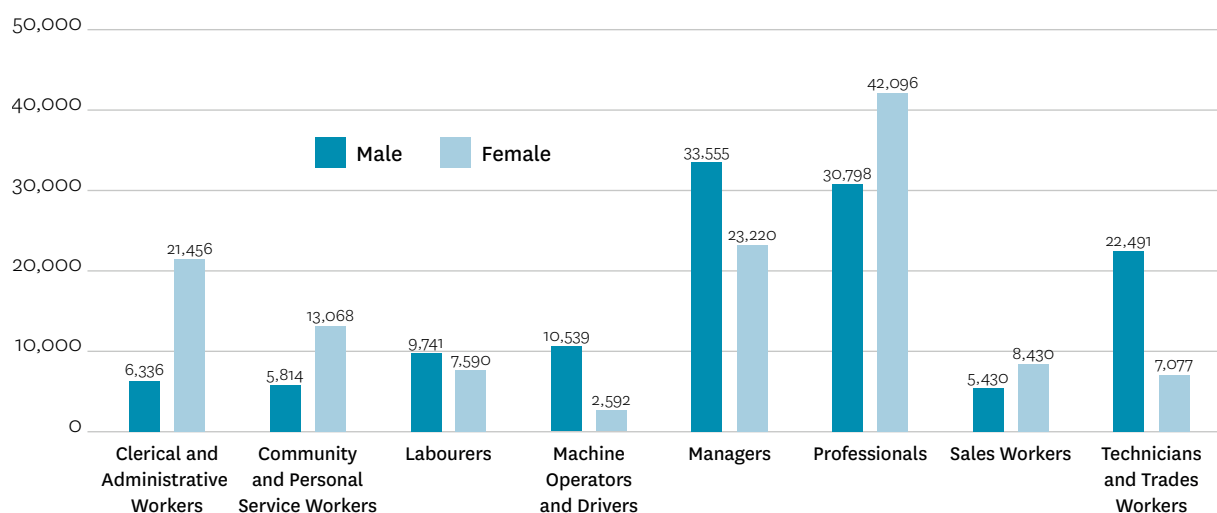
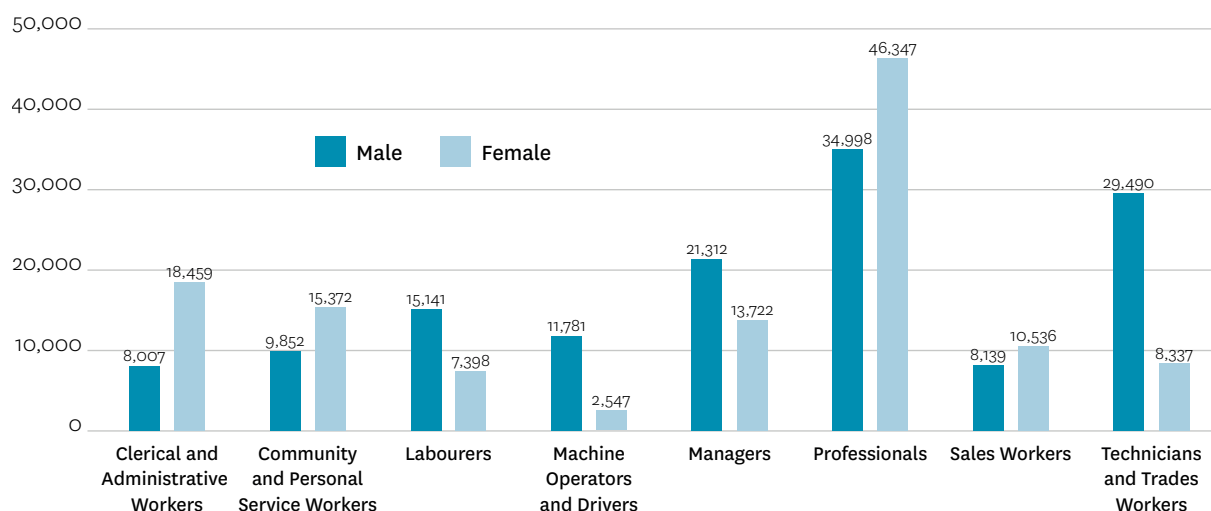


Figure 14. Occupation counts, census 2023. 25-29 years



Of course, New Zealand's labour market is constantly in flux, and the requirements of particular roles are continually changing. Furthermore, the replacement of workers by AI will unfurl unevenly over a decade, with some businesses and industries adopting automation faster than others depending on capital and leadership. These and other factors make work-related predictions hard but not pointless. In fact, trends in the technology's growing capabilities and uptake among wealthy and forward-looking businesses make them urgent.¹¹³

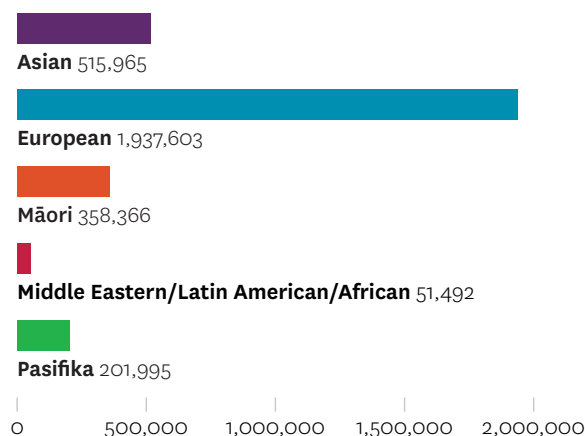
Ethnicity

We now touch on the impact of AI and labour among different ethnicities. There is a considerable body of literature that examines racial and ethnic bias as it is found in AI design, the justice system and policing, human resourcing, CV selection, etc. Here, the focus is less on bias (which *might* be rooted historically and presently in employment patterns) but more on the fact that certain industries and occupations carry greater proportions of workers of particular ethnicities than others.¹¹⁴ The observation is important. Just as more women work, for example, as receptionists and secretaries than men, they face a greater degree of threat from AI replacement due to the nature of the tasks associated with those roles. Similarly, ethnicities that cluster in certain fields of work face greater disruption and loss of work to AI than others. Indeed, "an unintended consequence of AI

adoption is the potential for negative impact on certain [ethnic] demographics."¹¹⁵ Thankfully, the disparities and numbers in New Zealand are not as stark as they are in Europe or the USA,¹¹⁶ but in some sectors, they are visible.

The figure below breaks down New Zealanders currently employed by ethnicity.¹¹⁷

Figure 16. Employment by ethnicity



European and Asian

There are two areas where Europeans and Asians have higher representation than other New Zealand ethnicities: finance and insurance services, and administrative and support services. Māori have a proportionally higher presence in the latter, too. The first area is at high risk from disruption, and the second slightly less. Financial transactions, forecasting, trading, company performance analysis, comparative analyses, automation of form filling, tax and GST returns, accounting, and bank transactions, etc., are vulnerable to machine intelligence. It is already operating, too, across company systems, shadowing and even executing some transactions with limited human oversight. The degree to which it will replace humans over the next decade might only be limited by employer determinations. Workers in administrative and support services are also exposed to AI because many of these tasks can be done through machine learning and automation.¹¹⁸

Figure 17. Employees in Financial and Insurance Services

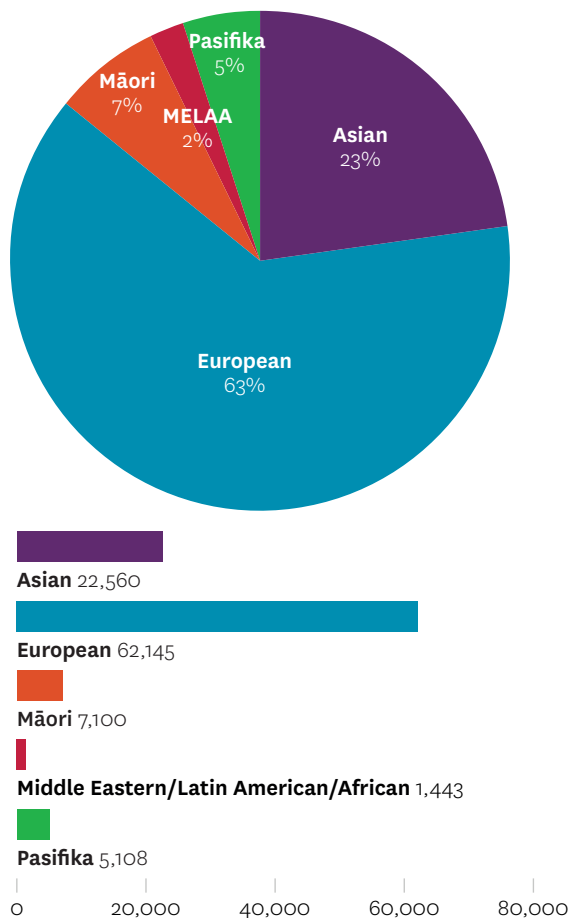
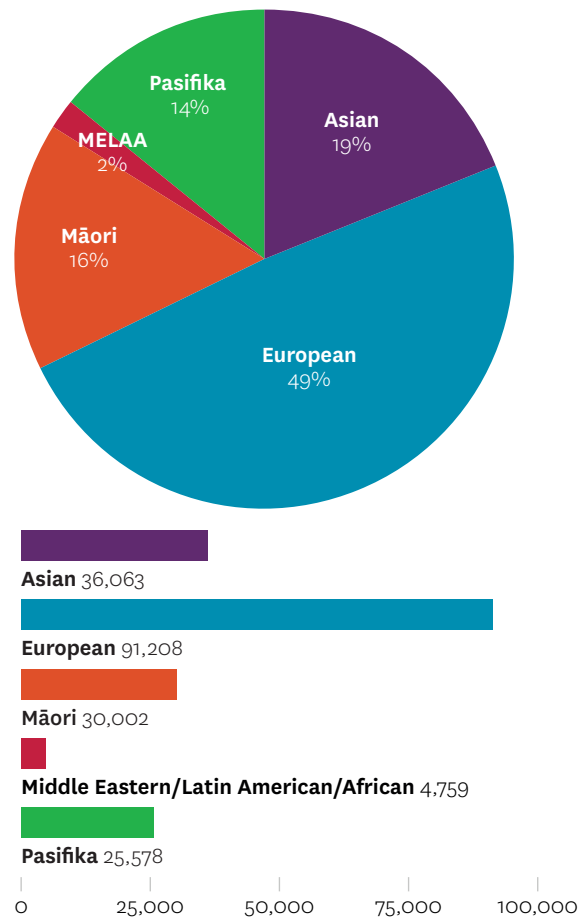


Figure 18. Employees in Administrative and Support Services



Using the same metric of AI replacement at only 10%, financial and insurance services, and administrative and support services, 15,300 European and 5,900 Asian (and 3,700 Māori) jobs would be affected by machine intelligence, with a possible total of 28,600 jobs disrupted. The likelihood, however, is that penetration by AI in these industries will be much higher. Current iterations of the technology in finance, accounting, calendar appointments, meeting transcriptions, etc., are impressive; in the next five years, they will become more so. Apple Intelligence, Microsoft Copilot, ChatGPT, etc., are each making their mark. The tasks AI can execute effectively in these areas of work are projected to run to 80%, and the question then becomes: “Why wouldn’t an employer adopt it?”¹¹⁹ While it is hard to put exact numbers on job losses, employees who work in administrative and support services will be disproportionately and negatively affected when compared to other ethnicities.

Māori

Public administration and safety is also vulnerable to machine intelligence. Budgeting, legal compliance, personnel management, and, at a lower level, data collection, analysis, and reporting make up a significant part of its activities. AI is forecast to not only assist with many of its undertakings but also to replace staff. However, the complexity of its services around policy implementation and human points of contact means that it is more sheltered from labour force disruption than, for instance, administrative and support services.¹²⁰

A second area of work where Māori are proportionately more highly represented than other ethnicities is in transport, postal, and warehousing. Postal services have already been highly automated, but each one of these fields is strongly exposed to robotic and machine intelligence. Additionally, in a number of jurisdictions,

self-driving buses, trucks, trains and taxis are operating or being trialled overseas. Likewise, warehousing is being revolutionised by machine intelligence in logistics, storage, and distribution by robotics. Tyson and Zysman find that “Platforms for selling goods (such as Amazon and Netflix) recast what tasks are performed by humans and where. They reduce workplace density and provide contactless service to customers. Transactions continue to move from in-person, brick-and-mortar retail to e-commerce and digital platforms, with tasks shifting from shop floors to warehouse operations and long and short-haul [automated] delivery and transportation.”¹²¹ People employed in such areas might experience very high retrenchment rates over the next five years.

If we use the metric applied earlier of AI replacement at 10%, in public administration and safety, and transport, postal and warehouse employees, the jobs of approximately 4,600 Māori and a total of 33,000 other

Figure 19. Employees in Public Administration and Safety

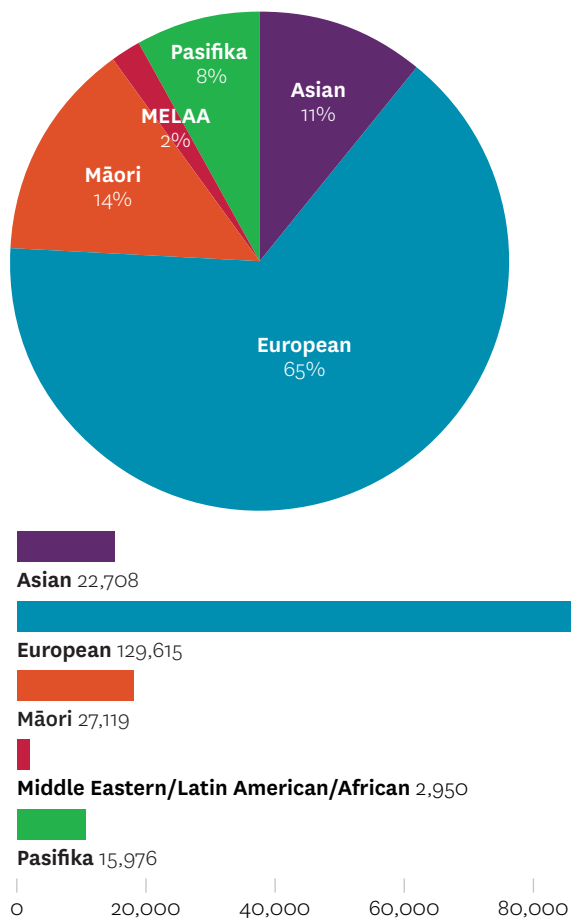
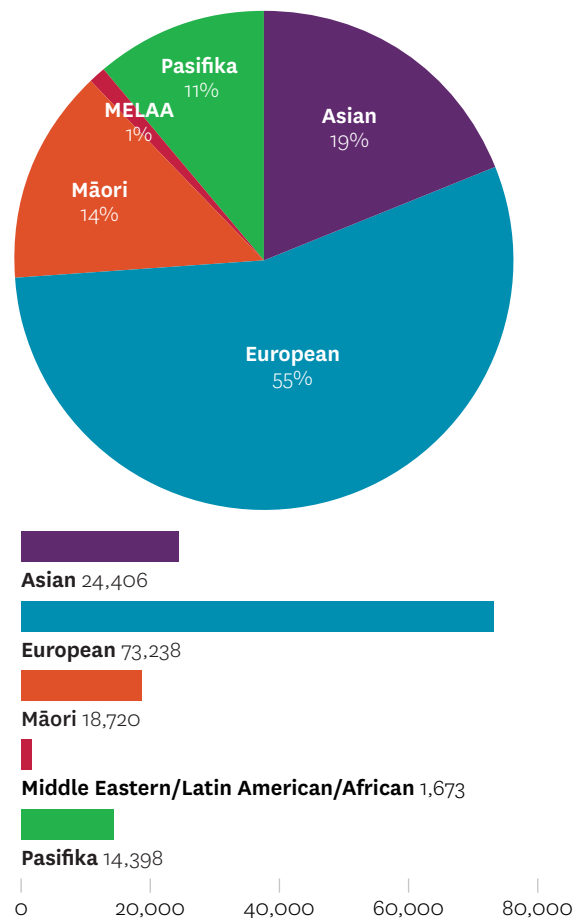


Figure 20. Employees in Transport, Postal and Warehousing

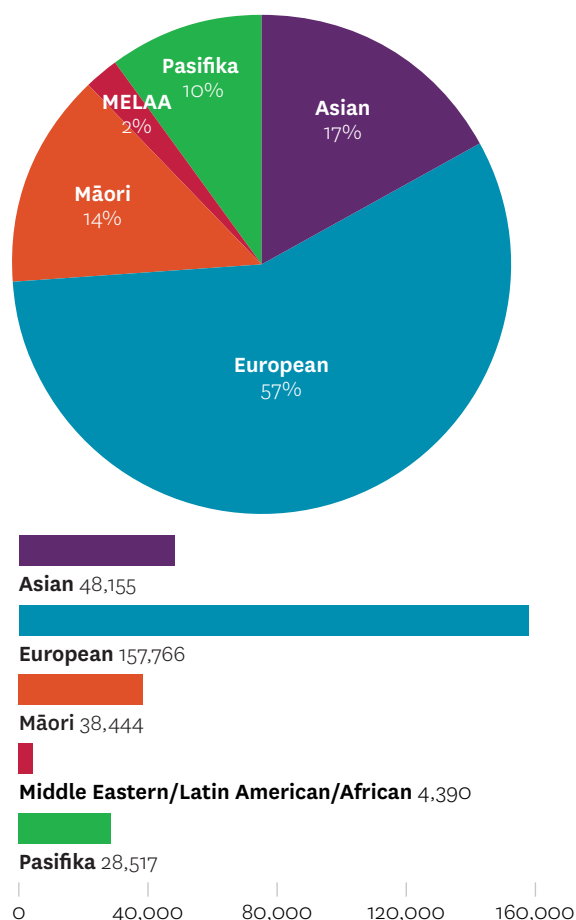


jobs would be affected by machine learning and robotic intelligence. The likelihood of disruption by AI is very high. Up to 80% of these sectors' tasks will be doable by machine and robotic intelligence within five years.

Pacific Peoples

As stated earlier, the proportional differences of ethnicities employed in various industries and occupations are notably less than in countries like America, where African Americans, Hispanics or Europeans are disproportionately represented in employment in certain fields. However, in some areas of work, such as finance, public administration, retail trade, and mining, there are disparities in New Zealand. Within manufacturing, Pacific Peoples have a slightly higher representation proportionally than other ethnicities. Therefore, the impact of AI on their families and communities will likely be felt more acutely and probably be more significant, especially as manufacturing is susceptible to automation due to its repetitive nature.¹²²

Figure 21. Employees in Manufacturing



If AI were to replace 10% of people in manufacturing over the next five years—and every indicator suggests it could be higher—then, based on current data, 2,900 Pacific Peoples could be looking for work along with 27,700 other people from the same sector. Of course, job losses will be uneven and occur over time. They will not all drop in one day. However, in addition to deciding who remains essential to the business, employers will face the difficult task of choosing whether to retain workers part-time, retrench them, or reallocate their few remaining tasks to others.

Summary

Historically, predicting employment trends has been challenging, especially over extended time frames. In 2013, researchers at the University of Oxford published a widely discussed study that surveyed hundreds of occupations and considered how likely it was that they would be automated in coming decades due to computerisation. They analysed 702 professions and estimated that 47% of U.S. jobs were at high risk of automation. However, these our predictions have not come to pass. The president of the Information Technology and Innovation Foundation argues that, in some ways, the opposite of what the Oxford publication predicted has come true. Since 2013, the U.S. economy has added jobs to its workforce.¹²³ Despite this forecasting failure, and because of the present and tangibly emerging capabilities of AI, we think it still prudent to reflect on its possible impact on employment. We have accurate information on the tasks AI can perform, and we have long known what tasks workers do to be productive. While an accurate assessment of how employers might adjust or redistribute employee hours is difficult, and while AI and robotics adoption may not occur immediately, over time, they will become an increasing presence in our workplaces and lives. We should plan and prepare for this.¹²⁴ Employment gender, age, and ethnicity are relevant considerations when estimating AI's impact. However, note IMF managing director Kristalina Georgieva's observation that "in most scenarios, AI will likely worsen overall inequality."¹²⁵ A modest replacement rate by AI of 10% over five years would result in a marked disruption in New Zealanders' lives.

RESISTANCE TO AI

In our recent reports on the impact of AI on agriculture¹²⁶ and education,¹²⁷ we outlined several reasons for resistance to the uptake of the technology. We add to these here. Some of the reasons for opposition are compelling, while others are less so.

The foremost argument against quick AI adoption is uncertainty about its value proposition. How much will it cost? What is its benefit? Will it generate better outcomes? This line of reasoning is prudent, and it will only be answered by evidence from domestic and international experience, ideally in analogous industries or businesses. However, it is risk-averse and may lead to missed opportunities for businesses.

Questions of value and cost touch on a second impediment to AI's rollout across our workplaces: capital availability. The USA, Canada, Australia, India, and major economies in Europe—countries that are leaning into AI adoption—have access to significant investment capital. We have less. Moreover, our businesses tend to be smaller concerns, and in the primary sector, for instance, carry debt. Talk of trialling or introducing AI into these businesses is just that—interesting, possibly valuable, but not viable. However, the emergence of AI-as-a-service means that the technology will become available as a subscription model, substantially reducing the expenditure required for deploying machine intelligence and learning.

A third obstacle to AI implementation is scepticism. Apart from basic doubts about its utility, there is a growing body of literature that explores “unforgiving” human responses to technological failure. These types of responses are not new; rather, they typify those associated with the introduction of any new technology. They amplify a form of scepticism that runs along the lines of, *Have tried that, didn't work. Or If it ain't broke, don't fix it.* Research underscores that we tend to be more forgiving of humans who make errors than of machines. In education, findings show that administrators and teachers are more tolerant of a colleague who let them down than they are of a technology. The unwillingness to press into and trial a technology further—scepticism about its utility—is inhibiting the adoption of AI. If it is successfully introduced and seen to add value in neighbouring businesses, the obstacle of scepticism will, over time, be overcome. Note, too, in our report on AI and

education, we highlighted the importance of professional development for teachers using the technology in the classroom.¹²⁸ Poor induction on how to use it and a failure to show its value all but guarantees AI's rejection. In contrast, successful explanation and patient onboarding in usage leads to its adoption.¹²⁹ The same will apply to other industries and occupations.

Lack of knowledge will also slow AI adoption. It is not so much a wilful ignorance, but it is because people do not have time to research opportunities. The pressure each day brings to running a business means that there is little time for reading and reviewing. Add other commitments around family, etc., and talk about AI becomes very distant, even though its ubiquity is already part of our lives. While New Zealanders are seen as innovative, we are not known to be great readers. If there is any truth to this observation, then AI's advance into the workplace, for better or worse, will be slowed.

Research also suggests that philanthropic impulses will play an important role in the speed, scope, and depth of AI's penetration into industry. Business owners place value on their employees not only because of what they bring to the bottom line but also because of a sense of solidarity. Employers know what it means, for instance, to sustain a family, pay a mortgage, or build towards a dream, and they understand the anxieties that come with lockdowns, illness, and unemployment. They may be forced to lay off staff but do not enjoy doing so. The difficulty for them, as alluded to previously, is the way competitive pressure on pricing goods from companies that have effectively embedded AI into their operations may force their hand.

Self-interest, a sense of self-worth, and reductions in status and pay may also impede the quick implementation of AI. Self-interest and worth are not necessarily negative human qualities. And concerns about diminishing social status and falling income are genuine fears in the face of a pending reality.¹³⁰ It is probable that those with more to lose and who often hold senior management positions will either actively or passively resist change.¹³¹ Understandably, men and women of every age and ethnicity might want to try to slow AI's disruptive power, but short of mass movements and demonstrations, those who have executive authority can do so most easily.

A final, but not-to-be-underestimated, factor in AI's uptake—or lack thereof—might be described as the Tesla Factor. It occurs when a technology becomes politicised or, adopted or rejected by an identity group, a political party, or the right or left wings of politics.¹³² Thus, despite Elon Musk's political stance, Tesla vehicles are associated with Democrat environmental policies in the US and boycotted by some petrol-loving Republicans. The utility and value of the technology is glossed over. The risk is the same with AI. Lobby groups, businesses that see their business models threatened, and politicians with an eye to the electorate can each, to a degree, stymie or spruik the deployment of machine intelligence across an industry. Indeed, AI is ripe for politicisation: surveillance, lethal autonomous weaponry, labour force displacement, etc., fuel dystopian fears.

The reasons outlined above for a pause in or a gradual uptake of AI by industry and government are understandable and valid. But they are not necessarily sound. The desire and pressure to make things and do things efficiently, cheaply, and of good quality will, to varying extents, drive the replacement of humans by machines in the workplace. What this might mean and how we should think about it are the subjects of the following sections.

EFFECTS RELATING TO ADOPTION OF AI ON THE LABOUR MARKET

As prefaced in the previous section, the question of a dystopian future should be taken seriously. It revolves around whether AI will usher in an employee winter or spring. A wintry view sees some—an elite—benefitting greatly from AI's adoption by (big multinational) industry but sustained misery for the majority who are focused on eking out a living. This seems an unlikely possibility and one that should be avoided.

An alternative progressive view, put forward by some futurists and tech moguls, is that AI will engender a societal spring.¹³³ Indeed, some “economists and technology experts contend that AI will substitute for human work at such a scale that social-economic organisations will be shaken to the ground as a result. This is a major aspect of debates on the centrality of work today, and often the initial argument for ‘post-work’ models of social organisation (typically Danaher 2019).”¹³⁴ Such models move towards a post-work leisure society—one that perhaps works for only 2-3 days a week.¹³⁵ We see this as possible, difficult to bring about, and undesirable.

The details of the debate are beyond the scope of this paper, but note each position says much the same thing about work: it is a burden. The first view believes it is one we cannot do without. Work pays our bills and allows us to enjoy other areas and things in life. To be unemployed jeopardises these, bringing on a societal winter. In a solitary, poor and nasty world, we *need* the burden of work. The second—that a post-work future should be enthusiastically embraced because ... labour is a burden: one that capitalist elites have tricked us into believing is important to our personal development—that it is good for us. Actually, relaxing on a beach, hiking, playing sports, socialising, studying what we are interested in—living a life of leisure—would be satisfying and fulfilling. The thorny question of how all this would be funded has not yet been clearly answered.

The discussion, however, raises a question that will become increasingly important for industry and government. Is work purely an instrumental good? Should we weight its value towards productivity, or does it have other more intangible goods that relate to recognition of

personal strengths and weaknesses, learning what it is to work with or to confront others, to being stretched, building stamina and resilience, and perhaps to have achieved something?¹³⁶ If AI, therefore, does bring about higher levels of unemployment in the next five years, then, as a society, our estimation of the value of work will become more important. And productivity aside, if we determine work is an activity important to human development and relations, then policies advancing a post-work society will need to be tempered.

Winter or spring? The analogy is not particularly helpful. However, there are several trends emerging overseas that might be mirrored in Aotearoa New Zealand, and that might provide policy leads.

On a positive note, AI is creating new jobs.¹³⁷ A new member is being added to c-suites: the CAIO (Chief Artificial Intelligence Officer). The role will become increasingly common across all areas of business—in industry, schools, hospitals, government departments, defence, etc.—serving as an executive team member responsible for everything AI-related. It is also being attended by employees who implement, oversee and maintain AI operations.¹³⁸ In other words, a new opportunity is emerging for people who are experts in seeing where the value proposition of AI lies for their businesses or clients, and for assisting in its adoption and entrenchment. A new industry might be evolving.

A second phenomenon, also leveraging the AI megatrend, is the strengthening of existing IP super-hubs, the creation of others and a growth in migration to service them. Silicon Valley is just one example. Indian, Indonesian, Philippine, British, Scandinavian, and other nationals who are exceedingly competent in the development and application of machine learning and intelligence continue to be mobile and focused. A country's “brainboxes” go overseas to emerging centres of innovation and excellence whether these are in districts, valleys, or cities such as Shenzhen, Singapore, Bangalore, London, or Sydney.¹³⁹ David Howcroft and Phil Taylor believe that “Whatever the future of AI, it is likely to inspire heavy investments in new ventures for some time to come. Where these investments occur will help determine the future spatial distribution of activities in IT. Because AI is the current frontier of IT, which locations host its creation is of enormous interest to government and industry alike. In the US, the regions that are best able to attract the computer scientists, data scientists,

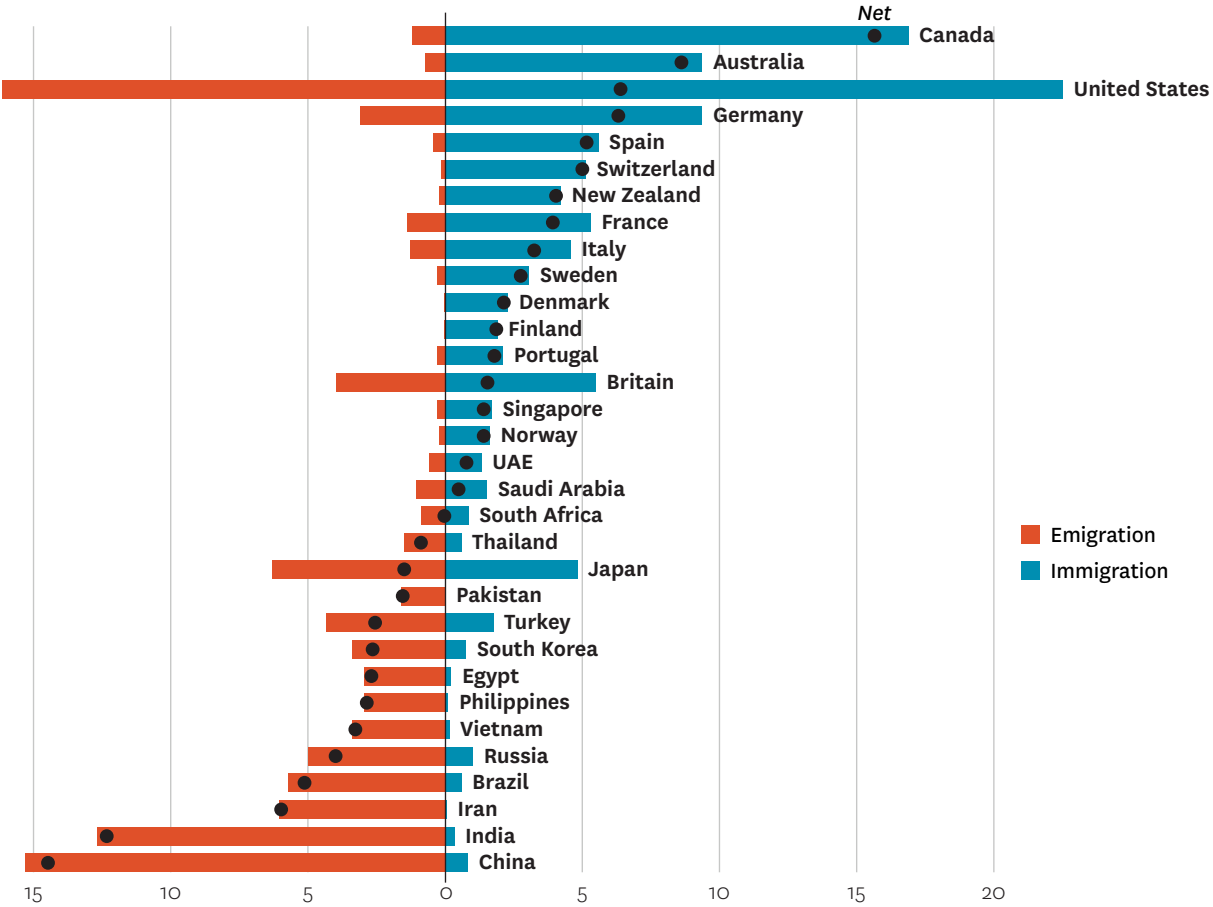
and computer systems engineers who are most adept at machine learning and related activities are likely to be the ones that acquire a comparative advantage in AI.”¹⁴⁰ Indeed, a recent Harvard study estimates that immigrants in America “though only 14% of the population are responsible for a colossal 36% of innovation.”¹⁴¹ In relation to these super-hubs, new commuting zones (CZs) are appearing, which, in themselves, require servicing. Figure 22 below shows the USA, Canada, Australia, and Germany as the most sought-after countries by migrants, suggesting how much nations might gain from the “brain drain.”¹⁴²

If the labour market does tighten in response to AI adoption, then countries will see more of their “best” people travelling internationally for work.¹⁴³ And if machine and robotic intelligence replaces employees across a wide range of occupations, then the CZs and super-hubs people travel to for employment will become

exceptionally important to a nation, even if these have a regional rather than a global focus due to decaying international relations.

Running parallel with centres of innovation and excellence is the re-emergence of a post-WWII trend: in-house industry research and development. Longitudinal studies indicate that top innovation in the 1950s-70s came from companies such as General Electric and not universities. They came from people with a successful track record *in* the company (often with PhDs, for instance, in chemistry or physics), who understood a product’s development (having been a part of it), thoroughly understood the dynamics of the problem being addressed, and who grasped the niche abilities of colleagues. They became part of an in-house, grounded community producing new developments in fields in which they had mastery. The practice is maturing with companies such as Samsung Group, Johnson & Johnson, Amazon.com, Inc. and

Figure 22.



Sources: Gallup, The Economist

Toyota Motor Corporation conducting internal research and development and creating hubs with their own CZs. Universities are still working with businesses, but the degree to which they do so may be changing.¹⁴⁴ Their role in educating students for employment in super-hubs might be taking on a premium.

Another effect of AI adoption, of human replacement rather than assistance, will be reshoring.¹⁴⁵ Companies have taken businesses offshore for taxation purposes and/or because, in developing countries, labour remains cheap. Thus, Vietnam, Cambodia, Thailand, and Mexico, for instance, have become manufacturing centres for clothes, shoes, electronics, and other goods. Fisher & Paykel, Icebreaker, and Kathmandu have found benefits in this, as have their customers.¹⁴⁶ But domestic companies that can access the capital to invest in AI and robotics are beginning to bring business back home. This carries the advantage of generating employment for locals—albeit at the oversight and quality control level, and therefore small in number—but it will bring significant disruption to workers overseas affected by a decline in manufacturing. The point is that reshoring in manufacturing appears to be an emerging trend, energised by political nationalism and protectionism, which, whether we like it or not, provides an opportunity for New Zealand entrepreneurs.

RECOMMENDATIONS

Futurists, think tanks, and policy statements on how to respond to AI's pending impact on employment include proposals such as: a tax on companies that own or use machine learning and robotic intelligence,¹⁴⁷ wealth taxes on AI company owners,¹⁴⁸ and higher corporation taxes in general. These taxes would provide for government, a universal basic income, and support a society with a three-day work week and fewer people working. These proposals reflect an anxiety associated with higher-than-previous levels of unemployment and sincere questions as to how people are sustained without work.

Our recommendations are different in tenor. They focus on preparing for a society with a tighter, tougher job market that is living and working shoulder-to-shoulder with AI.¹⁴⁹ The recommendations build on the conviction that people and “AI systems working as a team will do more than either on their own.”¹⁵⁰ We think that just as electricity has a wide variety and number of applications that permeate our lives invisibly, AI will be as pervasive and influential. It will lessen the administrative burden and drudgery of work, enabling us to focus on doing what we are really good at. Productivity will increase. Ultimately, the benefits accruing from AI adoption will depend not only upon its design but also on the leadership and policies of business owners, local leaders, and government.

Recommendations:

For Associations

Associations such as the New Zealand Institute of Chartered Accountants, the New Zealand Medical Association, the New Zealand Council of Trade Unions, the New Zealand Law Society, the Institute of Directors and regional chambers of commerce regularly gather and/or commission quantitative research that provides an accurate picture of the:

- Tasks performed by employees in New Zealand's major areas of industry.
- Tasks performed by AI in their industries.
- Projected impact of AI on industry employment over a five-year period.

For MPs and key decision-makers in the Ministry of Business, Innovation and Enterprise, and

Immigration New Zealand

That immigration policy prioritises visas and residency for migrants who have knowledge and expertise in AI and those fields that support its development and use.

For educational decision-makers in society, the Ministry of Education, and the Tertiary Education Commission

If jobs become fewer and harder to obtain, it is essential that New Zealanders are given the best head start. Therefore, while acknowledging that AI will reshape education's infrastructure, delivery mechanisms, and business models, we recommend the following:

- That the compulsory education sector (Years 0-13) selects and teaches the best curricula in the world. These should prepare students for science, technology, engineering, and mathematics, or the subjects that most effectively prepare them for working with AI.
- The continuation of the close monitoring of student outcomes in mathematical and scientific literacies in relation to international peers, and the curricula and examination boards with which they work.
- A willingness to alter, drop and introduce new curricula, pedagogies, and examinations—for instance, from Singapore, Canada, or South Korea—that demonstrably yield better results than those currently used.

That our universities:

- Acknowledge the diminishing value of marginal degrees, deliberately specialise in a field of study, and clearly signal to prospective students their specialisation.
- That a named university becomes the go-to place for students who want, for example, to focus on engineering, commerce, medical science, or agriculture and the key disciplines aligned with AI.
- Introduce demanding entry requirements for those fields and focus on producing highly educated graduates who are prepared for work in domestic industry and emerging centres of innovation and excellence, and super-hubs, either domestically or abroad.

For business groups and owners

The main reason the uptake of technology falters is insufficient onboarding. Given this, we recommend decision-makers:

- Prioritise the development and delivery of materials to onboard staff with new technology.
- Continuously evaluate how AI works as an assistant to employees.
- Pace the adoption of AI and allow the technology to mature.
- Provide visibility on market-leading AI providers in relation to pricing, effectiveness and reliability, and the exact impact it has on workforces. We need good metrics to evaluate AI innovation.

The value of work

Due to the importance of gainful employment, even a short-term reduction in available jobs will create challenges, both financial and existential. Community and business leaders should prepare upskilling and retraining programmes, consider ways to support those who are out of work and, reinforce the value of *all* work.

We have much to discuss regarding the value of work beyond its utility. We must consider its place in New Zealand society, reflecting a long tradition of considering human dignity and its relation to work. To this end, community and business leaders working with MPs should hold a national conversation to determine limitations on AI in the workplace and the scope of its authority and decision-making.

CONCLUSION

Makridakis (2017) provides four different accounts of the impact of AI on humans: “The optimists, pessimists, pragmatists and the doubters. The optimists predict that humans will soon rely on robots to perform most of the work and thus be able to spend time on more important things. The pessimists believe that AI and robots could threaten to end humanity as AI might exceed human intelligence. The pragmatists believe that AI augments our skills, can be controlled and regulated, and we will stay ahead in the race against AI. Finally, the doubters believe that AI is a fad and cannot replace humans.”¹⁵¹

The mood of this report reflects the pragmatist cited above. It does not anticipate a golden age of leisure or the end of humanity, nor does it regard talk about AI and its abilities as a fad. Rather, the making of machine intelligence and learning is a remarkable achievement. Moreover, “rather than framing the AI debate as a zero-sum game between job killer and creator, it is crucial to consider the possibilities of human-AI collaboration. Indeed, the future of work will likely revolve around augmenting human potential with AI technologies rather than replacing humans altogether.”¹⁵²

We are more sanguine about AI when it comes to control and regulation. We see the latter as a threat to its development and the former as something difficult to affect—and at times unwanted. This raises an important issue we have already alluded to: the question of authority. How much authority do we cede to AI in our workplaces, and how much do we retain? Will there be instances where we need AI to act unilaterally, for example, during a kinetic or cyberattack, or in anticipation of a workplace accident or financial mishap? These might seem to be intangible considerations, but in relation to AI and the future of work, questions of autonomy or authority will become increasingly pressing for owners and employers. How much human oversight will they wish to retain?

With respect to accounts of AI’s impact on the future of employment, Howcroft and Taylor note that “Integral to [some] narratives is conjecture, that ‘big bang’ automation is imminent. If jobs or tasks can be automated, then they will be; technology adoption is unstoppable and even unproblematic and wholesale job displacement is inevitable. The sense of impending system-wide transformation is captured in the articulation of a paradigm shift, whether a Second Machine Age

(Brynjolfsson & McAfee, 2014), a Fourth Industrial Revolution (Schwab, 2016), a ‘fifth wave’ (Mason, 2015).”¹⁵³ This report is more ambivalent. It acknowledges an “impending system-wide transformation” is underway with AI permeating our lives, but does not accept that there will be “wholesale job displacement.” Too many variables and counterfactuals make this improbable. We see some occupations and industries being more rapidly and deeply affected by AI integration than others but anticipate that the practicalities and opportunities arising from implementation will prevent a sort of blanketing singularity where, suddenly, we all find ourselves out of work.¹⁵⁴ We agree that “accounts of automated futures suffer from a lacuna of agency, eschewing the mediating effects of possible variation in government policy, employers’ strategic choice and worker response,” and that “they neglect that technological implementation emerges through complex processes and that it is impossible to predict future uses of emerging technologies, which may well take pathways unanticipated by its originators.” But we strongly contend that while it might be “impossible to predict future uses of emerging technologies,”¹⁵⁵ it is wise to attempt to do so. We must plan for contingencies.

In sum, we think it prudent to prepare for AI’s rapid integration into work (and other areas of life), and we are challenged by the compelling simplicity of the claim that “our children will have a very different view of the place of humans in the world—that there is going to be a shift of focus from humans to machines. In the future, when we want to get the most objective, accurate, sensible, and wise advice, we’re not going to turn to a human being. We’re going to go ask a machine.”¹⁵⁶

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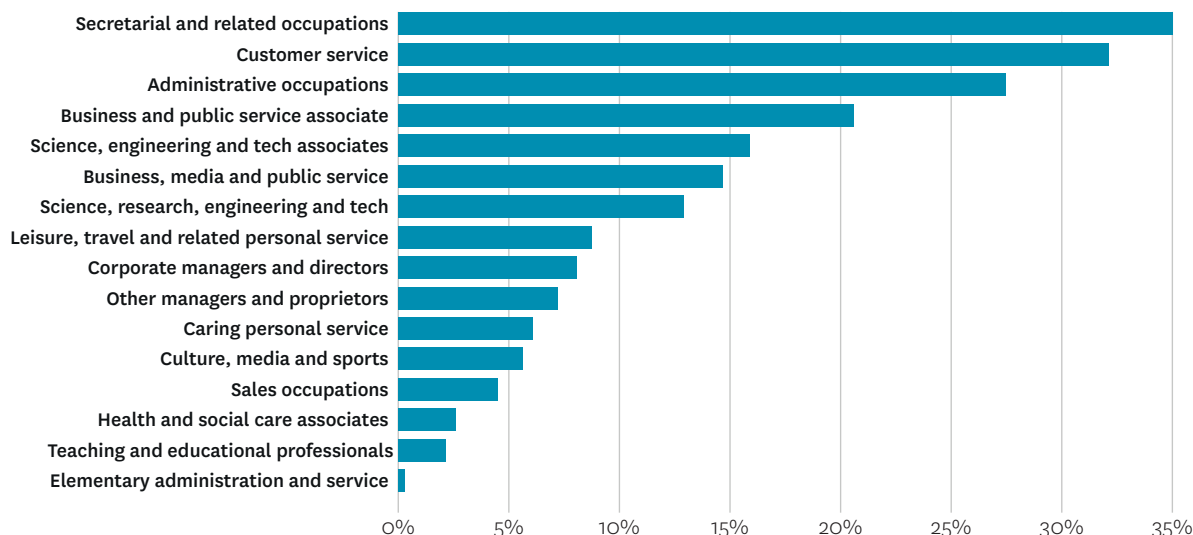
ENDNOTES

- 1 Robotic systems have markedly improved as machine intelligence has moved them away from simple automation to learning and engagement. Loredana Fattorini Nestor Maslej, Raymond Perrault, Vanessa Parli, Anka Reuel, Erik Brynjolfsson, John Etchemendy, Katrina Ligett, Terah Lyons, James Manyika, Juan Carlos Niebles, Yoav Shoham, Russell Wald, and Jack Clark, *The AI Index 2024 Annual Report*, Institute for Human-Centered AI, Stanford University (April 2024), 135-39.
- 2 Laura D. Tyson and John Zysman, "Automation, AI and Work," *Daedalus* (Cambridge, Mass.) 151, no. 2 (2022): 259, https://doi.org/10.1162/daed_a_01914.
- 3 Simon Benson, "AI Report Warns 30 Per Cent Of Australian Workers Could Be Affected Within Five Years," *The Australian*, 9 December 2024, <https://www.theaustralian.com.au/business/technology/ai-report-warns-30-per-cent-of-australian-workers-could-be-affected-within-five-years/news-story/f256e8baa76bee264e167f55aeca69ed>. Accessed 15 January, 2025.
- 4 Jean-Philippe Deranty and Thomas Corbin, "Artificial Intelligence and Work: A Critical Review of Recent Work from the Social Sciences," *AI and Society: Journal of Knowledge, Culture and Communication* (2022): 2, read://<https://link.springer.com?url=https%3A%2F%2Flink.springer.com%2Farticle%2F10.1007%2Fso0146-022-01496-x>.
- 5 Debra Howcroft and Phil Taylor, "Automation and the Future of Work: A Social Shaping of Technology Approach," *New technology, work, and employment* 38, no. 2 (2023): 352, <https://doi.org/10.1111/ntwe.12240>; Jeremy Schulz, Laura Robinson, and Barry Wellman, "Digital Automation and AI: Trajectories and Cultures in and Outside the Workplace," *The American behavioral scientist* (Beverly Hills) 67, no. 14 (2023): 1667, <https://doi.org/10.1177/00027642221127245>.
- 6 See, for instance, *Medical AIs With Human Faces Are On Their Way*, an article from the *Economist*, Technology Quarterly, a series of articles dedicated to AI. "Medical AIs With Human Faces Are On Their Way," *The Economist*, *Technology Quarterly* (2024), <https://www.economist.com/technology-quarterly/2024/03/27/medical-ais-with-human-faces-are-on-their-way>. Accessed January 15, 2025.
- 7 Gordon Hanson, "Immigration and Regional Specialization in AI," in *AI and Robots*, ed. Lili Yan Ing and Gene M. Grossman (Oxon: Routledge, 2023), 180.
- 8 "Early research on the benefits of industrial robots and AI has emphasized two potential sources of gain. First, these technological advances reduce production and operational costs. Robots can perform many tasks faster than humans and with greater precision and accuracy. AI can be used to predict problems along the production line and to leverage computation as an input to production. Agrawal et al. (2019), Atkinson and Ezell (2019), and Varian (2019), for example, have studied the potential productivity gains from the use of AI and robots and the associated declines in total production costs." Philippe Aghion et al., "The Effects of Automation on Labor Demand: A Survey of the Recent Literature," in *Robots and AI*, ed. Lili Yan Ing and Gene M. Grossman (Oxon: Routledge, 2023), 4. Other reasons include concerns over privacy and data security, as well as transparency, bias, and interference with democratic processes. Nestor Maslej, *The AI Index*, 160-211.
- 9 "Automation and offshoring affect similar occupations. Accordingly, automation may act as a substitute for offshoring, allowing firms to use robots in tasks that were previously performed abroad." A. Bonfiglioli et al., "Robots, Offshoring, and Welfare," ed. L. Y. Ing and G. M. Grossman (Oxon: Routledge, 2023), 67.
- 10 Ruiqui Sun and Daniel Trefler, "AI, Trade, and Creative Destruction: A First Look," in *Robots and AI*, ed. Lili Yan Ing and Gene M. Grossman (Oxon: Routledge, 2023), 310.
- 11 Which also carries challenges over bias: "Key ethical considerations for HR relate to ensuring that AI does not introduce bias into the hiring process, and other processes ranging from promoting and compensating, to training, evaluating, and developing." Bernadette Baum, "AI Challenges in The Workplace: Are Artificial Intelligence Policies Meeting Diversity, Equity, and Inclusion Thresholds?" *Journal of Business and Behavioral Sciences* 35, no. 3 (2023): 6.
- 12 One of the challenges New Zealand faces in this regard is its comparative lack of elasticity. It does not have broad and deep industry elasticity. Furthermore, the agriculture sector which dominates national GDP can quickly benefit from AI without increasing sector employment.
- 13 Deranty and Corbin, "Artificial Intelligence and Work," 14.
- 14 Aishat Semenova, Eliza Ozdamirova, and Svetlana Zyryanova, "The Future of Work: Automation, Artificial Intelligence and Information Technology," *New Technol Work Employ* 38 (2023 2023): 3, <https://doi.org/10.1051/e3sconf/202345105011>.
- 15 Tyson and Zysman, "Automation, AI and Work," 262.
- 16 Jaures Badet, "AI, Automation and New Jobs," *Open Journal of Business and Management* 9 (2021): 2457, <https://doi.org/10.4236/ojbm.2021.95132>.
- 17 Note, too, a "feature of the robot and AI industries is that a small number of countries hold significant shares in world production and exports with the dominance of Japan and Germany in robot exports in 2018. AI companies are also geographically concentrated in a few countries such as the US, China, the UK, Germany, France, and India (Samoli et al., 2020)." Taiji Furusawa, Shoki Kusaka, and Yoichi Sugita, "The Impacts of AI, Robots, and Globalization on Labor Markets Analysis of a Quantitative General Equilibrium Trade Model," in *Robots and AI*, ed. L. Y. Ing and G. M. Grossman (Oxon: Routledge, 2023), 124.
- 18 "With Sam Altman's Return, A Shift in AI From Idealism To Pragmatism," *The Economist* (2024), <https://www.economist.com/business/2023/11/23/sam-altmans-return-marks-a-new-phase-for-openai>; Miles Kruppa and Deepa Seetharaman, "A Godfather Of AI Just Won A Nobel. He Has Been Warning The Machines Could Take Over The World," *Wall Street Journal*, 9 October 2024, https://www.wsj.com/tech/ai/a-godfather-of-ai-just-won-a-nobel-he-has-been-warning-the-machines-could-take-over-the-world-b127da71?mod=saved_content. Accessed January 15, 2025.
- 19 "NVIDIA Blackwell Platform Arrives to Power a New Era of Computing," 2024, <https://nvidianews.nvidia.com/news/nvidia-blackwell-platform-arrives-to-power-a-new-era-of-computing>. Accessed January 15, 2025. But "the transformative potential of artificial intelligence (AI) is already apparent from our daily use of smartphones. We log in using AI-enabled facial recognition, issue commands with AI-enabled speech recognition, conduct AI-enabled internet searches, buy from stores pushing AI-enabled recommendations, and receive goods shipped with AI-enabled logistics systems. Not only has AI enabled the creation of new services, but it has also improved on existing services and disrupted older services in a familiar process of creative destruction (Schumpeter, 1942). All of these changes can be seen in the palm of our hand and are meticulously tracked by corporations." Sun and Trefler, "Creative Destruction," 310.
- 20 Even so, "According to a poll by the career guidance website Resumebuilder.com in February of this year [2023], some American businesses have begun using ChatGPT instead of actual employees. One thousand business leaders participated in the poll, and nearly half of the US corporations said they were using ChatGPT to replace staff in their organisations." Preeti Anand, "Is AI Stealing Jobs? Over 4000 Techies Lose Jobs to AI," *Dataquest* (2023): 1.
- 21 And note that "in 2023, a total of 149 foundation models [large-scale neural network architectures that undergo pre-training on vast amounts of unlabelled data—GPT, DALL-E, Llama, Mistral, etc.] were released, more than double the amount released in 2022." Furthermore, that "the number of AI patents skyrocket[ed]." Nestor Maslej, *The AI Index*, 14.
- 22 Meriem Zane, "Artificial Intelligence and Job Security Challenges," *Akofena* 3, no. 10 (2023): 23, <https://doi.org/10.48734/akofena.n010v3.02.2023>.
- 23 So, "By its very nature, technological change always disrupts the economic and social status quo, which is why innovation has created many opponents throughout history." Adam Thierer, *Can We Predict the Jobs and Skills Needed for the AI Era*, R Street (Washington DC, 2023), 2. Tech Council of Australia, *Meeting the AI Skills Boom* (Sydney, June 2024).

- 24 Tyson and Zysman, "Automation, AI and Work," 256.
- 25 "Overall, AI is designed to mimic cognitive functions, and it is likely that higher-paying, white-collar jobs will see a fair amount of exposure to the technology." Rakesh Kochhar, *Which U.S. Workers Are More Exposed to AI on Their Jobs?* Pew Centre (Washington, DC, 2024), 6, <https://www.pewresearch.org/social-trends/2023/07/26/which-u-s-workers-are-more-exposed-to-ai-on-their-jobs/>.
- 26 Nestor Maslej, *The AI Index*, 81. The research also records the countries with the highest degree of AI-related work employment with India, the USA, Germany, Canada, Israel, the UK, and Singapore leading the charge.
- 27 Indeed, "artificial intelligence is a routine-based technological change on steroids, adding intelligence to automation tools that substitute for humans in physical tasks and substituting for humans in routine and increasingly nonroutine cognitive tasks.... Artificial intelligence is the latest tool in a toolkit of 'automation' technologies that perform tasks previously performed by humans, often more cheaply, faster, and better." Tyson and Zysman, "Automation, AI and Work," 256.
- 28 Nestor Maslej, *The AI Index*, 279.
- 29 Aghion et al., "Labour Demand," 4.
- 30 Annabelle Liang, "AI to Hit 40% of Jobs and Worsen Inequality, IMF Says," *BBC* 2024, 1, <https://www.bbc.com/news/business-67977967>. See, too Carl Benedikt Frey and Michael A. Osborne, "The Future of Employment: How Susceptible are Jobs to Computerisation?" *Technological Forecasting and Social Change* 114, no. C (2017). The study has been cited over 10,000 times. The two business scholars predict that 47% of all jobs within the U.S. are at risk of technological replacement within two decades. Using a similar approach, Bowles arrives at an even higher figure, claiming that 54% of jobs in the EU and USA are under threat in the same time span (Bowles 2014). Many studies, using a variety of methods have added to these anticipations (Benzel et al. 2015; Bruun and Duka 2018; Halal et al. 2017; Schwab 2017; Chessell 2018; Gruetzemacher et al. 2020; Gruetzemacher et al. 2021). Deranty and Corbin, "Artificial Intelligence and Work," 6. Others are more upbeat and see regulation as critical to employment relations: "What we need to be thinking about is not, how do I regulate the technology? But how do I regulate the uses so that what we judge as a society to be bad uses....These are tools, plain and simple. We can argue whether they're conscious or whatever it might be. They don't have any goals or aspirations. They're not going to be drinking our fine wine and buying up all the beachfront property and marrying our children. You know, that's not the kind of thing we need to be worrying about. And they have no desire to wipe us out. If we build a machine using this technology to wipe us out, that'll be somebody, a human, designing and building that and making that happen." J. Kaplan, S. Likens, and A. Hazarika, "How will GenAI transform the workforce?" interview by E. O'Leary, 15 January, 2024, 4, <https://www.pwc.com/gx/en/issues/reinventing-the-future/take-on-tomorrow/gen-ai-workforce-podcast-episode.html>.
- 31 Joe Alan Jones, "Expanding Understandings of 'Work' in Response to AI," *Humanistic Management Journal* 8, no. 3 (2023): 381, <https://doi.org/10.1007/s41463-023-00163-7>.
- 32 Furusawa, Kusaka, and Sugita, "General Equilibrium," 123.
- 33 But note: "The most striking aspect of AI-based automation is the capacity of machines to operate autonomously, to 'learn' rather than function solely on preset patterns. As a result, labour economists, notably Acemoglu, Autor and Restrepo, highlight AI's relationship to "high skill automation" (Acemoglu and Restrepo 2018a, b), which compounds the exposure to automation of "higher skill" jobs. The Susskinds' related prediction of "the end of professions" is corroborated by a number of reports (for instance Manyika et al. 2017). In the area of medical diagnosis for instance, a number of AI systems (VizAI, PathAI, Buoy Health, Enlitic) are already operating, that complement and, in the future, might fully replace human specialists in symptoms diagnosis and treatment advice." Deranty and Corbin, "Artificial Intelligence and Work," 7.
- 34 Liang, "AI, Jobs and Inequality," 1.
- 35 Baum, "AI Challenges in The Workplace," 3.
- 36 Even so, "AI will continue, even intensify, automation's adverse effects on labour, including the polarization of employment, stagnant wage growth for middle- and low-skill workers, growing inequality, and a lack of good jobs." Tyson and Zysman, "Automation, AI and Work," 256.
- 37 Semenova, Ozdamirova, and Zyryanova, "The Future of Work: Automation, Artificial Intelligence and Information Technology," 2; Tyson and Zysman, "Automation, AI and Work," 257.
- 38 Thierier, *Skills Needed*, 10.
- 39 While acknowledging the categories we use for industry will be reworked, too. Consider the impact of Uber or Airbnb on transport, accommodation, and in the latter's case on housing and rentals.
- 40 But note: "Brynjolfsson and McAfee's publications, two business and technology experts, extol the capacity of intelligent machines to lift productivity, massively increase outputs and spur wealth creation, driving prices to zero for some commodities. Their celebrations of the digital revolution, however, come with warnings about the severe impact of AI-driven automation on labour markets, as technological advances create more losers than winners because of skill and capital bias." Deranty and Corbin, "Artificial Intelligence and Work," 6.
- 41 But note: "Weeks (2011) and Ferguson (2019), argue much of the necessary work of society is done in the home and outside of the workplace, and thereby remains unpaid and unappreciated. Furthermore, understanding work strictly in terms of economic necessity that can be wholly automated without issue does not adequately represent the entire nature of automation at work (Smith 2020)." Jones, "Understandings of 'Work'," 380.
- 42 For instance, from the T Resource Centre, "ONET 28.2 Database," ed. National Centre for O*NET Development (2023). www.onetcenter.org/database.html.
- 43 "A key issue [is] the methodological challenges in measuring AI-enabled technology's impact on jobs within organisations. In Europe at least, there is no administrative dataset or statutory survey dedicated to the impact of AI on jobs at the organisational level. Datasets that do include items on job related new technology and innovation do not allow in-depth examination of the effects of these on jobs (Napolitano and Greenan, 2021)." Wil Hunt, Sudipa Sarkar, and Chris Warhurst, "Measuring the impact of AI on jobs at the organization level: Lessons from a survey of UK business leaders," *Research Policy* 51, no. 2 (2022): 1, <https://doi.org/10.1016/j.respol.2021.104425>.
- 44 And see, "Studies have found large productivity gains and substantial price-reducing effects of the application industrial robots and AI at both the firm and aggregate levels. Notable examples of papers with such findings include Acemoglu and Restrepo (2018), Autor and Salomons (2018), Graetz and Michaels, (2018), Agrawal et al. (2019), Koch et al. (2019), and Acemoglu et al. (2020)." Aghion et al., "Labour Demand." Semenova, Ozdamirova, and Zyryanova, "The Future of Work: Automation, Artificial Intelligence and Information Technology," 2.
- 45 And note: "The automotive industry, plastic and chemical industries, and electrical, electronics, and machinery industries are most affected. The number of low-skilled workers in China, India, and Thailand among others would have been substantially higher in these respective industries if robot technology was at its 1993 level. It is worth emphasizing that in the automotive industry, which is one of the industries that install a large number of robots, robot technology displaced 213,092 low-skilled workers worldwide." Furusawa, Kusaka, and Sugita, "General Equilibrium," 141.

- 46 Placide Poba-Nzaou et al., "The Impacts of Artificial Intelligence (AI) on Jobs: An Industry Perspective," *Strategic HR review* 20, no. 2 (2021): 61, <https://doi.org/10.1108/SHR-01-2021-0003>. And see: "500,000 people work in the 10 occupations are set to be affected most by AI, with about 70 per cent of relevant workers earning above average salaries." Tom McLroy, "The 10 occupations that will be most affected by AI," *Australian Financial Review* 2023, <https://www.afr.com/politics/federal/the-10-occupations-that-will-be-most-affected-by-ai-20230516-p5d8vl>. Accessed January 15, 2025.
- 47 And, "Human skills can be complemented rather than copied by automated processes, with machines taking charge of the routine aspects of the job (Autor 2014; Brooks et al. 2020; Alarie et al. 2018; Ekbja and Nardi 2017)." Deranty and Corbin, "Artificial Intelligence and Work," 6.

See, too, current productivity gains by occupation:



C. Jung and B. S. Desikan, *Transformed by AI: How Generative Artificial Intelligence Could Affect Work in the UK-And How to Manage it*, Institute for Public Policy Research (London, 2024), 24.

- 48 Nestor Maslej, *The AI Index*, 257,58.
- 49 A study conducted by Harvard Business School in collaboration with Boston Consulting Group found that consultancy workers using generative AI became more efficient. Consultants using generative AI, specifically the large language model GPT-4, completed 12 per cent more tasks on average and finished tasks 25 per cent faster compared to those without AI access. Responses produced by consultants with access to generative AI were of higher quality, with a 40 per cent increase in quality compared to those without AI support (BCG 2023). Jung and Desikan, *Transformed by AI*, 20. Note, too, Accenture, for instance, is looking to employ 150,000 "AI agents" for 2025.
- 50 Cited in, for example, Jung and Desikan, *Transformed by AI*.
- 51 Jung and Desikan, *Transformed by AI*, 6.
- 52 Daron Acemoglu et al., "AI and Jobs: Evidence from Online Vacancies," (Cambridge: National Bureau of Economic Research, Inc, 2020), 2.
- 53 And note: "About 30 percent of the activities in 60 percent of all professions could be automated. In addition, automation affects less-educated workers and employees in less educated jobs." Badet, "New Jobs," 2454.
- 54 Acemoglu et al., "Jobs: Evidence," 25; Badet, "New Jobs," 2454.
- 55 With three advantages: "1. Quality of work: By taking over repetitive and mundane tasks, automation liberates human workers to focus on more intellectually stimulating and fulfilling work.
2. Safety and risk reduction: automation can be employed in hazardous or physically demanding work environments, reducing the risk of accidents and injuries for human workers.
3. (Remembering AI is a branch of computer science that aims to create machines that can learn, reason, and solve problems.) Enhanced decision-making: Advanced data analytics and AI enable organizations to make data-driven decisions, leading to more accurate and informed choices." Semenova, Ozdamirova, and Zyryanova, "The Future of Work: Automation, Artificial Intelligence and Information Technology," 2.
- 56 Zane, "Job Security," 23.
- 57 And Meriem Zane: AI will affect "job security in diverse ways, acting in certain situations as a complement to human skills, and in other cases as a replacement for them." Zane, "Job Security." Moreover: "The most striking aspect of AI-based automation is the capacity of machines to operate autonomously, to 'learn' rather than function solely on preset patterns. As a result, labour economists, notably Acemoglu, Autor and Restrepo, highlight AI's relationship to 'high skill automation' (Acemoglu and Restrepo 2018a, b), which compounds the exposure to automation of 'higher skill' jobs. The Susskinds' related prediction of 'the end of professions' is corroborated by a number of reports (for instance Manyika et al. 2017). In the area of medical diagnosis for instance, a number of AI systems (VizAI, PathAI, Buoy Health, Enlitic) are already operating, that complement and in the future might fully replace human specialists in symptoms diagnosis and treatment advice." Deranty and Corbin, "Artificial Intelligence and Work," 5. And Eva Selenko et al., "Artificial Intelligence and the Future of Work: A Functional-identity Perspective," *Current Directions in Psychological Science* 31, no. 3 (2022): 273, <https://doi.org/10.1177/096372142210918>; Patrick Kulp, "AI and Task Replacement: New Study Finds High-Wage Jobs With More Training Are More Exposed To AI," *Emerging Tech Brew*, 19 September 2024, https://www.emergingtechbrew.com/stories/2024/09/18/science-study-high-wage-jobs-ai?mbcid=36783734.356716&mbld=f1faa890bc85&mid=b4be0e0fbc476937d53b745356c9e6e8&utm_campaign=etb&utm_medium=newsletter&utm_source=morning_brew. Accessed January 15, 2025.
- 58 Note, too: "Algorithmic management raises obvious issues of privacy (Bhave et al. 2020; Ebert et al. 2021; Fukumura et al. 2021; Tsamados et al. 2022), not just

at the workplace, but also at home, notably following the pandemic-induced shift to home-based working (Collins 2020). Privacy infringements can occur at all stages of the data cycle: at the time of collection, in the analysis of the data, in the use of the data, and when data ought to be erased. Breaches of privacy touch on a fundamental human right, but they also represent a strong leverage tool for managers, with which they can exert control and undermine autonomy (Shapiro 2018). Haenlein et al. (2022) give the example of a technology such as Status Today, which 'can scrutinize staff behaviour on a minute-to-minute basis by collecting data on who sends emails to whom at what time, who accesses and edits files, and who meets whom and allows firms to compare such activity data with employee performance.' Surveillance can lead to increased pressure on workers to perform, taking away moments of respite, as is well documented in warehouse (Hanley and Hubbard 2020) and platform work (Newlands 2021a, b). This can have severe and long-term impact on well-being. Algorithmic control of the work process takes away the dimensions of personal intervention, choice and even of creativity (Huang 2021)." Deranty and Corbin, "Artificial Intelligence and Work," 12.

59 Kochhar, *Which Workers?* 5.

60 "Uniquely human skills not susceptible to AI *currently* [emphasis added] include social/interpersonal skills (teachers, care and health care workers, physical therapists, and hairdressers); physical skills in unpredictable environments (construction workers and plumbers); and general intelligence skills required for nonroutine tasks and problem-solving (management and artists)." Tyson and Zysman, "Automation, AI and Work," 261.

61 Jung and Desikan, *Transformed by AI*, 10.

62 Re tasks Selenko, et al., note that: "AI-enhanced processes can also replace various cognitive and manual tasks previously done by humans, including (a) arduous and repetitive tasks (e.g., pattern recognition, stock refilling), (b) other routine tasks (e.g., scheduling, diagnostics, data search), and (c) more highly skilled tasks associated with complex decision making (e.g., AI-automated financial, legal, or policing decisions; customer service).....If the replacement of tasks is accompanied by the replacement of humans, this will also alter the social fabric of work, which, in turn, will affect how remaining workers can validate their existing work-related identities (Endacott, 2021)." Selenko et al., "Artificial Intelligence and the Future of Work: A Functional-identity Perspective," 276.

63 Furusawa, Kusaka, and Sugita, "General Equilibrium," 123.

64 Jung and Desikan, *Transformed by AI*, 11.

65 And "within health care, AI is likely to complement the demand for high-wage workers performing nonroutine tasks requiring specialized skills and education while substituting for workers performing routine tasks. In particular, AI applications are likely to substitute for humans in data-dependent cognitive tasks in administrative and office support activities and patient relationship management while increasing the demand for humans in work performed by health professionals like nurses, doctors, physical therapists, and dentists whose responsibilities require high-level cognitive and/or highly skilled physical and social interaction tasks. The automation of administrative and data collection tasks, further enabled by telemedicine platforms, could be transformative for nurses who spend on average a quarter of their time on such duties, empowering them to use AI-informed results to offer more real-time health advice, diagnosis, and treatment." Tyson and Zysman, "Automation, AI and Work," 263.

66 Patrick Kulp, "AI Has Become A Key Tool For Gen Z Side Hustles," *Emerging Tech Brew*, 13 September 2024, https://www.emergingtechbrew.com/stories/2024/09/12/ai-gen-z-side-hustles-samsung-report?mbcid=36714364.366623&mbid=4e04084da050&mid=b4be0e0fe476937d53b745356c9e6e8&utm_campaign=etb&utm_medium=newsletter&utm_source=morning_brew, Accessed January 15, 2025.

67 *AI: From Experimentation to Implementation*, (2024), 17, <https://www.eiu.com/n/campaigns/ai-from-experimentation-to-implementation/>. Accessed January 15, 2025. With Gartner noting "the number of organizations implementing AI grew 270 % in the past seven years and has tripled in the last two years." Zane, "Job Security," 22.

68 Zane, "Job Security," 22.

69 Sri Viswanath, Vibhor Khanna, and Yijia Liang, *The AI Revolution* (New York: Coatue Management, 2023), 7. <https://www.coatue.com/blog/perspective/ai-the-coming-revolution-2023>.

70 Viswanath, Khanna, and Liang, *The AI Revolution*, 25.

71 Deranty and Corbin, "Artificial Intelligence and Work," 10.

72 Viswanath, Khanna, and Liang, *The AI Revolution*, 50.

73 Roughly corresponding with the three phases of Jung and Desikan, *Transformed by AI*, 6.

74 And note: "A significant portion of professional work in fact involves routine activities (Ford 2015, 2021; Susskind and Susskind 2015, 2020) such that, even if some "higher" cognitive components are involved (memorisation, or complex judgement, or evaluation), "higher skill" jobs are themselves open to automation by AI. In legal practice, for instance, Susskind's own area of expertise, PerfTech. AI's "Artificial Law Clerk" promises vastly increased accuracy and productivity and overall reduced costs." Deranty and Corbin, "Artificial Intelligence and Work," 5.

75 Adapted from Jung and Desikan, *Transformed by AI*, 17.

76 Anand, "Is AI Stealing Jobs? Over 4000 Techies Lose Jobs to AI," 1.

77 Kochhar, *Which Workers?* 3.

78 Ester Faia et al., "On the Employment Consequences of Automation and Offshoring: A Labor Market Sorting View," in *Robots and AI*, ed. Lili Yan Ing and Gene M. Grossman (Oxon: Routledge, 2023), 87.

79 Thierier, *Skills Needed*, 12.

80 "Jobs [USA] with a high level of exposure to AI tend to be in higher-paying fields where a college education and analytical skills can be a plus.

—Those with more education: workers with a bachelor's degree or more (27%) are more than twice as likely as those with a high school diploma only (12%) to see the most exposure;

—Women: a greater share of women (21%) than men (17%) are likely to see the most exposure to AI. This is because of differences in the types of jobs held by men and women. Asian and White: Asian (24%) and White (20%) workers are more exposed than Black (15%) and Hispanic (13%) workers.

—Higher-wage workers: in 2022, workers in the most exposed jobs earned \$33 per hour, on average, compared with \$20 in jobs with the least amount of exposure." Kochhar, *Which Workers?* 4.

81 Milena Nikolova and Femke Cnossen, "Robots, Meaning, and Self-Determination," *Research Policy* 53, no. 5 (2023), 104987, <https://doi.org/https://doi.org/10.1016/j.respol.2024.104987>.

- 82 The *actual* number of people employed is fewer than the total 2,991,357 indicated as responses included individuals working in more than one industry. Further, the total of 2,991,357 includes a "Missing" row of 110,103 people who are known to be employed but whose area of industry is uncertain. And note: At the time of writing this report, 2023 Census tables showing industry responses disaggregated by level 1 ethnicity are unavailable. This information is expected to be released in mid-2025. To address this gap, the experimental administrative population census (APC) figures were utilised, which include 2022 data for industry responses by ethnicity. To estimate 2023 values, percentage changes derived from the Household Labour Force Survey (HLFS) were applied for the June quarters of 2022 and 2023. These percentage changes serve as marginal constraints, guiding the estimation of 2023 figures. The iterative proportional fitting (IPF) method was selected as a robust approach to integrate these marginal constraints, ensuring that both row (industry) and column (ethnicity) totals align with more closely with observed trends.
- See: <https://www.stats.govt.nz/research/experimental-administrative-population-census-third-iteration-information-by-variable/#employment-ind>; <https://www.stats.govt.nz/research/experimental-administrative-population-census-data-sources-methods-and-quality-second-iteration/>; <https://www.stats.govt.nz/information-releases/labour-market-statistics-december-2023-quarter> <https://www.stats.govt.nz/experimental/experimental-administrative-population-census#:-.text=The%20administrative%20population%20census%20%28APC%29%20derives%20census-type%20information,use%20of%20administrative%20data%20to%20produce%20census%20information>. Accessed January 15, 2025.
- 83 Ibid. And note: The *actual* number of people employed is fewer than the total 2,991, 357 indicated as responses included individuals working in more than one industry. Further, the total of 2,991, 357 includes a "Missing" row of 110,103 people who are known to be employed but whose area of industry is uncertain. The total number of responses by gender for 2022 was 2,873,847 Accessed January 15, 2025.
- 84 Regarding new discoveries and solving problems, Ray Kurzweil notes: "In all of history until November 2023, humans had discovered about 20,000 stable inorganic compounds for use across all technologies. Google's GNoME AI discovered far more, increasing that figure overnight to 421,000." Ray Kurzweil, "Ray Kurzweil on How AI will Transform the Physical World," *The Economist* (June 2024), <https://www.economist.com/by-invitation/2024/06/17/ray-kurzweil-on-how-ai-will-transform-the-physical-world>. Accessed January 15, 2025.
- 85 "AI can be used to learn about human preferences, to allocate goods and services from where they are most readily available to where they are needed, thereby enhancing efficiency in logistics and delivery. These potential benefits of AI have been touted in recent work by Parkes and Wellman (2015), Atkinson (2019), Milgrom and Tadelis (2019), Davenport et al. (2019), and McKinsey and Company (2019)." Aghion et al., "Labour Demand," 4. Furthermore, "Artificial intelligence is transforming the retail industry across its value chain. On the demand side, businesses are shifting from traditional instore channels to e-commerce channels, especially digital platforms, to anticipate demand and personalize the customer experience. On the supply side, AI is being applied to improve inventory forecasts, optimize merchandising and product assortment, and automate warehousing and store operations. Overall employment in retail is likely to continue to decline." Tyson and Zysman, "Automation, AI and Work," 263.
- 86 ONET Resource Centre, "ONET 28.2 Database," ed. National Centre for O*NET Development (2023). www.onetcenter.org/database.html.
- 87 Office for National Statistics, "Labour Force Survey Q1 2023," ed. ONS (2023). <https://www.ons.gov.uk/surveys/informationforhouseholdsandindividuals/householdandindividualsurveys/labourforcesurvey>.
- 88 AI-exposure rankings of 873 detailed occupations from the O*NET data are matched to 485 broader occupations. Kochhar, *Which Workers?* 1.
- 89 Adapted from Jung and Desikan, *Transformed by AI*, 18.
- 90 Jung and Desikan, *Transformed by AI*, 23.
- 91 Adapted from Jung and Desikan, *Transformed by AI*, 18.
- 92 Though Rakesh Kochhar: "About a fifth of all workers [USA] have high-exposure jobs; women, Asian, college-educated and higher-paid workers are more exposed." Kochhar, *Which Workers?* 1.
- 93 Moreover, in two further areas AI performs impressively: "*Legal knowledge and reasoning*. GPT4 scored better than about 90 per cent than humans in the US Bar exam (Eloundou et al 2023). Martin et al (2024) found that Large Language Models (LLMs) such as GPT4 performed "on par with LPOs and Junior Lawyers, accurately determining legal issues within contracts", while "a 99.6 per cent reduction in cost". GPT4 also scored highly on standardised tests such as the SAT, GRE, and various AP exams (OpenAI 2023). Notably, these tests aim to check the ability to apply complex reasoning to novel tasks rather than simply checking whether models are able to 'regurgitate' answers from their training data. While there is still some controversy about this, there is little doubt that generative AI models have significant reasoning abilities in certain tasks and contexts. *Medical knowledge and reasoning*. A comprehensive evaluation highlighted GPT-4's proficiency in medical competency exams, where it exceeded the passing score on the United States Medical Licensing Examination (USMLE), without being explicitly trained on the exam (Nori et al 2023)." Jung and Desikan, *Transformed by AI*, 12.
- 94 An interesting summary of a Gartner Symposium observes that in relation to AI, health and therapy, and issues of replacement, "humans have always tended to anthropomorphize things." Thus, "Kate Darling (MIT Media Lab) noted how people relate to stuffed animals, as we are born to recognize faces. But we also respond to movement, and she claimed that 85% of Roomba owners give those robotic vacuum cleaners names. She went back to an experiment referenced in the opening keynote, in which researchers spent an hour playing with Pleo, a robotic toy dinosaur. After groups of researchers spent time with the toy and gave it a name, they were handed a hammer and knife and told to destroy it. All refused. She had seen similar things with other robots and says we respond on cue to lifelike robots. 'People treat these things differently to other devices,' she said. Darling discussed how people react to humanoid robots, telling some of the same stories as Mesaglio did in her talk, including talking about how people react to robots in hospitals. She believes we should take people like Blake Lemoine—the Google engineer who said he thought Google's AI system was 'sentient'—more seriously. What matters is that people treat some robots as if they were sentient. She noted that such robots have already served as a substitute for animal therapy. In the future we have the choice as to how to deal with social robots, and how to integrate them into our lives responsibly and effectively. The true potential of robots and AI is not to replace something we have, but to create something new." Mary Mesaglio and Helen Poitevan, "Gartner: How AI Will Impact Work" (paper presented at the Gartner Symposium, Gold Coast, Australia, 2024), 3; US-EU Trade and Technology Council, *The Impact of Artificial Intelligence on the future of workforces in the European Union and the United States of America*, The White House (2022), 17, <https://www.whitehouse.gov/wp-content/uploads/2022/12/TTC-EC-CEA-AI-Report-12052022-1.pdf>. Accessed January 15, 2025.
- 95 Adapted from Jung and Desikan, *Transformed by AI*, 19.
- 96 There may be an opportunity to extend and develop hubs or centres of excellence in the North and South Island which focus on sport and become beacons that attract men and women who want a future in sport, and the industries which surround it (coaching, physiotherapy, nutrition, mental health, etc.). AI will no doubt be a part of these, but the core practices and business of sport will remain human ones. New Zealand should continue to make its mark on sport at home and internationally. Elevating its importance and the building blocks to make it so should be a priority in relation to future careers and employment.
- 97 "That AI and robotics will upend some jobs, skills and industries is a given. But which ones, and in what measure are questions that remain unanswered. The result of these questions has been continuous crystal ball-gazing exercises by academics and policymakers....It's tough to make predictions, especially about the future." Thierier, *Skills Needed*, 2.
- 98 Baum, "AI Challenges in The Workplace," 4.

- 99 Baum, "AI Challenges in The Workplace," 4.
- 100 "U.S. tech giant Google signed a nuclear power purchase agreement with small modular reactor developer Kairos Power to buy 500 megawatts of electricity to support its data centres and artificial intelligence technologies, according to an Oct. 14 post on Google's blog. Google said the deal is intended to help bring Kairos Power's first SMR online by 2030, with the rest of the six reactors included under the deal being built by 2035." *Rane Intelligence*, (15 October 2024), <https://worldview.ranenetwork.com/content/situation-report/us-google-signs-deal-small-modular-reactor-developer-nuclear-power>. Accessed January 15, 2025.
- 101 And this on top of the indirect disruption, for example, in transport and logistics, caused by gig workers with Amazon and Uber.
- Selenko, et al., state that "Work-related identities reflect "who you are" and "what you do" regarding work. They are informed by the social groups people feel part of and by enactment of certain behaviours that are prototypical for those groups, and they offer important social recognition for those behaviours (Ashforth & Schinoff, 2016; Nelson & Irwin, 2014). Work offers plenty of opportunities for social self-categorization in that people can see themselves as part of an occupation, an organization, or a work team. People act according to social-group norms in their work and thereby gain social recognition. Furthermore, work-related identities fulfil multiple important identity functions. For example, they provide a sense of self-esteem and offer opportunities to experience meaning, a sense of belonging, and competence (see Ashforth & Schinoff, 2016). In addition, work contexts—especially teams, colleagues, and supervisors, along with their respective organizations and communities—can offer social validation to ingrain those work-related identities." Selenko et al., "Artificial Intelligence and the Future of Work: A Functional-identity Perspective," 275.
- 102 For: "Some skills which come naturally to human beings require massive amounts of computational power to replicate and consequently, "it will be hardest for new technology to replace the tasks and jobs that workers in the lower skill level occupations perform, such as security staff, cleaners, gardeners, and chefs." Deranty and Corbin, "Artificial Intelligence and Work," 6.
- 103 Flavia Pereira, "USAF's F-16 to Fly Pilotless for First Time in 2025," *Shephard*, 14 May 2024, <https://www.shephardmedia.com/news/air-warfare/us-air-forces-f-16-to-first-fly-pilotless-next-year/>. Accessed January 15, 2025.
- 104 James Hurley, "AI Has The Potential To 'Cure All Diseases,'" *The Australian*, 2 October 2024, <https://www.theaustralian.com.au/world/the-times/ai-has-the-potential-to-cure-all-diseases/news-story/ego64fa7d2a71b1d1f3c6d99c9dab8d>. Accessed January 15, 2025; Nestor Maslej, *The AI Index*, 314, 19.
- 105 Adapted from Jung and Desikan, *Transformed by AI*, 21.
- 106 Thierier, *Skills Needed*, 2.
- 107 Kaplan comments: "Being positive around this is important, but being responsible around this is more important." Kaplan, Likens, and Hazarika, interview.
- 108 Maxim Institute has published a separate supplementary paper on the statistical method used to calculate numbers in this paper. The *actual* number of people employed is fewer than the total 2,991,357 indicated as responses included individuals working in more than one industry. Further, the total of 2,991,357 includes a "Missing" row of 110,103 people who are known to be employed but whose area of industry is uncertain. See: <https://www.stats.govt.nz/research/experimental-administrative-population-census-third-iteration-information-by-variable/#employment-ind>; <https://www.stats.govt.nz/research/experimental-administrative-population-census-data-sources-methods-and-quality-second-iteration/>; <https://www.stats.govt.nz/information-releases/labour-market-statistics-december-2023-quarter> <https://www.stats.govt.nz/experimental/experimental-administrative-population-census#:~:text=The%20administrative%20population%20census%20%28APC%20%20derives%20census-type%20information,use%20of%20administrative%20data%20to%20produce%20census%20information>. Accessed January 15, 2025.
- 109 [https://explore.data.stats.govt.nz/vis?fs\[o\]=2023%20Census%20Co%7CWork%23CAT_WORK%23&fs\[1\]=Occupation%20Co%7CTotal%20-%20ooccupation%2399%23&pg=o&fc=Occupation&snb=2&df\[ds\]=ds-nsiwsdisseminate&df\[id\]=CEN23_WRK_008&df\[ag\]=STATSNZ&df\[vs\]=1.o&dq=2023.9999.77%2B1%2B2%2B3%2B4%2B6%2B7%2B8%2B5.9.10%2B11%2B12%2B13%2B14%2B15%2B16%2B17%2B18%2Bog%2B19%2B08%2Bo7%2Bo6%2Bo5%2Bo4.99%2B3%2B2%2B1&ly\[cl\]=CEN23_AGE_007&ly\[rw\]=CEN23_OCC_002%2CCEN23_GEN_002&to\[TIME\]=false](https://explore.data.stats.govt.nz/vis?fs[o]=2023%20Census%20Co%7CWork%23CAT_WORK%23&fs[1]=Occupation%20Co%7CTotal%20-%20ooccupation%2399%23&pg=o&fc=Occupation&snb=2&df[ds]=ds-nsiwsdisseminate&df[id]=CEN23_WRK_008&df[ag]=STATSNZ&df[vs]=1.o&dq=2023.9999.77%2B1%2B2%2B3%2B4%2B6%2B7%2B8%2B5.9.10%2B11%2B12%2B13%2B14%2B15%2B16%2B17%2B18%2Bog%2B19%2B08%2Bo7%2Bo6%2Bo5%2Bo4.99%2B3%2B2%2B1&ly[cl]=CEN23_AGE_007&ly[rw]=CEN23_OCC_002%2CCEN23_GEN_002&to[TIME]=false). Accessed January 15, 2025.
- 110 Baum, "AI Challenges in The Workplace," 11.
- 111 Note, "Recent studies increasingly adopt a task-based approach to estimating the labour-market impacts of industrial robots and AI, and these typically predict less dire outcomes than those that focus on displacements. For example, Arntz et al. (2016) using a task-based approach, estimate that only about 9% of occupations in OECD countries are highly vulnerable to automation." Aghion et al., "Labour Demand," 5.
- 112 [https://explore.data.stats.govt.nz/vis?fs\[o\]=2023%20Census%20Co%7CWork%23CAT_WORK%23&fs\[1\]=Occupation%20Co%7CTotal%20-%20ooccupation%2399%23&pg=o&fc=Occupation&snb=2&df\[ds\]=ds-nsiwsdisseminate&df\[id\]=CEN23_WRK_008&df\[ag\]=STATSNZ&df\[vs\]=1.o&dq=2023.9999.77%2B1%2B2%2B3%2B4%2B6%2B7%2B8%2B5.9.10%2B11%2B12%2B13%2B14%2B15%2B16%2B17%2B18%2Bog%2B19%2B08%2Bo7%2Bo6%2Bo5%2Bo4.99%2B3%2B2%2B1&ly\[cl\]=CEN23_AGE_007&ly\[rw\]=CEN23_OCC_002%2CCEN23_GEN_002&to\[TIME\]=false](https://explore.data.stats.govt.nz/vis?fs[o]=2023%20Census%20Co%7CWork%23CAT_WORK%23&fs[1]=Occupation%20Co%7CTotal%20-%20ooccupation%2399%23&pg=o&fc=Occupation&snb=2&df[ds]=ds-nsiwsdisseminate&df[id]=CEN23_WRK_008&df[ag]=STATSNZ&df[vs]=1.o&dq=2023.9999.77%2B1%2B2%2B3%2B4%2B6%2B7%2B8%2B5.9.10%2B11%2B12%2B13%2B14%2B15%2B16%2B17%2B18%2Bog%2B19%2B08%2Bo7%2Bo6%2Bo5%2Bo4.99%2B3%2B2%2B1&ly[cl]=CEN23_AGE_007&ly[rw]=CEN23_OCC_002%2CCEN23_GEN_002&to[TIME]=false). Accessed January 15, 2025.
- 113 Matt Bell, "Accounting Firms Deloitte, EY, KPMG And PwC Reveal How AI Will Change Professional Services," *Australian Business Review* (9 December 2024), <https://www.theaustralian.com.au/business/companies/accounting-firms-deloitte-ey-kpmg-and-pwc-reveal-how-ai-will-change-professional-services/news-story/gd604ece534c897f028ef7b4b20621d9>; and note: Patrick Kulp, "Business' Not Ready," *Emerging Tech Brew*, 23 November 2024, https://www.emergingtechbrew.com/stories/2024/11/22/businesses-ai-readiness?mbcid=37612972.364231&mbid=6c22126a7aa2&mid=b4be0e0fbae476937d53b745356c9e6e8&utm_campaign=etb&utm_medium=newsletter&utm_source=morning_brew; Belle Lin, "Bain Expanding: One Million Customers Paying for Chat GPT, Including 13,000 Consultants," *Wall Street Journal*, 17 October, 2024, <https://www.wsj.com/articles/openai-bain-expand-ai-partnership-to-sell-chatgpt-to-businesses-d17775dc>. Accessed January 15, 2025.
- 114 And note in addition to usual concerns about AI and bias generally, the attention given to *algorithmic management* which can "perpetuate societal biases and reproduce discriminatory practices at work, whether the discrimination is built into the algorithms, or management's use of the algorithm, or as a result of customer's rating of workers (Noble 2018; Benjamin 2019; Kellogg et al. 2020; Akter et al. 2021; Zajko 2021; Heinrichs 2022). Deranty and Corbin, "Artificial Intelligence and Work," 12.
- 115 Baum, "AI Challenges in The Workplace," 6.
- 116 For instance: "A recent report by Pew Research Center revealed that Asian American employees are more exposed than other racial groups to artificial intelligence. The survey of about 11,000 employees found that 24 percent of Asian American workers are in fields categorized as 'most exposed' to AI, followed by white (20 percent), Black (15 percent), and Hispanic (13 percent) employees (Gonzalez, 2023)." Baum, "AI Challenges in The Workplace," 7. And note, Geoffrey Hinton, the pioneer of artificial neural networks admits that while AI's contributions to health care, for example, are "groundbreakingly positive," its potential for bias and disruption in employment should be of significant concern. Scott Pelley, *The Risks and Promise of Artificial Intelligence, according to the "Godfather of AI" Geoffrey Hinton*, CBS (2023), https://www.cbs.com/shows/video/msBwYU_iFWFTzPcN1b0caPIMGxwYuU2/.
- 117 Stats NZ Tātaraunga Aotearoa, "National Census," (2018). <https://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE8324#>. Accessed January 15, 2025.

118 The following data for Europeans and Asians is drawn from: *Employment indicator and status in employment*: <https://www.stats.govt.nz/research/experimental-administrative-population-census-third-iteration-information-by-variable/#employment-ind>; Stats NZ (2022); *Experimental administrative population census: Data sources, methods, and quality (second iteration)*: [www.stats.govt.nz: https://www.stats.govt.nz/research/experimental-administrative-population-census-data-sources-methods-and-quality-second-iteration/](https://www.stats.govt.nz/research/experimental-administrative-population-census-data-sources-methods-and-quality-second-iteration/); and *Experimental administrative population census* | Stats NZ: <https://www.stats.govt.nz/experimental/experimental-administrative-population-census#:~:text=The%20administrative%20population%20census%20%28APC%29%20derives%20census-type%20information,use%20of%20administrative%20data%20to%20produce%20census%20information>. Accessed January 15, 2025. See also supplementary paper to this report *Statistical Analysis: Method for Estimating 2023 Industry Responses by Ethnicity Using the Iterative Proportional Fitting (IPF) Method*.

119 In answer to this question, business owners/users might decide *where privacy and security risks are a concern*; i.e., if organisations do not develop their LLMs and generative AI in-house, they will likely be giving away large and important data to the developers of those technologies, which they might not want to do. Moreover, these complex ML models are very difficult to understand which means business owners/users are effectively unable to be transparent about how biased the models are. These two ethical hurdles may especially slow down government adoption.

120 The following data for Māori is drawn from: *Employment indicator and status in employment*: <https://www.stats.govt.nz/research/experimental-administrative-population-census-third-iteration-information-by-variable/#employment-ind>; Stats NZ (2022); *Experimental administrative population census: Data sources, methods, and quality (second iteration)*: [www.stats.govt.nz: https://www.stats.govt.nz/research/experimental-administrative-population-census-data-sources-methods-and-quality-second-iteration/](https://www.stats.govt.nz/research/experimental-administrative-population-census-data-sources-methods-and-quality-second-iteration/); and *Experimental administrative population census* | Stats NZ: <https://www.stats.govt.nz/experimental/experimental-administrative-population-census#:~:text=The%20administrative%20population%20census%20%28APC%29%20derives%20census-type%20information,use%20of%20administrative%20data%20to%20produce%20census%20information>. Accessed January 15, 2025. See also supplementary paper to this report *Statistical Analysis: Method for Estimating 2023 Industry Responses by Ethnicity Using the Iterative Proportional Fitting (IPF) Method*.

121 And “platforms for renting out assets (such as Airbnb and BlaBlaCar) also offer new labour and income opportunities, even while they alter the character of work and the skills required for tasks.” Tyson and Zysman, “Automation, AI and Work,” 262.

122 The following data for Pacific Peoples is drawn from: *Employment indicator and status in employment*: <https://www.stats.govt.nz/research/experimental-administrative-population-census-third-iteration-information-by-variable/#employment-ind>; Stats NZ (2022); *Experimental administrative population census: Data sources, methods, and quality (second iteration)*: [www.stats.govt.nz: https://www.stats.govt.nz/research/experimental-administrative-population-census-data-sources-methods-and-quality-second-iteration/](https://www.stats.govt.nz/research/experimental-administrative-population-census-data-sources-methods-and-quality-second-iteration/); and *Experimental administrative population census* | Stats NZ: <https://www.stats.govt.nz/experimental/experimental-administrative-population-census#:~:text=The%20administrative%20population%20census%20%28APC%29%20derives%20census-type%20information,use%20of%20administrative%20data%20to%20produce%20census%20information>. Accessed January 15, 2025. See also supplementary paper to this report *Statistical Analysis: Method for Estimating 2023 Industry Responses by Ethnicity Using the Iterative Proportional Fitting (IPF) Method*.

123 Thierer, *Skills Needed*, 7.

124 On a separate note, Oxford Insights, which provides AI strategy for governments, created an index in December 2023, ranking 193 countries on AI readiness and using 39 indicators, like privacy legislation, foundational IT infrastructure, and STEM graduates. New Zealand ranked 49th with Australia at 12th and Canada at 5th. Billy Hurley, “‘Best’ Country Analysis Also Reveals Who’s Most Excited About AI,” *Emerging Tech Brew*, 12 Septembr 2024 2024, https://www.itbrew.com/stories/2024/09/11/best-country-analysis-also-reveals-who-s-most-excited-about-ai?mbcid=36726669.354734&mblid=g1f1903dcfao&mid=b4be0e0f467937d53b745356c9e6e8&utm_campaign=etb&utm_medium=newsletter&utm_source=morning_brew. Accessed January 15, 2025.

125 Liang, “AI, Jobs and Inequality,” 1.

126 Paul Henderson, *At the Cutting Edge: How Artificial Intelligence will Change our Primary Sector Forever*, Maxim Institute (Auckland, 2023), <https://www.maxim.org.nz/article/at-the-cutting-edge-how-artificial-intelligence-will-change-our-primary-sector-forever/>.

127 Natasha Baulis, *AI and Education* (Auckland: Maxim Institute, 2024).

128 Thus, “research shows that employers can assist workers in forming new identities conducive to acceptance and mastery of AI by providing narratives that focus on sensemaking and identity development (e.g., “we are on the advanced side of technology”), and help reduce workers’ fears or aversion to AI (Tong et al., 2021). Employers must also appropriately retool, retrain, and reskill workers (Brunn et al., 2020), so that they can interact with AI in ways that get them closer to their ideal work selves (Endacott, 2021). Offering social validation and a safe liminal space to restructure and enact new identities can also help sustain these efforts (Chen & Reay, 2021).” Selenko et al., “Artificial Intelligence and the Future of Work: A Functional-identity Perspective,” 277.

129 And creates other problems. Gartner’s Helen Poitevin has revealed “that workers who thought AI could replace their jobs were 27% more likely to intend to leave those jobs in the next year. At an average organization of 10,000 employees, this decrease in intent to stay costs \$53million per year in total costs and lost productivity. Employers can change this by demystifying some of the thoughts about AI and work. Intent to stay can increase significantly by training and upskilling.” Mesaglio and Poitevin, “Gartner: How AI Will Impact Work,” 5.

130 Schulz, Robinson, and Wellman, “Digital Automation and AI,” 1668.

131 And see, “People who have been found to mourn the loss of changed work, try to conserve existing professional identities, and avoid new tasks (Chen & Reay, 2021).” Moreover, “Workers who are entrenched in standard procedures are likely to experience threat after AI implementation (Nelson & Irwin, 2014), whereas those with a more playful frame of reference (e.g., high levels of openness to experience) are more likely to experience positive identity growth (Schneider & Sting, 2020). Research confirms that senior experts tend to experience greater identity threat from task replacement by AI than beginners do (Strich et al., 2021).” Selenko et al., “Artificial Intelligence and the Future of Work: A Functional-identity Perspective,” 276; AI Centre for Education and Training, *Future of Jobs Report*, World Economic Forum (2023), 2. <https://www.weforum.org/publications/the-future-of-jobs-report-2023/>. Accessed January 15, 2025.

132 Schulz, Robinson, and Wellman, “Digital Automation and AI,” 276.

133 While some see an AI summer arriving and others an autumn. Mesaglio and Poitevin, “Gartner: How AI Will Impact Work,” 7.

134 “[Reporting] frequently take a binary Utopian or dystopian form. ‘Tech Utopians’ (notably Bastani, 2019; Mason, 2015; Srnicek & Williams, 2015) regard automation as delivering a postcapitalist society culminating in liberation from work and a commensurate expansion of leisure time. Dystopian perspectives, mostly concerned with automation’s ability to polarise labour markets and eradicate ‘susceptible’ lower-skilled jobs, have focussed additionally on threats to the highly skilled and highly paid.” Howcroft and Taylor, “Automation and the Future of Work: A Social Shaping of Technology Approach,” 353. And: “Developments in digital technology have raised debates about the future of work and, indeed, whether there will be any work in the future for humans (Dunlop, 2016).” Hunt, Sarkar, and Warhurst, “Measuring the impact of AI on jobs at the organization level: Lessons from a survey of UK business leaders,” 1.

135 Thus, “For scholars who hold a ‘post-work’ position, including Bastani (2019) and Danaher (2019), this lessening of human engagement in work is an inherently positive move. Economically necessary work is argued to be meaningless in its own right, actively preventing the engagement in meaningful activities of self-actualisation, and therefore the move to displace these activities onto automated and autonomous technologies could result in a world ‘beyond both scarcity and work.’” Jones, “Understandings of ‘Work,’” 381.

And a false “assumption that technology exists beyond the realm of values, beliefs, and interests, and thus from the social world within which it resides, and assigns a blameless, agency-free inevitability to technology-driven change.” Howcroft and Taylor, “Automation and the Future of Work: A Social Shaping of Technology Approach,” 353.

And see, Kweilin Ellingrud et al., *Global AI and The Future of Work*, McKinsey Global Institute (2023), <https://www.mckinsey.com/mgi/our-research/generative-ai-and-the-future-of-work-in-america>. Exhibit 1.

Nestor Maslej, *The AI Index*, 223-40; Thierer, *Skills Needed*, 5.

Hanson observes: “The concentration of foreign-born workers in AI-related activities is the latest manifestation of the propensity for immigrant labour to specialize in technology-oriented fields in the US labour market.” Furthermore: “that immigrants specializing in jobs more intensive in abstract and quantitative reasoning tend to come from countries that deliver higher quality K-12 education, as evidenced by their students achieving higher PISA exam scores.” Further, that “the technical talent that creates AI is also footloose. In the US, much of this talent is foreign born—and from India and China in particular. The location choices of newly arrived immigrants, whether low-skilled or high-skilled, tend to follow the location choices of previous generations of workers from their origin countries.” Hanson, “Specialization,” 185, 210.

Howcroft and Taylor, “Automation and the Future of Work: A Social Shaping of Technology Approach,” 210.

“America Is Sabotaging Itself In The Global Battle For Talent,” *The Economist* (August 2024), <https://www.economist.com/leaders/2024/08/15/america-is-sabotaging-itself-in-the-global-battle-for-talent>. Accessed January 15, 2025. But note: “To create AI, China is taking a more state-directed approach, including trade protection for domestic technology firms (Goldfarb & Treffer, 2018) and is relying mostly on domestic talent.” Hanson, “Specialization,” 84.

“Talent Is Scarce. Yet Many Countries Spurn It,” *The Economist* (2024), <https://www.economist.com/briefing/2024/08/15/talent-is-scarce-yet-many-countries-spurn-it>. Accessed January 15, 2025.

Thus: “Governments, too, will need to change their thinking. Their fondness for industrial policy focuses on handouts. But progress in AI is as much about having the right talent and a flourishing ecosystem as it is about amassing capital and computing power. Countries in Europe and the Middle East may find that the hard graft of cultivating ingenuity matters as much as buying in computer chips. America, by contrast, is blessed with chips, talent and enterprise. It has many of the world’s best universities and, in San Francisco and Silicon Valley, an enviable and long-established cluster of talent.” “The Breakthrough AI Needs,” *The Economist*, 2024, <https://www.economist.com/leaders/2024/09/19/the-breakthrough-ai-needs>. Accessed January 15, 2025.

Ashish Arora et al., *The Effects of Public Science on Corporate R&D*, National Bureau of Economic Research (Cambridge, MA, 2023), <http://www.nber.org/papers/w31899>.

Even so, “Advances in robotics technologies have led to the widespread use of automation in tasks previously performed by workers. At the same time, improvements in communication technologies have led companies to offshore stages of production to low-wage countries. These two phenomena are having a profound effect on advanced economies. Although they are believed to bring about higher productivity and lower costs, they are also often blamed for the decline in manufacturing employment and stagnation of real wages (see, for instance, Baldwin, 2019). More recently, a new hypothesis is gaining attention: that automation, which is much more prevalent in advanced economies, can increase competitiveness and bring back jobs that had been previously relocated to low-wage countries. Examples of this process of “reshoring” have started to populate the business literature.” Bonfiglioli et al., “Offshoring,” 40.

Howcroft and Taylor also ask readers to “compare, for example, the rapid uptake of robotisation in auto manufacturing with limited technology adoption in garment manufacture. According to the International Federation of Robotics (2019), the automotive industry is the largest user of industrial robots, an industry with relatively high-paid, male-dominated, unionised labour. In contrast, textile work, traditionally carried out by women who sew for low wages, either as migrants in Western countries or in the global South, such as Cambodia and Vietnam, is largely bypassed by technological innovation (ILO, 2016). Aversion to automation exists when the labour force is low-cost and nonunionised.” But cheaper robotic and machine intelligence will change this. Howcroft and Taylor, “Automation and the Future of Work: A Social Shaping of Technology Approach,” 361.

Thus: “A growing theoretical literature has examined the reasons that may justify the taxation of robots, notably limiting the potential rise in income inequality that automation might create. Costinot and Werning (2018) examine whether taxation or protectionist trade policies might help to better distribute the economic benefits of AI technologies. Their results indicate that taxing the innovators or developers of the technology is undesirable because it would impede innovation; yet, if robots lead to an increase in inequality, a modest tax on the use of technology (as opposed to innovation per se) may be the optimal prescription because of distributional concerns.” Aghion et al., “Labour Demand,” 19.

Thus “to counteract the deleterious effects of technological unemployment, Susskind in *A World Without Work* (2020) canvasses a ‘big state’ as the solution. This is a state that imposes high taxes on elite workers who manage to remain relevant in a depleted labour market, on privileged individuals inheriting wealth, on big business and on what Marx called “constant capital” (machines); a state that introduces a conditional basic income; and that shapes the ways in which individuals fill their leisure time to find meaning and purpose.” Deranty and Corbin, “Artificial Intelligence and Work,” 15.

There are a number of approaches advocating for a more deliberately human future in work, for example, Humanistic Management (Pirson 2017), the politics of care (The Care Collective 2020), and the reclamation of Workplace Democracy (Ferrerías et al. 2022). Jones, “Understandings of ‘Work’,” 394.

David Petterson, “An Agenda To Maximise AI’s Benefits And Minimise Harms,” *The Economist* (3 December 2024), <https://www.economist.com/by-invitation/2024/12/03/an-agenda-to-maximise-ais-benefits-and-minimise-harms-by-david-patterson>. Accessed January 15, 2025; Christopher Mims, “The Secret Weapon Helping Businesses Get Results From AI: Humans,” *Wall Street Journal* (9 December 2024), <https://www.wsj.com/tech/ai/the-secret-weapon-helping-businesses-get-results-from-ai-humans-f9ga0907?st=sPFkBz>. Accessed January 15, 2025.

Poba-Nzaou et al., “The Impacts of Artificial Intelligence (AI) on Jobs: An Industry Perspective,” 61.

Daya Prakash, “Breaking the Myth: AI – Job Killer or Creator?” *Express Computer* (Mumbai), 17 July 2023, 1, <https://www.expresscomputer.in/guest-blogs/breaking-the-myth-ai-job-killer-or-creator/101097/>.

Howcroft and Taylor, “Automation and the Future of Work: A Social Shaping of Technology Approach,” 352.

We are mindful that “there is no consensus on the quantification of the potential impacts of these technologies on jobs. Some studies reveal very pessimistic projections. Frey and Osborne (2017) estimate that 47% of jobs are at risk of automation in the USA in the next 20 years, whereas Hopkins (2016) projects that by 2025, 16% of jobs will be replaced by technological systems, and at the same time, 9% of new jobs will be created, netting a 7% jobs loss.” Poba-Nzaou et al., “The Impacts of Artificial Intelligence (AI) on Jobs: An Industry Perspective,” 62.

Howcroft and Taylor, “Automation and the Future of Work: A Social Shaping of Technology Approach,” 365.

With personal pronouns changed to first person plural. Kaplan, Likens, and Hazarika, interview.



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